Risk Taking , Religiosity and Denomination Heterogeneity *

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Abstract

In this paper, I have merged the European Social Survey, World Values Survey and Eurostat (European Statistics Information) into SHARE (Survey of Health, Aging and Retirement in Europe) by regional geographical cell (NUTS2). By using this specific merged data set, I have evaluated the effect of household level religiosity and regional denomination heterogeneity (Catholic/Protestant ratio) on household risk preference. The finding is as follows : the higher the level of religious belief the lower the risk-taking incentive the households have; however, for regional denomination heterogeneity, the higher the regional Catholic/Protestant ratio, the more popular the local risk-taking incentive prevails.

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1 Introduction

Previous literature has shown empirically that religion affects the economy at an aggregate level. However, from a micro perspective, it is still not clear whether religion plays a role in economic decision-making especially along the financial dimension.

By utilizing the Survey of Health, Ageing and Retirement in Europe (thereafter known as SHARE), I have a rich source of information on households' risk-taking motives and religious background, which allows me to explore how household religious belief influences risk preference. However, simply measuring religiosity is not enough, as heterogeneity in denomination background always plays a determinant role in shaping people's behavior. Following Alok Kumar et al (2011) and Tao Shu et al (2012), I also analyze the impact of regional denomination structure on household's risk attitudes.

In this paper, I empirically evaluate the effects of local religious belief on risk preference and extend the analysis to the regional denomination composition structure. My findings suggest that religiosity reduces risk-taking incentive, however, a higher regional Catholic-Protestant ratio promotes risk tolerance possibly due to the different religious doctrines. The above findings are exciting, that religiosity is not the only determining factor on risk preference, and that regional denomination composition also plays an important role.

To cross verify the validity of the finding above, I exploit another implicit channel to measure risk preference, namely by using life insurance holding. Life insurance designs for hedging mortality risk, hence the participation in life insurance market or the amount of purchased life insurance product would be an implicit proxy for individual risk preference. My premise is that if regional denomination heterogeneity affects risk preference, then the related attitude difference would be projected onto the purchase of financial products designed for hedging risk, hence life insurance holdings would reveal such differences across different denomination compositions at the regional level. My findings suggest that the higher the regional fraction of catholic believers, the less individual would purchase life insurance products, which is consistent with my previous finding that a higher Catholic/Protestent ratio would induce higher risk-taking incentives.

To check whether findings from SHARE data, representative of the 50+ elder population, is robust or not, I repeat the core analysis by using the European Social Survey (thereafter known as ESS) which is representative of the entire population, and the related results consolidate the previous finding from SHARE. To further confirm the credibility of the findings, I create a matched sample using the nearest-neighbor method and re-estimate the model again. To deal with omitted variable bias, I adopt an instrumental variable approach.

The rest of the paper is organized as follows. Section 2 reviews the existing literature on the topic. Section 3 provides details about the data and presents descriptive statistics. Section 4 discusses the econometric specification, primary identification issues, and the baseline results, while Section 5 extends the analysis to ESS data. Section 6 applies an instrument variable approach. Finally, section 7 offers concluding remarks.

2 Literature Review

When Karl Marx stated that "Religion is the opium of the people", he recognized religion as an illusion. As he wrote, "The religious world is but the reflex of the real world". He thus focused mainly on the socially organizing role of religion, bringing it strongly to the fore. Max Weber (1905) in his "The Protestant Ethic and the Spirit of Capitalism", analyzed the influence of religious belief on social development. In Weber's opinion, the bond of the doctrine of salvation and the concept of good works created and enforced a protestant ethic, which has been transformed gradually onto believers' own preferences and thus subsequently shaped their behavior.

The literature on economics and religion showes evidences in support of the core ideas of both Marx and Weber. In favor of Max Weber, Guiso, Sapienza and Zingales (2003) found that religion has a positive correlation with pro-market economic attitudes. By using long term cross-country data, Barro and McCleary (2003) demonstrated a positive association between religious belief and economic growth. Beyond religion's impact from a macro perspective, sociologists and economists have analyzed the connection between religion and subjective wellbeing by using survey data (Ellision 1991; Ellison, Gay, and Glass 1989; Clark and Lekles 2005), with researchers finding that religion can buffer the impact of stressful life events on well-being. Religious believers are seen to enjoy higher levels of life satisfaction, and are insured against certain adverse life events.

In terms of the socially organizing's role of religion, Scheve and Stasavage (2006) argued that religion and welfare state spending are substitute mechanisms that insure individuals against adverse life events. As a result, individuals who are religious are predicted to prefer lower levels of social insurance than individuals who are secular. Erzo F.P. Luttmer et al. (2007) used data from the Consumer Expenditure Survey, and found that households who contribute to a religious organization are better able to insure their consumption against income shocks. By using the National Survey of Families and Households, they also found that individuals who attend religious services are better able to insure their happiness against income shocks. In general, religious organizations provide informal insurance to its members.

Without doubt, religion forms culture, at least partially. As is well known from previous studies, local culture can exert a significant impact on individual economic behavior for several reasons. Individuals are likely to conform to the norms of local culture, as social identity theories (Tajfel , 1978 ; Hogg and Abrams, 1988) suggest that the value of sharing an identity and having a sense of being part of a particular group has a substantial influence on people's behavior. Recently there has been a growing literature empirically examining the impact of local religious beliefs, as an important aspect of local culture, on a wide range of corporate decisions, such as corporate investment (Hilary and Hui 2009) , corporate (Mis)behavior (Grullon, Kanatas, and Weston 2009), corporate financial reporting (Dyreng, Mayew, and Williams 2010) and tax avoidance (McGuire, Omer, and Sharp 2011). Alok Kumar et al. (2011) found that religious background can affect mutual fund manager's investment strategy. Tao Shu et al. (2012) also found that funds located in highly-Catholic areas exhibit significantly higher fund return volatilities. Risk-taking associated with local religious beliefs is manifested in higher portfolio concentrations, higher portfolio turnover and more aggressive interim trading.

One innovative study from Benjamin, Choi and Fisher (2013) tried to analyze religious identity and economic behavior using a laboratory experiment. They found that religious identity salience makes Catholics become less risk averse, while no effect was found on Protestants. Charles Noussair et al. (2013) use an experimental procedure to elicit risk attitudes and correlate the related risk measure with the religious behavior and beliefs of the Dutch population. They found evidence that more religious people, as measured by church membership or attendance, are more risk averse regarding financial risks, and found that protestants are more risk averse than Catholics in dealing with risk-taking tasks.

Following the finding from prior literature, I merge European Social Survey, World Values Survey and Eurostat (European Statistics Information) into SHARE (Survey of Health, Ageing and Retirement in Europe) by regional geographical cell. Using such a specifically created data, I evaluate the effect of household level religiosity and regional denomination heterogeneity (Catholic/Protestant ratio) on household level risk preference.

The former studies use mainly U.S. and Dutch data, hence empirical support from other regions especially from the European continent is necessary. One important advantage of this paper is that, by merging different data sources together I am able to control more variables potentially correlated with religion than previous research such as social capital variables. To the best of my knowledge, this paper is the first one to find the significant impact of regional denomination heterogeneity on household level risk preference in a European context.

3 Data and Summary Statistics

3.1 The Survey of Health, Ageing and Retirement in Europe (SHARE)

The main data set used is the 2nd wave of SHARE which was conducted between 2006 and 2007[1]. SHARE is a multidisciplinary and cross-national panel database of micro data on health, socio-economic status and social and family networks of more than 85,000 individuals from 19 European countries(plus Israel) aged 50 or over. The countries selected in my sample includes Sweden(SE), Denmark(DK) , Germany(DE), the Netherlands(NL), Belgium(BE), Austria(AT) and Czech Republic(CZ). [2]

The unit of analysis is the household, given that most of the asset questions are asked at household level. The common design of the survey has enabled international comparisons of household wealth holdings (see Christelis, Georgarakos, and Haliassos, 2010).

One special question was asked about peoples' risk preference, the questions were

[1]I use data from SHARE 2006/2007, Wave 2, release 2.5.0.

[2]The reason of not using France(FR) is that France does not release the information related with religion. As for Greece, regarding the majority believe in Orthodox, hence it does not fit in the research framework. For Italy(IT), Spain(ES) and Poland(PL), these are single religion countries, where I could not evaluate that whether different denominations impose different long term impact on risk preference, so I also dropped them.

demonstrated in the following way : " When people invest their savings they can choose between assets that give low return with little risk to lose money, for instance a bank account or a safe bond, or assets with a high return but also a higher risk of losing, for instance stocks and shares. Which of the following statements on the card comes closest to the amount of financial risk that you are willing to take when you save or make investments ? "

Four categorical responses could be chosen :

1. *Take substantial financial risks expecting to earn substantial returns.*
2. *Take above average financial risks expecting to earn above average returns.*
3. *Take average financial risks expecting to earn average returns.*
4. *Not willing to take any financial risks.*

From the above questions, I combine the first and the second category to create a (0,1) binary variable " Risk Taking ", if one would like to take substantial financial risk or above average financial risk in order for a higher return, then this individual is recognized as having higher risk tolerance relative than the others.

Another important variable is about the religious belief, a question regarding religious praying frequency is explicitly implemented for each member in the household, the question is as following :

" And what about your religious background? Thinking about the present, how often do you pray? " the categorical responses are :

1. *More than once a day*
2. *Once daily*
3. *A couple of times a week*
4. *Once a week*
5. *Less than once a week*
6. *Never*

Summary statistics of religiosity and risk tolerance across countries are listed in Table 1 and Table 3.

3.2 European Social Survey (ESS)

Denomination information only exists in SHARE's first wave drop-off questionnaire, which has an obvious disadvantage, that nearly 60% of the sample is marked as missing due to non-response by not sending the drop-off letter back . To deal with this problem, I exploited the European Social Survey (ESS). ESS is a biennial multi-country survey covering over 30 nations, in which I have selected the same nations appeared in SHARE from 2002 round, 2004 round, 2006 round and 2008 round.

One outstanding characteristic of the data design both on SHARE and ESS is that they use the same geographical territory definition, namely the NUTS classification information (Nomenclature of territorial units for statistics in Europe) [3] , which allows me to aggregate the related religious information from ESS (ESS are individual level data sets) up to regional geographical cells (NUTS 2 level), and then merge the regional data into SHARE. The details of the region information together with regional denomination composition structure are shown in Table 5.

ESS has collected the most detailed information regarding religion to my best knowledge under the context of Europe , moreover, ESS is population representative and unlike SHARE which only focus on 50 and elder. By utilizing the rich religion related information from ESS, I computed a rich set of regional religious measure over the full sample. And this is consistent with the contextual nature of religion, a 50+ individual interacts with individuals of any age in her/his region of residence, hence the regional level data such as fraction of different denomination believers (Catholicism, Protestantism, Orthodox, other denominations and non-believers) and the regional denomination heterogeneity measured by $\frac{Catholics \quad No.}{Protestants \quad No.}$ are ought to be population wide representative. In Figure 1, I show the regional differences regarding fraction of catholics and protestants.

3.3 World Values Survey (WVS)

Following Guiso, Sapienza and Zinglas (2003) , I also use the parents religious background to solve the potential endogeneity problem of household religiosity. However, ESS doesn't collect such information, instead the World Values Survey (WVS) does.

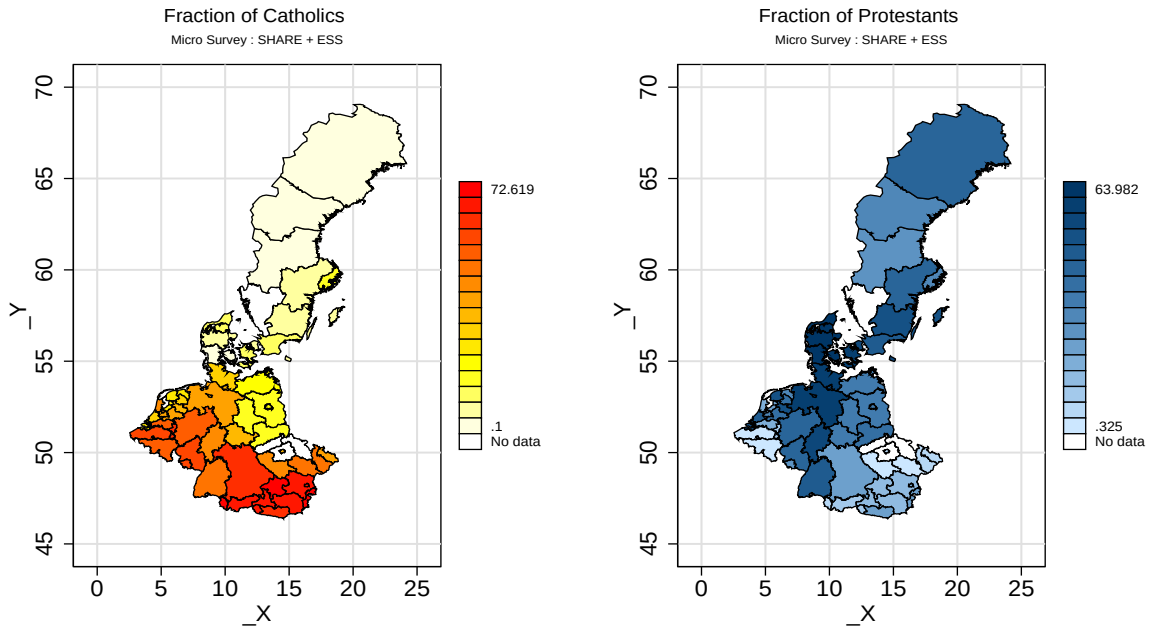
The WVS is a global network of social scientists who have surveyed the basic values and beliefs of the publics of over 100 societies, on all six inhabited continents. It studies changing values and their impact on social and political life. I am using the first five waves data of WVS, which dated from 1981 to 2007. The interest variable is whether raised up religiously as a measure for childhood religious upbring environment.

One difficulty occurred is that the WVS doesn't share the same regional information as SHARE or ESS, I followed the NUTS (see the NUTS definition) geographic map to relocate the WVS survey cities into the same geographical cell that I have used in SHARE and ESS. Finally, around 90% of the SHARE sample could be merged with World Values Survey at regional level (NUTS Level 2).

[3]Details of the NUTS classification information could be found from Web Link . The NUTS classification is a hierarchical system for dividing up the economic territory of the EU. The Socio-economic analysis of the regions include 3 levels,

- NUTS 1 : major socio-economic regions. (Nation level)
- NUTS 2 : basic regions for the application of regional policies. (Province level)
- NUTS 3 : small regions for specific diagnoses. (City level)

Figure 1: Regional Fraction of Catholics and Protestants



Country : Austria, Germany, Sweden, Netherland, Denmark, Belgium, Czech Republic

Note : Fractions of different denominations across region.

3.4 *Eurostat*

While one target interest variable, the denomination heterogeneity measured by $\frac{Catholics \quad No.}{Protestants \quad No.}$, is at regional level, it is important to control multiple regional macro indicators to capture regional development heterogeneity [4]. By using regional statistics information from Eurostat [5], I have included the regional PPP adjusted GDP, regional population density and regional life expectancy to capture the regional development difference.

4 Econometric Specification and Empirical Findings

4.1 *Econometric Specification*

I estimate the following simple binary choice model :

$$y_i = X_i'\beta + \gamma_1 \cdot pray_i + \gamma 2 \cdot CPratio_j + \epsilon_i \tag{1}$$

$$y_i = \begin{cases} 1 & \text{if is defined as risk taking} \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad \epsilon_i \sim N(0,1)$$

y_i is a dichotomous variable taking the value 1 if household i are defined as would like to take risk in a substantial scale or above average scale and 0 otherwise . Under X_i I include country dummies, various demographic and pecuniary characteristics, details are shown in Table 6 and I will discuss in detail below. The first variable of interest is $pray_i$, which denotes the pray frequency of household i. The second variable of interest $CPratio_j$ is the ratio of the number of catholic believers over protestants in the region j where household i resides.

Given that my measure of regional denomination heterogeneity is regional invariant, I cluster the standard errors at regional level (see Moulton , 1990) in all estimations. In addition, I take into account the fact that missing values have been imputed in SHARE using a multiple imputation method. Hence I perform the estimation and compute standard errors corrected for clustering within each implicate, and then combine the estimates and standard errors across implicates using the rules described in Rubin(1987). The estimated coefficients from Probit models are not directly interpretable; thus I calculate and report marginal effects averaged across individuals using calibrated survey weights.

The control variables under my specifications include a rich set of household demographics and measures of resources. More specifically, I include in X_i a broad set of demographics like nonlinear age effects[6], gender, marital status, education status and

[4]Although I include country fixed effect in all the estimations, it would be robust to control several key regional economics indicators.

[5]Eurostat is the statistical office of the European Union situated in Luxembourg. Its task is to provide the European Union with statistics at European level that enable comparisons between countries and regions.

[6]second order polynomials on age

number of children/grandchildren. Given that the bequest planning or inheritance experience would possible affect risk attitudes, I also condition on the self-reported probability of leaving a sizeable bequest and the actual amount of inheritance in the past. In terms of employment status, which has been taken into account by distinguishing among those working, retired, and unemployed.

Moreover, I allow for an independent role of resources including separate controls for net financial wealth, net real wealth and income through an inverse hyperbolic sine transformation that allows for non-linear effects of these variables (see Burbidge, Magee, and Robb, 1988) [7]. Controlling for resources is dictated by theory, with its emphasis on income and wealth as key determinants of risk attitudes.

Households with health problems would be considered as more risk averse. In order to take into account the effect of adverse health conditions, I include the subjective self reported health indicator as explanatory variable. Following Christelis, Jappelli, and Padula (2010), cognitive abilities play an important role in economic activities. I employ two cognitive indicators in the estimation equation, namely the respondents' ability to recall words correctly out of a list that is read to them by the interviewer, and the numeracy score after taking a math test.

Moreover, I include country dummies to capture country-specific factors that are likely to affect risk attitudes, such as the level of legal environment and economic development, market transparency. Country dummies will also capture differences in the average levels of religious belief and denomination heterogeneity, which are most likely to be due to country differences in the institutional environment. This implies that the marginal effect of my indicator on regional denomination heterogeneity is likely to represent a conservative estimate of the overall effect.

Finally, beyond including the country dummies, I have also controlled other regional indicators from Eurostat, such as the 2001 to 2010 average regional values of purchasing power adjusted GDP, unemployment rate, population density and life expectancy. With conditioning on these regional indicators I could be less concerned about the heterogenous distribution of regional differences that may bias my estimation. Following Alok Kumar et al (2011), regarding the regional denomination structure, I include the fraction of roman catholicism, protestantism, eastern orthodox and other denominations.

In what follows, I will first discuss several econometric issues, and then show the empirical results of my benchmark estimation.

4.2 Econometric Issues

4.2.1 Measurement error in general

To deal with missing values and inaccurate responses during the survey, SHARE provides multiple imputed data for key characteristics and pecuniary variables, such as numeracy, reading, risk preferences , household net financial assets, household net wealth

[7]The inverse hyperbolic sine transformation, in forms of $log(x + (x^2 + 1)^{1/2})$, allows for nonlinear effects of net financial wealth, real wealth and income (which all have skewed distributions) and is defined for zero and negative values (see also Pence, 2006). My results are robust to alternative specifications of net wealth and income (e.g., dummies denoting quartiles)

and more. By using multiple imputed data sets and calculating the multiple imputed standard errors, the estimation results are relative more robust regarding the possible measurement error.

4.2.2 Measurement error in measuring religiosity

There exist several ways to measure religiosity, for example, SHARE has information on self reported religious magnitude, the frequency of attending religious ritual (church participation) and the frequency of praying. The first one is rather subjective, huge difference may exist for same level of self reported magnitude. The second measure is also problematic in terms of unclear motive in religious participation, people may go to church for social reasons such as wedding or funeral. The frequency of praying is the most clear measurement of religiosity among the above 3 choices, the person who prays more often is undoubted to be the one has higher religiosity. Regarding misreport during the survey, there doesn't exist any special argument about why someone would lie about his/her religious belief , conditional on that Catholicism and Protestantism are major denominations in the surveyed location.

4.2.3 Endogeneity of religiosity with respect to risk preference

In SHARE, the question regarding risk preference is limited only in financial terms. However, I could not rule out the scenario that a person with high risk-taking motive (such as gambler) would pray more often after taking risk (although rare), which actually cause the classical endogeneity problem. Later, I would like to use the upbring environment namely whether has been raised religiously in childhood to solve the endogeneity problem. The argument is simple, that current risk preference could not affect a predetermined event at grown up period. The regional denomination heterogeneity doesn't suffer from such concern, while individual preference could not affect the regional denomination composition.

4.2.4 Does religiosity proxy for other characteristics that affect risk preference

One may be concerned that religious believers have different observable characteristics and that these characteristics are the actual driven factors of risk preference. I deal with this concern in two ways. First, all my regressions include an extensive list of household control variables, including nonlinear age effects, gender, households composition such as number of children and grand children, number of rooms, education status, work status, marital status, cognition and health condition , financial information of income and different types of assets, inheritance and bequest. Second, I control for as many of the omitted variables for which religion could be a proxy as possible. Religion would influence the formation of social capitals in the region, hence I also control household's trust level and political opinion. Regarding the strong social organization's role of religion, I also control measures that evaluate household's social activity and whether a household have helped others or contributed to any voluntary work in last month.

4.2.5 Does regional denomination heterogeneity proxy for other characteristics that affect risk preference

The regional denomination heterogeneity is measured by $\frac{Catholics \quad No.}{Protestants \quad No.}$. To make sure the interest variable does not capture other regional factors, I have controlled the PPP adjusted regional GDP, regional unemployment rate, regional population density and life expectancy along with country fixed effects. Following Alok Kumar et (2012), I also control the regional denomination composition structure, namely the regional fraction of Roman Catholic, Protestant, Eastern Orthodox and Other denominations. With controlling the regional denomination composition structure, I could interpret the $\frac{Catholics \quad No.}{Protestants \quad No.}$ as religion related local culture, which is mainly shaped by the joint interaction of Catholicism and Protestantism.

4.3 Empirical Results Rewrite this part

4.3.1 Bench mark estimation on risk preference

Table 7 shows my bench mark estimation results. Model 1 to model 4 consist four different specifications with gradually adding different block variables, such as variables related with social capitals, variables measuring financial information and inheritance or bequest. In general, the higher the religiosity the lower risk tolerance a household would have. In contrast, the higher the catholic fraction wrt. the protestant fraction of the local resident, the higher the risk-taking incentive [8].

Taking model 4 as an example, the average marginal effect is reported, the magnitude of the estimated coefficient on pray intensity is -.0019 and is statistically significant at 5% level. In terms of economic explanation, on average those who pray multiple times a day have 0.95 percentage points lower probability in taking risk compared with those who never pray. Regarding the regional denomination heterogeneity, I have positive and statistically significant results at 1% level. The result also has economic significance, compared with the people who lived in the most Protestants concentrated area, people who lived in the most Catholics concentrated area have 3.70 percentage points higher in probability to take financial risk.

The benchmark estimation shows interesting results. Risk aversion increases with religiosity, however a higher regional concentration of Catholics would increase risk tolerance.

The observed pattern may relate with the doctrine differences between two denominations as stated in Alok Kumar et al. (2012). In particular, the Protestant and Catholic churches have very distinct views on gambling. A strong moral opposition to gambling and lotteries has been an integral part of the Protestant movement since its inception, and many Protestants perceive gambling as a sinful activity (e.g. Starkey, 1964; Ozment, 1991; Ellison and Nybroten, 1999). The United Methodist Church's 2004 Book of Resolutions stated its views on gambling which is typical of many Protestant churches

[8] This empirical pattern also has been found from the mutual fund industry (Alok Kumar et al. 2012, Shu Tao et al. 2013) but not been found by using the household level data.

: "Gambling is a menace to society, deadly to the best interests of moral, social, economic, and spiritual life, and destructive of good government. As an act of faith and concern, Christians should abstain from gambling and should strive to minister to those victimized by the practice." [9]

In contrast, the Roman Catholic Church maintains a tolerant attitude towards moderate levels of gambling and is less disapproving of gambling activities. It has even used gambling in the form of bingo and charitable gaming events as an important source of fund raising (e.g., Diaz, 2000; Hoffman, 2000). In detail, the position of the Catholic Church on gambling is summarized in the New Catholic Encyclopedia : "A person is entitled to dispose of his own property as he wills ... so long as in doing so he does not render himself incapable of fulfilling duties incumbent upon him by reason of justice or charity. Gambling, therefore, though a luxury, is not considered sinful except when the indulgence in it is inconsistent with duty" (O'Hare, 2002).

The doctrinal differences have possibly been projected onto local culture, which in turn has the potential to systematically affect the decisions of local individuals across multiple dimensions, with risk attitudes being one of many.

4.3.2 Religion and life insurance

Life insurance would cover pure mortality risk and it is known that positive correlation exists between risk aversion and insurance purchasing. It occurs that SHARE has recorded the life insurance holding, which gives me opportunity to test whether individual religiosity and regional denomination heterogeneity actually affect life insurance purchasing decision.

Table 8 shows estimation results when the dependent variables are extensive and intensive margin of holding life insurance, where the amount of life insurance is Inverse-Hyperbolic-Sine transformed. The estimated coefficients on individual religiosity measured by pray intensity is statistically insignificant, however, the regional denomination heterogeneity plays an important role, the coefficients are both statistically significant for extensive and intensive margin. The magnitude of estimate on whether hold life insurance is -0.0011 , and the magnitude for the amount of life insurance holding is -0.0123. In terms of economics interpretation, suppose there exists a 1 standard deviation in $\frac{Catholics \quad No.}{Protestants \quad No.}$ from the minimum value, on average the probability of holding life insurance would be decreased by 2.60 percentage points , as for the extensive margin, on average the amount of life insurance purchased would be decreased by 28.66%.

The results here have close interconnection with the estimation results from the above section. If higher regional Catholics concentration indicates higher risk taking motive, and higher risk taking motive would discourage the demand for life insurance, then the above results make sense.

[9] Alok, Kumar et al. (2012), P672 , footnote 3.

4.3.3 Robustness check using data from former generation

To deal with endogeneity issue, I attempt to use predetermined value as proxy for current variables. Whether has been brought up in a religious environment (0,1 dummy variable) at childhood is chosen to be the proxy for individual religiosity, the fraction of raised Catholics and raised Protestants are chosen for approximating $\frac{Catholics \quad No.}{Protestants \quad No.}$.

The estimation results are shown in Table 9. Upbring in a religious environment would depress risk taking motive by 1.22 percentage points in probability on average compared with those not, the estimate is statistically significant at 10% level. Regarding the fraction of raised Catholics variable, a 1% increase in regional fraction of raised Catholics, the likelihood of being categorized as risk taking would increase by 0.23 percentage points, and the coefficient is statistically significant at 5% level. Although the estimated coefficient of regional fraction of raised Protestants is not statistically significant, the sign of the coefficient is negative. The results is consistent with the bench mark estimation showed in Table 7, which relieve us from the concern that endogeneity issue would potentially bias my estimates.

4.3.4 Geographical Distance wrt. Vatican City and Wittenberg-City as Instrument

to be fitted in ...

5 Results from European Social Survey

5.1 ESS as Robustness Check

One disadvantage of using SHARE data is that I cannot control the individual denominations, which only exist in the drop-off data set from the first survey implemented at 2004/2005 and around 60% of the full sample is missing due to non response. In this section, I change the base data by using European Social Survey Wave 1 (2002) to Wave 4 (2008), and keep the data merging procedure the same as before. Detailed summary statistics of general risk preference from ESS are listed in Table 2, the definition of risk taking under ESS context is that either pick the answer "very much like me" or "like me" and the related question is "Looks for adventures and likes to take risks, is this like you?". Regarding the information of individual denomination, attendance of religious services and pray frequency, detailed information could be found in Table 4.

The ESS pooled data is population wide representative at individual level. The control variables are generated as close as what I have used before under SHARE context. Country and time fixed effects are controlled, social-economics characteristics such as income quartiles, work status (whether employed or not), education categories, health status (self reported health, whether health prevent some daily actions), gender, age and age square, no. of children at home and marital status are also included in the regression. Regarding variables related with social capitals, I include whether help other people , whether involve in any social activities, measure of trust and political opinion. The regional indicators are same as what I have used before. The additional variables introduced into the estimation equation include detailed information of individual denomination (instead of regional denomination fraction as before), such as whether belongs to Catholics, Protestants , Orthodox and other religion.

Figure 2 visualize the estimation results by plotting the predicted probability surface of being categorized as risk taking along two dimensions, the degree of individual religiosity (X-axis) and regional Catholics over Protestants ratio (Y-axis). What has been shown clearly is that the predicted probability of taking risk for religious individual who pray every day is significantly lower than those who never pray conditional on living in a certain region. From the other side, conditional on certain degree of religiosity the predicted probability of taking risk is significantly higher for those individuals who live in higher Catholics concentrated region compared with Protestants. Such prediction is consistent with the results before by using SHARE data.

5.2 Nearest Neighbor Matching

Although I include an extensive list of household/individual control variables in the regressions, one may concern that the religious believers have different observable characteristics and that these characteristics are the actual driven force of the estimated results. To deal with this concern, I create a matched sample in which each religious believer is matched to a non-believer using the nearest-neighbor method such that the K-dimension Mahalanobis distance from selected match criteria of being a believer is roughly equal for the actual believer and non-believer.

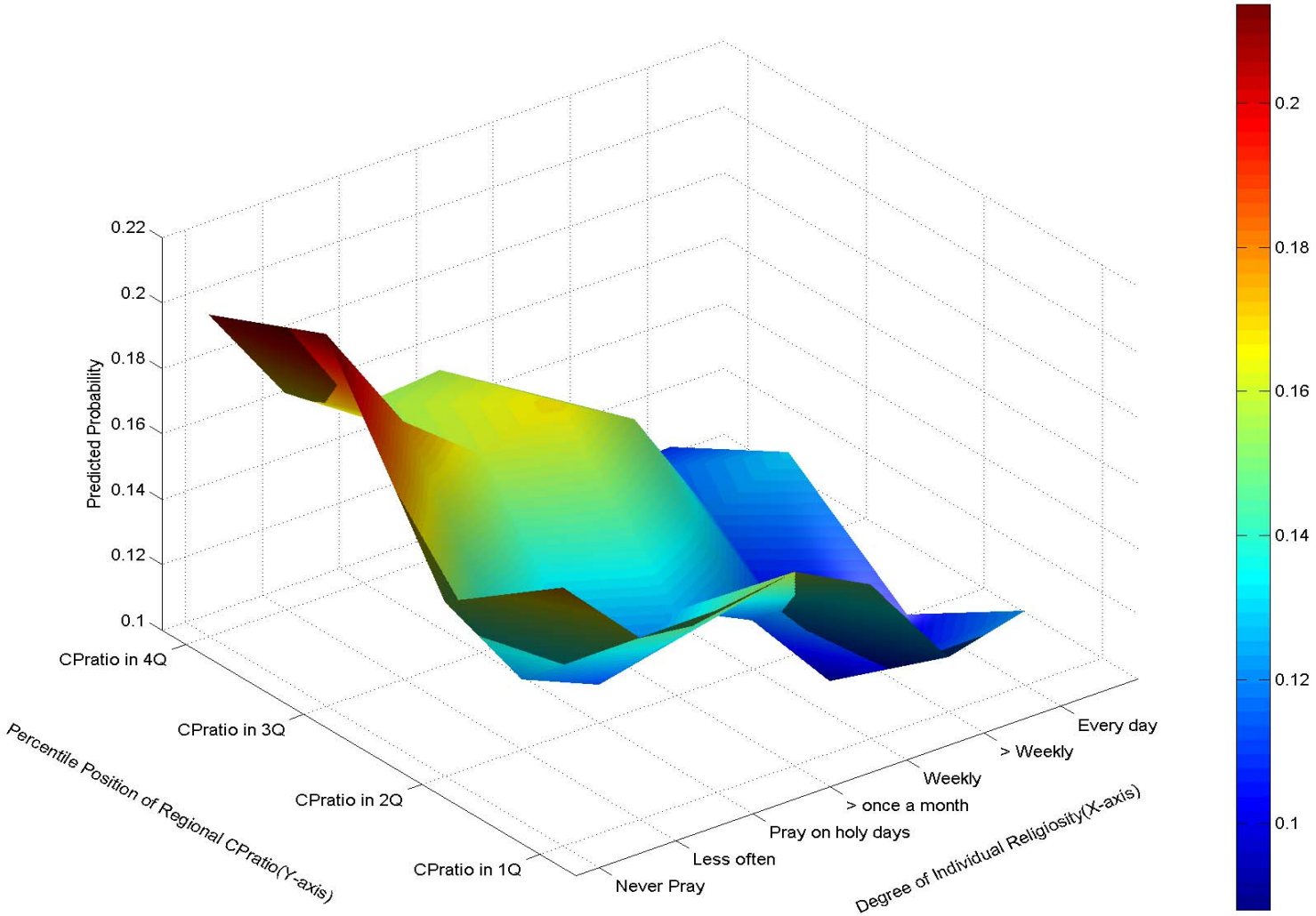
For purpose of the matching routine a religious believer is defined as at least pray once in the past year. A non-believer matched to multiple believers is only entered once in the regression but with a weight that is equal to the number of participants to which it was matched. While the matched sample contains all believers, some non-believers may not be matched. Thus, the matched sample contains fewer observations than the original sample. The matching criteria [10] is based on $k = 11$ dimensions, which includes country dummies, income, net financial wealth, net real wealth, number of children at home, age, education year, work status, marital status, health status and cognition ability. Note that Dehejia, DeLeire and Luttmer 2007 have used the Propensity Score Matching approach under the religious attendance context.

The nearest matching approach creates a sample in which the distribution of observable characteristics, to the extent they correlate with religious belief, is similar for both believers and non-believers. I then run the former regression exactly on this matched sample, at this stage, I am less concerned about that the heterogeneity in characteristics distribution would generate the above observed results.

Table 10 shows the estimation results by using the matched sample generated from ESS data. A 1 standard deviation increase in individual pray intensity would decrease the probability of being risk-taking by around 0.9 percentage points on average; a change from the minimum value of praying frequency to the maximum value would lead to 3 percentage points decrease in probability of being risk-taking on average. On the other hand, a 1 standard deviation increase in the regional Catholics over Protestants ratio would increase the probability of being risk-taking by around 3.5 percentage points on average; a change from the minimum value to maximum would lead to almost 11 percentage points increase in the probability of being risk-taking on average. The findings from using matched sample are consistent with the findings before, which demonstrate that the significance of the estimated coefficients are not driven by the heterogeneity from characteristic variables.

[10] The selection of matching criteria is based on the Backdoor Criterion, details could be found in several studies from Abadie, A. and G.W. Imbens, DAG (Directed Acyclic Graph) analysis is always used in such context, the general idea is to find X variables for blocking the potential backdoor paths.

Figure 2: Predicted Probability Surface using ESS



6 The Instrument Variable Approach

6.1 Discussion on Endogeneity

Some would argue that self-reported religiosity, as measured in survey data, is potentially shaped by personal beliefs about other people's religiosity, which in turn have been influenced by formal and informal institutions. Hence, one might argue that there are some unobserved components in the error term in Equation (1) that systematically correlate with religion proxies across households or regions within a country and the outcome variable. Such potentially omitted variables at household or regional level would possibly bias my estimation results, hence I need to find instruments to test for the omitted variables bias. To implement the validity test (Sargan Test or Over-identification Test), I need at least three instruments for the two potential endogenous variables, namely the individual pray intensity and regional denomination heterogeneity measured by $\frac{Catholics \quad No.}{Protestants \quad No.}$.

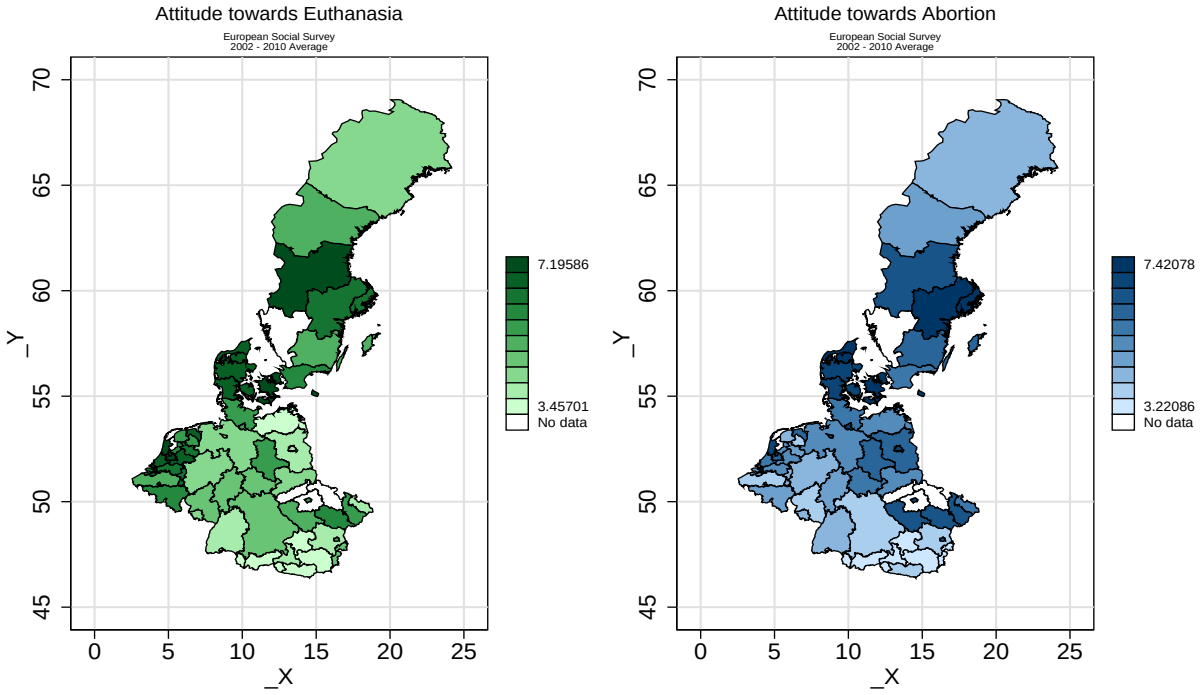
In 2010, SHARE has released a special wave of retrospective life history (SHARElife), where it revisited the people surveyed in 2006/2007 and asked detailed questions about what has been happening during their early life. From SHARElife, I created one specific variable at household level, that the time difference between the start of the relationship and getting married in a first marriage. This time difference is predetermined [11] and would not affect current the actual decision, hence it does not correlate with the omitted variables from household's current actions, which makes it a potential valid instrument. Moreover, intuitively, the time length between the start of relationship and getting married would be affected heavily by the local culture, which is formed historically and for sure interacts with the local religion in a close and dynamic way. It would not be a surprise that strong correlation exists between this time difference and the religiosity variable. Under the context that I have controlled the regional religion channel by including the regional denomination fraction variables, with the assumption that this time difference between the start of the relationship and getting married in a first marriage would not affect the household risk preference except through the religiosity channel, then it would behave as a good instrument.

Regarding instruments for the regional denomination heterogeneity measured by $\frac{Catholics \quad No.}{Protestants \quad No.}$, the IV variables used are regional attitudes towards abortion and euthanasia [12]. The regional dispersion of the above instrumental variables is shown in Figure 3.

[11] The respondents in SHARE Life are 50+ people, so the marriage experience (only considering the 1st marriage) is on average 20 years before 2007 or 2008, namely the data collecting time.

[12] These two variables are generated from the European Social Survey: Please tell me for each of the following actions whether you think it can always be justified, never be justified, or something in between? Taking abortion as example, 1 means never justifiable , 10 means always justifiable.

Figure 3: Attitude toward Euthanasia and Abortion



Country : Austria, Germany, Sweden, Netherland, Denmark, Belgium, Czech Republic

These two variables exhibit a strong correlation with the regional Catholic/Protestant ratio. The difference in denominational doctrine generates heterogeneous attitudes towards death and birth. What I need here is not the very sharp contrast of different religious perception towards the life (e.g. like Protestantism and Islamism), but that the slight heterogeneity caused by different denominations (e.g. like Catholicism and Protestantism) is enough for identification. Intuitively speaking, small differences between religious doctrines would be projected onto the local culture and hence generate permanent heterogeneity in economics attitudes through time.

It would be a rather rational assumption that regional attitudes towards abortion and euthanasia could only affect risk-taking attitudes through the religion denomination channel. It is hard to establish a theory that the higher(lower) degree of intending to agree with abortion or euthanasia would indicate stronger(weaker) risk preference. The risk preference is defined by whether an individual would take substantial or above average risk to gain substantial or above average potential gain, moreover, the attitude towards abortion or euthanasia is about a moral standing on birth and death, which is the deeper side of the human value system. Statistically or logically it is very hard to find a direct correlation between risk preference, especially on financial terms, and moral attitudes related to death and birth.

6.2 *Empirical Implementation*

Table 11 shows the linear IV regression results [13]. I am assuming that Linear Probability Model fits for the analysis. LPM model is convenient for running several statistical test, such as weak identification test, endogeneity test and overidentification test.

Each of the first two models (Column 1 and Column 2) has one potentially endogenous covariate (i.e. religiosity measure is discrete and Catholic/Protestant ratio is continuous), while the latter model has two potentially endogenous covariates. I test the endogeneity regarding the above two covariates by using the two-step procedure of Rivers and Vuong (1988). The procedure can be summarized as follows (see Wooldridge, 2002, p.473):

- First, I estimate an auxiliary ordinary least squares regression of the potentially endogenous covariate on the relevant instrument and the remaining explanatory variables (X_i). An F-test (Weak identification test in Table 11) on the significance of the instrument provides a test for instrument validity. Subsequently, I derive from this auxiliary regression the associated residuals.

- I estimate the baseline LPM model by adding as explanatory variable the residual series obtained from the above step. Given that this LPM model conditions on a generated regressor, I use parametric bootstrap with 300 replications to evaluate the standard errors, multiple imputation has been taken into consideration at this stage. Under the null hypothesis of exogeneity, the test of significance of the added residual series should not exceed standard critical values.

Regarding the F-tests on the employed instrument for the three models, I report the results in row three. The instruments that I employ in the auxiliary regressions are highly significant at 1% and the relevant statistics exceed 10, providing strong support to instrument validity (the statistics follow the χ^2 distribution with 1 degree of freedom for the first and second models and 2 degrees of freedom for the third one).

As for the Rivers-Vuong procedure (Endogeneity test in row 4 and row 5), the relevant p value exceeds the standard criteria in all cases. Hence I could reject the null hypothesis that the two indicators of interest (considered either individually or jointly) are not endogenous to risk preference, hence instrumental variable approach is necessary.

I have also implemented an overidentification test following Sargan (1958) and Basmann (1960). The null hypothesis is that the excluded instruments are valid instruments, i.e., uncorrelated with the error term. Details of this test could be seen from Davidson and MacKinnon (1993, 236) and Wooldridge (2002, 123). The results from Table 11 row 6 and 7 clearly show that I cannot reject the null hypothesis, hence the statistical validity of the instruments is established through this test.

The estimates are qualitatively consistent with what I have found in previous section.

[13] Table 12 shows the regression results from Non-linear IV model (ivprobit model) to make further inference.

7 Conclusions and Limitations

Building on a rich literature that investigates how religion affects decision making, I investigate whether religiosity and regional denomination heterogeneity affects household risk attitudes. I find that higher religiosity measured by praying frequency is associated with higher risk aversion, and the higher concentration of Catholics believers in a region is associated with higher risk-taking motives. The findings are consistent with previous studies by Alok Kumar et al and Tao Shu et al. However, their research mainly focused on how religion affects corporate financial decisions, while mine focuses on the household side.

The challenge of evaluating how religion would affect household risk attitudes is that religion is imbedded so deeply into the human value system, namely that religion affects everything around us. Hence it is extremely hard to identify the causal relationship between religion and risk attitudes. In this paper, I avoid the measurement error concern by carefully selecting religiosity measure and thanks to the SHARE multiple imputed structure; to ease the concern of reverse causality, I utilize the parents religious background information and the childhood upbringing environment of individuals, reflecting the fact that current attitudes could not have affected the predetermined variables happened before. In terms of the view that unobserved heterogeneous distribution in characteristic variables might contaminate my estimates, I use the nearest-neighbor matching method to verify my findings in a matched sample. Moreover, I also consolidate my empirical results by using another data set, namely the European Social Survey. Finally, to deal with the omitted variable bias, I adopt an instrument variable approach.

Although I find that the higher the regional Catholic/Protestant ratio, the more popular the local risk-taking incentive prevails, I am not able to go further to unveil what is the mechanism behind, which demands more information and is not available at this stage. One future research question that needs to be answered is: whether the heterogeneous effect is driven by Catholics who are more risk-seeking, or Protestantism which depresses risk tolerance, or both of them.

Nonetheless, I view my study as providing an initial step toward gaining a better understanding of the role of religion, respectively, on household risk preference.

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Table 1: Summary Statistics on Risk Preference by Country (%), SHARE

Attitudes towards financial risk and different scale of return.

Nation Code	SW	*DK*	*DE*	*NE*	*BE*	*AT*	*CZ*
Take substantial financial risks	2.9	2.2	0.7	1.4	1.2	0.4	0.6
Take above average financial risks	31.8	12.3	2.6	2.3	3.8	1.1	1.6
Take average financial risks	4.9	31.9	24.1	20.8	27.1	16.0	28.2
Take no financial risks	60.4	53.6	72.6	75.5	68.0	82.5	69.6

Note : The table reports the summary statistics of the household level risk preference towards pure financial risk. Weighted statistics of multiple imputations by using SHARE Wave2 data.

Table 2: Summary Statistics on Risk Preference by Country (%), ESS

General Risk Attitudes towards life events **looks for adventures and likes to take risks, is this like you ?**							
Nation Code	SW	*DK*	*DE*	*NE*	*BE*	*AT*	*CZ*
Very much like me	3.9	8.1	3.0	3.8	5.1	7.1	4.5
like me	10.6	15.6	9.4	12.4	12.7	14.5	12.0
some what like me	20.6	18.6	17.3	22.8	19.2	20.3	19.8
a little like me	23.4	22.2	18.9	29.9	25.5	25.1	21.5
not like me	30.4	27.7	32.5	21.6	23.9	21.7	24.6
not like me at all	11.2	7.9	18.9	9.4	13.6	11.3	17.5

Note : The table reports the summary statistics of the individual risk preference towards general life events. Weighted statistics by using pooled European Social Survey from Wave1(2000) to Wave4(2008).

Table 3: Summary Statistics on Religiosity and Denomination using SHARE Data

Panel A : Degree of Religiosity by country

Country	Raised religiously	Pray at least monthly	Pray at least weekly	Intensity of religious belief(0-5)
Sweden	0.319	0.511	0.281	1.264
Denmark	0.379	0.597	0.356	1.525
Germany	0.590	0.714	0.543	2.144
Netherlands	0.742	0.606	0.511	2.169
Belgium	0.844	0.709	0.550	2.160
Austria	0.773	0.812	0.616	2.272
Czech Rep.	.	0.428	0.282	1.135

Panel B : Distribution of population by religious denomination and country (%)

	Protestant	Catholic	Orthodox	Jewish	Muslim	Other	None
Sweden	78.1	1.5	0.3	1.2	0.9	2.3	15.7
Denmark	81.1	0.9	0.0	0.3	0.2	1.3	16.0
Germany	45.0	31.8	0.0	0.0	0.1	1.2	22.0
Netherlands	30.6	36.1	0.0	0.1	0.2	6.0	27.0
Belgium	1.1	76.2	0.6	0.8	0.3	1.3	19.6
Austria	6.4	78.9	0.3	0.1	0.3	0.8	13.2
Czech Rep.	Missing						

Panel A reports summary statistics of the degree of religiosity by country. The first column reports the percentage of respondents who was raised religiously at home, data is from the drop-off questionnaire of Share Wave 1. The second and third reports the fraction of people who prayed at least monthly and prayed at least weekly last year, the fourth column is an intensity measure from 0 to 5, where 0 means no religious belief and 5 means pray multiple times daily.Weighted statistics of multiple imputations.
Panel B reports the distribution of population by religious denomination and country. Weighted statistics of multiple imputations. All data are from the drop-off questionnaire of Share Wave 1.

Table 4: Religious Information from European Social Survey (% and population representative)

Denomination Information by country

	SE	*DK*	*DE*	*NL*	*BE*	*AT*	*CZ*
Roman Catholic	1.2	0.9	26.6	22.8	39.8	64.3	19.0
Protestant	25.4	57.0	29.4	17.3	0.6	3.2	0.8
Eastern Orthodox	0.5	0.2	0.6	0.1	0.3	0.8	0.0
Other Denomination	3.2	2.9	4.5	5.7	4.4	3.7	2.3
Non-Believers	69.8	39.0	38.9	54.1	54.9	28.1	77.8

Attendance of religious services apart from special occasions by country

	SE	*DK*	*DE*	*NL*	*BE*	*AT*	*CZ*
Every day	0.1	0.2	0.3	0.1	0.4	1.3	0.2
More than once a week	1.2	0.9	1.6	4.5	1.4	2.7	0.9
Once a week	2.7	2.0	7.6	9.3	7.8	13.2	5.3
At least once a month	5.7	7.4	10.8	8.8	7.1	15.6	3.4
Only on special holy days	17.4	24.1	20.4	12.9	15.3	23.4	13.3
Less often	33.8	29.8	22.0	15.5	17.4	19.5	12.9
Never	39.1	35.5	37.3	48.9	50.6	24.4	64.0

Pray frequency apart from at religious services by country

	SE	*DK*	*DE*	*NL*	*BE*	*AT*	*CZ*
Every day	8.9	11.9	14.6	25.0	14.9	18.5	4.3
More than once a week	3.4	4.0	8.7	6.1	6.1	13.4	3.7
Once a week	2.4	3.2	6.4	3.6	5.8	8.4	2.2
At least once a month	3.6	5.0	5.8	4.7	5.9	8.4	2.2
Only on special holy days	1.1	2.0	4.4	2.0	2.6	5.0	3.2
Less often	23.6	19.0	22.9	12.9	16.6	21.8	12.0
Never	57.1	54.9	37.3	45.7	48.1	24.4	72.3

Weighted statistics by using pooled European Social Survey from Wave 1(2000) to Wave 4(2008).

Table 5: Regional Fractions of Different Denominations

Nation Code	Geocell	Catholic Fraction	Protestant Fraction	Orthodox Fraction	Other Religion Fraction
AT	Burgenland	72.6	6.3	0.0	1.2
AT	Kaernten	59.7	6.3	0.4	3.0
AT	Niederoesterreich	67.7	2.5	0.6	3.0
AT	Oberoesterreich	71.7	3.7	0.2	2.3
AT	Salzburg	59.7	2.6	0.9	4.5
AT	Steiermark	63.3	3.0	0.2	3.2
AT	Tirol	67.3	2.4	0.7	2.4
AT	Vorarlberg	68.8	0.7	1.4	2.8
AT	Wien	41.2	3.9	1.7	6.6
BE	Bruxelles-Brussel	25.5	2.1	1.7	15.0
BE	Vlaams	42.9	0.5	0.1	3.8
BE	Wallonie	36.5	0.6	0.3	3.4
CZ	Jihovychod	35.4	0.3	0.0	3.2
CZ	Jihozapad	23.1	0.4	0.0	2.4
CZ	Moravskoslezsko	19.4	1.8	0.0	4.5
CZ	Praha	9.4	1.4	0.0	0.5
CZ	Severovychod	16.1	1.2	0.0	3.5
CZ	Severozapad	2.6	0.0	0.5	1.0
CZ	StredniCechy	15.1	0.0	0.0	0.9
CZ	StredniMorava	27.1	1.2	0.0	1.6
DE	Baden-Wuerttemberg	30.3	32.5	0.8	5.8
DE	Bayern	49.6	16.3	0.7	4.6
DE	Berlin	6.2	19.2	0.1	5.9
DE	Brandenburg	4.5	21.9	0.3	1.1
DE	Bremen	6.1	51.2	0.0	3.7
DE	Hamburg	9.7	43.0	1.9	5.8
DE	Hessen	24.1	41.2	0.2	6.5
DE	Mecklenburg-Vorpommern	4.9	20.7	0.4	1.7
DE	Niedersachsen	18.0	46.7	0.5	2.6
DE	Nordrhein-Westfalen	35.5	27.3	0.8	5.9
DE	Rheinland-Pfalz	40.7	28.6	0.5	4.3
DE	Saarland	48.6	19.6	0.0	5.6
DE	Sachsen	4.3	24.9	0.1	1.6
DE	Sachsen-Anhalt	3.8	22.4	0.1	0.9
DE	Schleswig-Holstein	7.5	50.5	0.7	2.0
DE	Thuerigen	9.0	23.9	0.6	1.2
DK	Hovedstaden	0.9	45.0	0.3	4.0
DK	Midtjylland	0.7	61.0	0.1	2.3
DK	Nordjylland	1.1	64.0	0.2	2.2
DK	Sjaelland	2.2	56.7	0.0	3.2
DK	Syddanmark	0.1	61.6	0.2	2.5
NL	Drenthe	8.7	25.2	0.0	3.7
NL	Flevoland	6.8	16.9	0.0	13.0
NL	Friesland	7.4	33.4	0.0	7.1
NL	Gelderland	17.4	24.8	0.0	7.4
NL	Groningen	7.1	20.1	0.4	4.3
NL	Limburg(NL)	52.6	1.9	0.2	1.6
NL	Noord-Brabant	39.8	5.2	0.1	3.9
NL	Noord-Holland	23.0	5.0	0.5	5.0
NL	Overijssel	9.0	35.2	0.4	5.1
NL	Utrecht	11.4	20.7	0.0	9.5
NL	Zeeland	6.3	36.4	0.0	6.3
NL	Zuid-Holland	8.4	30.3	0.0	6.6
SE	MellerstaNorrland	0.0	20.0	0.3	1.6
SE	NorraMellansverige	0.6	19.2	0.1	1.4
SE	OestraMellansverige	0.8	26.9	0.5	3.3
SE	OevreNorrland	0.4	26.4	0.0	1.7
SE	Smalandmedoearna	0.7	33.2	0.4	3.8
SE	Stockholm	2.3	20.4	1.0	4.0
SE	Sydsverige	1.8	29.7	0.4	3.7

Table 6: Country Dummies

Variable	Description	Values
	Control Variables	
Country Dummies		
	Country	Country Code
1	Austria	11
2	Germany	12
3	Sweden	13
4	Netherlands	14
5	Denmark	18
6	Belgium	23
7	Czech Republic	28

SHARE Wave2, continued

Social-Demographic Variables

Variable	Description	Note
	Control Variables : Blue Variables are dropped in the regression	
Social-Demographic Variables		
Demographics		
Age	Average age of the two partners in the couple or the age of the household heads if they don't have a partner	
Age Square	Average age square	
Male	= 1 : if sex of the household head	
nchild	Number of child in the household	
ngchild	Number of grand child in the household	
rooms	Number of rooms in the household	
Education Status		
college	= 1 : if any of the hhd has a college education or above education	
highs	= 1 : if any of the hhd has a high school education and other no education above high school	
nohigh	= 1 : if no one of the hhd has received a high school education or still in school or none or other	Base (Dropped)
Work Status		
hwork	= 1 : if any of the two partners is currently working , same for single head hhd	
hretired	= 1 : if both partners in a couple are retired, same for single head hhd	
hnowork	= 1 : if only both partners non-working-retired are counted as nowork	Base (Dropped)
Marital Status		
couple	= 1 : if respondent and their partner live together/married	
nonmarrige	= 1 : if respondent has never married	
divorced	= 1 : if respondent has divorced	
widow	= 1 : if respondent has died	Base (Dropped)

Variable	Description	Note
	Control Variables	
Social-Demographic Variables (Cont.)		
Health and Cognition		
hrecall	hhd recall score : maximum score of the couple and equal to the individual level if single head	
hnumeracy	hhd numeracy score : maximum score of the couple and equal to the individual level if single head	
hsrhealtha_fairpoor	self-reported health fair or poor : = 1 if any of the two partners (or the single head) report 'fair' or 'poor' health	
Social Capitals		
hhelp	= 1 : if any of the two partners (or the single head) provides help to friends relatives or neighbors in the month prior to the interview 2007	
hvoluntary	= 1 : if any of the two partners(or the single head) has done any voluntary or charity work in the month prior to the interview 2007	
hsocialac	= 1 : if any of the two partners(or the single head) has gone to a sport, social or other kind of club in the month prior to the interview 2007	
htrust	hhd level of trust, minimum value of the members in a household or equal to the individual level if single head . 1 means no trust, 10 means the extremely trust.	1 ... 10
hpolitics	hhd level of political view, minimum value value of political view among household members or equal to the individual level if single head .	1 ... 10

Financial, Inheritance and Regional Indicators

Variable	Description	Values
Financial Variables		
Net Inc	Net income (2006)	IHS transformed
Net Financial Wealth	Household net financial wealth (2007)	IHS transformed
Net Real Wealth	Household net real wealth (2007)	IHS transformed
Inheritance and Bequest		
Inheritance	Household,(max) chance of receiving inheritance	0 - 100
Bequest	Household,(max) prob. leaving inheritance more than 50k	0 - 100
Regional Indicators from European Social Survey		
Purchasing Power Adjusted Regional GDP	2001 - 2010	Average
Regional Unemployment Rate	2001 - 2010	Average
Regional Population Density	2001 - 2010	Average
Regional Life Expectancy	2001 - 2010	Average
Regional Fractions of Denominations		
Fraction of Roman Catholic	Regional Value	
Fraction of Protestant	Regional Value	
Fraction of Eastern Orthodox	Regional Value	
Other Denominations	Regional Value	
Non-Believers	Base (Dropped)	

Note: IHS transformed means Inverse-Hyperbolic-Sine Transformation
SHARE Wave2 + Eurostat, end

Table 7: Bench Mark Regression : Effect of Household Religiosity and Regional Denomination Heterogeneity on Risk-taking Attitudes (AME)

	Model1	Model2	Model3	Model4
Pray Intensity	-0.0014	-0.0024***	-0.0021**	-0.0019**
	(-1.64)	(-2.62)	(-2.29)	(-2.04)
$min \curvearrowright max$				- 0.95 pp **
				(-2.07)
$\frac{-sd}{2} \curvearrowright \frac{+sd}{2}$				- 0.35 pp **
				(-2.04)
Regional Denomination Heterogeneity ($\frac{Catholics \quad No.}{Protestants \quad No.}$)	0.0003***	0.0003***	0.0003***	0.0003***
	(3.09)	(3.16)	(3.09)	(2.81)
$min \curvearrowright max$				+ 3.70 pp **
				(2.37)
$min \curvearrowright +1sd$				+ 0.67 pp ***
				(2.77)
Country Dummies	yes	yes	yes	yes
Regional Indicator	yes	yes	yes	yes
Social-Demographic Vars	yes	yes	yes	yes
Social Capital Vars		yes	yes	yes
Financial Vars			yes	yes
Inheritance Vars				yes
Clustered S.E.	yes	yes	yes	yes
Multiple-Imputation S.E.	yes	yes	yes	yes
N	10778	10196	10196	9999

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In this table I report the estimated average marginal effect of household religiosity and regional denomination Heterogeneity on risk-taking incentives.
Country Dummies : Austria, Germany, Sweden, Netherlands, Denmark, Belgium. Czech Republic is dropped to avoid collinearity.
Regional Indicator : Regional information is obtained from Eurostat, the regional average PPP adjusted GDP level (2001 - 2010) , regional average unemployment rate (2001 - 2010) , regional population density in 2006 , regional average life expectancy (2001 - 2010). I have also controlled the denomination composition at regional level.
Financial Vars: Inverse Hyperbolic Sine transformed household level net income, net financial wealth and net real wealth
Inheritance Vars: Because inherit experience and bequest motive would affect decision maker's preference, I have included two terms in my regression, 1) The household probability of leaving inheritance more than 50,000 euro (0 - 100) 2) household's probability of receiving inheritance (0 - 100)
Social-Demographic Vars: Please refer to the Table 6, which has detailed description of the chosen social-demographic variables.
Social Capital Vars: In the regression, I have controlled 5 measures to represent social capital precessed by the household , 1) whether help others 2) whether do voluntary work 3) whether are social active 4) the trust level 5) the current self evaluation of political view
Standard Errors : Because $\frac{Catholics \quad No.}{Protestants \quad No.}$ is in regional level , I clustered the standard errors at regional level , the 7 nations are divided into 57 local region according to NUTS level 2. Moreover, the base SHARE data is multiple imputed, the multiple imputed standard error is also used.

Table 8: Dep. Var : Whether Hold Life Insurance and Amount of Holding Life Insurance(IHS Trans.)

	Probit(AME)	Tobit(AME)
Pray Intensity	-0.0038	-0.0437
	(-1.03)	(-1.03)
Regional Denomination Heterogeneity ($\frac{Catholics \quad No.}{Protestants \quad No.}$)	-0.0011***	-0.0123**
	(-2.80)	(-2.49)
$min \curvearrowright +1sd$	-2.60 pp ***	- 28.66 percent **
	(-2.80)	(- 2.51)
N	9999	9999

t or z statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

col.1 : Probit Regression, Average Marginal Effect of Multiple Imputed Dataset
col.2 : Tobit Regression, Average Marginal Effect of Multiple Imputed Dataset, left censored mean $E(y|x)$ are computed.
Net Financial Wealth was dropped from control variables.
Country Dummies : Austria, Germany, Sweden, Netherlands, Denmark, Belgium. Czech Republic is dropped to avoid collinearity.
Regional Indicator : Regional information is obtained from Eurostat, the regional average PPP adjusted GDP level (2001 - 2010) , regional average unemployment rate (2001 - 2010) , regional population density in 2006 , regional average life expectancy (2001 - 2010). I have also controlled the denomination composition at regional level.
Financial Vars: Inverse Hyperbolic Sine transformed household level net income and net real wealth
Inheritance Vars: Because inherit experience and bequest motive would affect decision maker's preference, I have included two terms in my regression, 1) The household probability of leaving inheritance more than 50,000 euro (0 - 100) 2) household's probability of receiving inheritance (0 - 100)
Social-Demographic Vars: Please refer to the Table 6, which has detailed description of the chosen social-demographic variables.
Social Capital Vars: In the regression, I have controlled 5 measures to represent social capital precessed by the household , 1) whether help others 2) whether do voluntary work 3) whether are social active 4) the trust level 5) the current self evaluation of political view
Standard Errors : Because $\frac{Catholics \quad No.}{Protestants \quad No.}$ is in regional level , I clustered the standard errors at regional level , the 7 nations are divided into 57 local region according to NUTS level 2. Moreover, the base SHARE data is multiple imputed, the multiple imputed standard error is also used.

Table 9: Robustness Check

Decision Made by Former Generation	
Upbring in Religious Environment	-0.0122*
	(-1.85)
Frac. of Raised Catholic (Region)	0.2283**
	(2.17)
Frac. of Raised Protestant (Region)	-0.0422
	(-1.11)
N	4935

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In this table I report the estimated average marginal effect on risk-taking incentives, I utilize whether someone has been raised in religious environment as a proxy for household religiosity. Fraction of raised Catholics and raised Protestants in the region are used as proxies for regional denomination Heterogeneity.
Country Dummies : Austria, Germany, Sweden, Netherlands, Denmark, Belgium. Czech Republic is dropped to avoid collinearity.
Regional Indicator : Regional information is obtained from Eurostat, the regional average PPP adjusted GDP level (2001 - 2010) , regional average unemployment rate (2001 - 2010) , regional population density in 2006 , regional average life expectancy (2001 - 2010). I have also controlled the denomination composition at regional level.
Financial Vars: Inverse Hyperbolic Sine transformed household level income, net financial wealth and net real wealth
Inheritance Vars: Because inherit experience and bequest motive would affect decision maker's preference, I have included two terms in my regression, 1) The household probability of leaving inheritance more than 50,000 euro (0 - 100) 2) household's probability of receiving inheritance (0 - 100)
Social-Demographic Vars: Please refer to the Table 6, which has detailed description of the chosen social-demographic variables.
Social Capital Vars: In the regression, I have controlled 5 measures to represent social capital precessed by the household , 1) whether help others 2) whether do voluntary work 3) whether are social active 4) the trust level 5) the current self evaluation of political view
Standard Errors : Because Frac. of Raised Catholic and Protestant are in regional level , I clustered the standard errors at regional level , the 7 nations are divided into 57 local region according to NUTS level 2. Moreover, the base SHARE data is multiple imputed, the multiple imputed standard error is also used.

Table 10: Probit Regression on Risk-taking Attitudes using Matched Sample

	AME	
Individual Pray Intensity	-0.0051**	
	(-2.37)	
Regional Denomination Heterogeneity ($\frac{Catholics}{Protestants}\frac{No.}{No.}$)	0.0006**	
	(2.17)	
Change in Predicted Prob. of Risk taking	$min \curvearrowright max$	$\frac{-sd}{2} \curvearrowright \frac{+sd}{2}$
Individual Pray Intensity	↓3.0pp	↓0.9pp
Regional Denomination Heterogeneity ($\frac{Catholics}{Protestants}\frac{No.}{No.}$)	↑10.8pp	↑2.2pp
N	25794	

z statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In this table I report the estimated average marginal effect on risk-taking incentives and the potential change in predicted probability of risk-taking motive if varying targeted control variables.
Country Dummies : Austria, Germany, Sweden, Netherlands, Denmark, Belgium. Czech Republic is dropped to avoid collinearity.
Regional Indicator : Regional information is obtained from Eurostat, the regional average PPP adjusted GDP level (2001 - 2010) , regional average unemployment rate (2001 - 2010) , regional population density in 2006 , regional average life expectancy (2001 - 2010). I have also controlled the denomination composition at regional level.
Financial Vars: I have controlled the income quartile dummies.
Social-Demographic Vars: One advantage of using European Social Survey is that I could also control the individual denomination information, such as Roman Catholic, Protestant, Eastern Orthodox, Other Denomination and Non-believers.
Social Capital Vars: In the regression, I have controlled 4 measures to represent social capital precessed by the individual, 1) whether help others 2) whether are social active 3) the trust level 4) the current self evaluation of political view
Standard Errors : I clustered the standard errors at regional level , the 7 nations are divided into 57 local region according to NUTS level 2.

Table 11: Linear IV Regression on Risk-taking Attitudes

	IV for religiosity	IV for CPratio	IV for religiosity and CPratio
Individual Pray Intensity	-0.0691^{**}	.	-0.0614^{*}
	(-2.07)		(-1.82)
Regional Denomination Heterogeneity (CPratio)	.	0.0022^{*}	0.0017
		(1.92)	(1.42)
Weak identification Test (F-test)	10.515	42.760	10.142
Endogeneity Test(χ^2-test)	6.291	4.673	8.136
Pvalue	0.012	0.031	0.017
Over identification Test(χ^2-test)	2.527	4.124	0.486
Pvalue	0.284	0.129	0.486
Observations	6554	6554	6554

t statistics in parentheses
IV Regression of Multiple Imputed Dataset
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Linear Instrument Variable Regression.
Instrument : The time difference between start the relationship and get married of the first marriage, regional attitude towards euthanasia, regional attitude towards abortion.
Weak Identification Test : The value of F test are generally larger than 10, hence I could reject the null hypothesis of weak instruments.
Endogeneity Test : The null hypothesis is that the instrument variables are not endogenous.
Overidentification Test : The null hypothesis is that the excluded instruments are valid instruments.
Standard Errors : The standard errors are corrected for multiple imputation.

Table 12: Nonlinear IV Regression on Risk-taking Attitudes

	IV for religiosity	IV for CPratio	IV for religiosity and CPratio
	AME	AME	Est. Coef
Individual Pray Intensity	-0.0609	.	-0.3126
	(-1.28)		(-1.28)
Regional Denomination Heterogeneity (CPratio)	.	0.0022**	0.0153*
		(2.11)	(1.92)
Endogeneity Test Pvalue	Not Reject.Null	*Reject.Null*	*Reject.Null*
Observations	6554	6554	6554
Estimation Method	MLE	*MLE*	$Newey-2step$

t statistics in parentheses
IVprobit Regression of Multiple Imputed Dataset
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

IVprobitt model, Average Marginal Effect are reported.
Instrument : The time difference between start the relationship and get married of the first marriage, regional attitudes towards euthanasia, regional attitudes towards abortion.
MLE : Maximum Likelihood Estimator. The 1st and 2nd column report the calculated Average Marginal Effect
Newey Two-Step Estimator : Because the MLE in ivprobit has problem to achieve convergence, for multiple endogenous variables I have used the Newey Two-Step Estimator instead, although the Two-Step estimator and MLE are not comparable, it is still sufficient to test for the statistical relationship of estimated coefficients . The 3rd column is the estimated coef. rather than the Average Marginal Effect.
Endogeneity Test : The null hypothesis is that the potential suspected variable is exogenous. For instrument variable religiosity, I can not reject the exogenous assumption, hence the probit model is enough for the analysis. For the instrument variable CPratio, we could reject the null hypothesis in a clear way, hence the usage of the non-linear model is necessary.
Standard Errors : The standard errors are corrected for multiple imputation.

Appendix A: Background Differences between Catholicism and Protestantism towards Taking Financial Risk

Jian Li

The Protestant and Catholic churches have distinct views regarding taking financial risk (e.g. gambling), which closely related with the doctrine differences. Here I briefly demonstrate the relevant historical divergence between the two. Figure 1 gives the main time axis of the historical Christianity division, this paper mainly focus on the after 16th century denominational differences between Roman Catholicism and Protestantism (after Reformation) [1].

1 Tolerant Criteria of Gambling under Roman-Catholicism

From its origin, Christianity has been critical of gambling (Slater, 1909). The early church fathers and councils clearly condemned gambling among all Christians. Two of the oldest church laws threatened excommunication of both clergy and laity found gambling [2].

Although the officials tried to curb the enthusiasm for gambling through restrictive laws (e.g. in the Roman republic), those laws could be flouted with impunity during the year-end holiday of Saturnalia. According to David (1962), the prohibitions against gambling other than during Saturnalia were repeatedly "renewed and ignored" (P.7).

During the medieval times, the distinction between providence and chance, was blurred. In spite of the condemnations of gambling, the medieval church did not deny that people were able to manipulate God's grace for earthly purposes. Aquinas, Boethius, and Dante all had stressed that the notion of divine providence did not exclude the operation of chance and luck [3].

After the Reformation, the current liberal attitude of the Roman Catholic Church towards gambling gradually emerged. Games of chance are not regarded as sinful in themselves, but only when played to excess and when they 'deprive someone of what is necessary to provide for his needs and those of others' (The Roman Catholic Catechism, paragraph 2413). Such liberal attitude doesn't change much till today.

[1] Notable differences also exist among Lutheranism, Calvinism and other protestant branches, however, such sub-denominational differences are not analyzed in the current paper.

[2] Quoted in Cunningham 1980, p.46. See also Walvin 1978, CH. 1.

[3] Reuven Brenner and Gabrielle A. Brenner 2008, CH.1.

The following quote is from the New Catholic Encyclopedia [4],

> "A person is entitled to dispose of his own property as he wills ... so long as in doing so he does not render himself incapable of fulfilling duties incumbent upon him by reason of justice or charity. Gambling, therefore, though a luxury, is not considered sinful except when the indulgence in it is inconsistent with duty."

2 Intolerant Criteria of Gambling under Protestantism

With its emergence, ascetic Protestantism stressed arguments relating to the work ethic that opposed gambling. Lutheran churches have been harsh in their condemnation of gambling. Luther once wrote that "money won by gambling ... is not won without self-seeking and love of self, and not without sin" (Works of Martin Luther, vol.4 [Philadelphia: Muhlenberg, 1931], p.58).

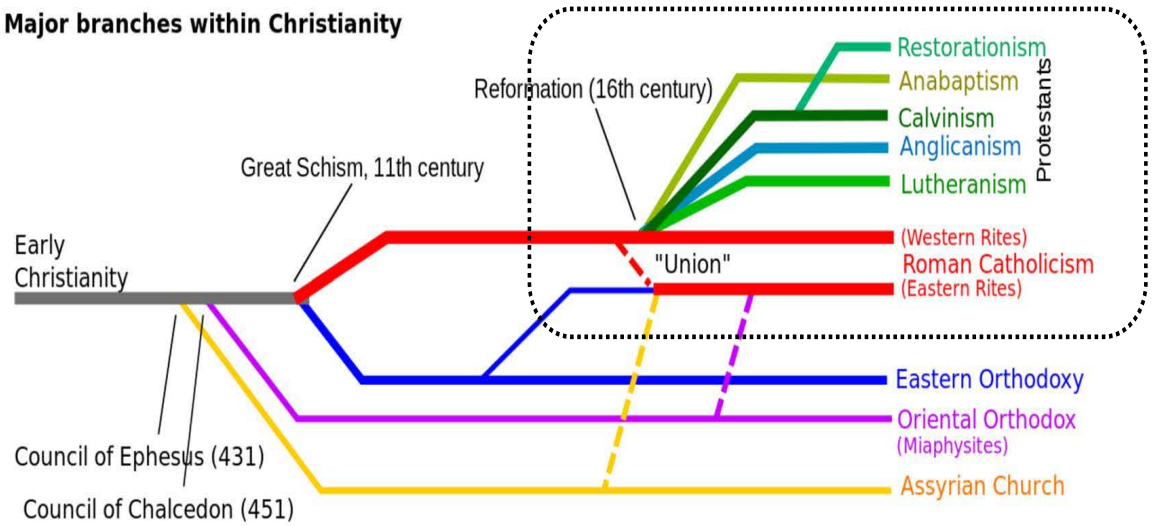
Financial success, for example, was seen as divine providence, the reward for hard work and faith. Games of chance were thought sinful because they trivialized providence (Miller, 1939, pp. 10-11; see also Winship, 1996). The Protestant reject of the idea of getting something for nothing in general, and usually declared that lotteries are morally wrong because they appear to offer the individual something for practically nothing, or at least hold out hope of a return utterly disproportionate to any effort or investment on his or her part.

Here I quote a statement from a recent book, "The United Methodist Church, 2004, Book of Resolutions", which shows the common attitudes towards gambling from Protestantism,

> " Gambling is a menace to society, deadly to the best interests of moral, social, economic, and spiritual life, and destructive of good government. As an act of faith and concern, Christians should abstain from gambling and should strive to minister to those victimized by the practice."

[4]The New Catholic Encyclopedia (NCE) is a multi-volume reference work on Roman Catholic history and belief edited by the faculty of The Catholic University of America.

Figure 1: Historical Division of Christianity



Note :.

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[2] Cunningham, Hugh. (1980). "Leisure and the Industrial Revolution c. 1780 - c. 1880." New York: St. Martin's

[3] David, F.N. (1962). "Games, gods, and gambling: A history of probability and statistical ideas" New York: Hafner

[4] Ferentzy, p.; Turner, N.E. (2013). "The History of Problem Gambling: Temperance, Substance Abuse, Medicine, and Metaphors" Springer, 2013, 174 p.2 illus., Hardcover

Appdendix B: A Quantitative Story about Historical Catholic-Protestant Regional-Level Distribution

Jian Li

December 09, 2014

1. Model

I propose a two period model under an agrarian-Malthusian Economy around year 1500.

In period 1, the local ruler[1] was under Roman-Catholicism. In period 2, the ruler has the opportunity to convert Catholicism into Protestantism (fully or partially at ruler's will)[2] . The model is able to answer three fundamental questions:

Question 1: In which scenario will the local ruler adopt Protestantism?

Question 2: And at which level? How about coexistence of Catholicism and Protestantism?

Question 3: At what cost?

The model structure is summarized as following,

1. Region are noted by $r \in (1, ..., R)$

2. For region r, the agricultural productivity is set by h_r, the land area is noted by Z_r

[1] Princes, dukes, counts, or Church dignitaries.

[2] Davide Cantoni's 2014 Paper, "The Economic Effects of the Protestant Reformation: Testing the Weber Hypothesis in the German Lands", offers a detailed review of the related historical background.

3. The related institutional parameter is denoted by λ_{rt}, where

$$\begin{cases} \lambda_{r1} & \text{stands for "Catholicism"} \\ \lambda_{r2} & \text{stands for "Protestantism"} \end{cases}$$

4. Regional economic structure is captured by output (Y_{rt}) and population (N_{rt}), where

$$Y_{rt} = \lambda_{rt} h_r Z_r$$

The economy is assumed to be agrarian-Malthusian type, namely the only economic activity is agriculture[3] . In equilibrium people live at the same subsistence level (χ), and income differences across regions are reflected in the population levels, $N_{rt} = \frac{Y_{rt}}{\chi}$.

5. Conversion to Protestantism from Catholicism is costly, and once conversion is made, a fraction $\alpha \equiv \alpha(D)$ of the regional output would be lost due to reformation cost; where $\alpha(D) = \frac{1}{\text{dist. to Vatican-City}}$, namely the longer the distance to Vatican City (the centre of the Holy Roman Empire and the spiritual center of Roman-Catholicism), the smaller the reformation cost would be[4] , where $0 < \alpha < 1$. Distances are used as rough measure for ideology dispersion efficiency.

6. The denomination reformation cost is $C_r = \alpha Y_{r1}$, if full conversion from Catholicism to Protestantism occurs.

1.1 Local Ruler's Decision

1. Local ruler chose $\phi \in [0, 1]$ as the desired fraction of Catholicism next period. If $\phi = 0$, the ruler stays with Catholicism, and triger no cost. If $\phi \neq 0$, the ruler would triger a

[3] It is harmless to assume a full agricultrual economy in 1500 - 1600 period when Europe is in pre-industrial era.

[4] The functional form here is simplified as the inversion of the distance to the Vatican City. A little bit complicated form could be used here, e.g., $\alpha(D) = \alpha_0 \frac{1}{\text{(dist. to Vantican-City)}} + \alpha_1(\text{dist. to Wittenberg})$

generalized linear reformation cost $C_r = \alpha Y_{r1}(1-\phi)$.

2. In period 0, the local ruler's utility under Catholicism is same as the regional output, as

$$\lambda_{r1} h_r Z_r$$

3. At period 1, the local ruler's general utility is assumed to be,

$$(1-p)\lambda_{r1} h_r Z_r + p\left[\phi\lambda_{r1} h_r Z_r + (1-\phi)\lambda_{r2} h_r Z_r\right]$$

where p is the successful probability of denomination conversion if the local ruler decides to reform.

4. Discount rate between period 0 and period 1 is β.

1.2 Utility Maximization

$$\max_{\phi\in[0,1]} \quad \lambda_{r1} h_r Z_r + \beta\left\{(1-p)\lambda_{r1} h_r Z_r + p\left[\phi\lambda_{r1} h_r Z_r + (1-\phi)\lambda_{r2} h_r Z_r\right]\right\} - \alpha Y_{r1}(1-\phi)$$

one can rewrite the maximization problem as

$$\max_{\phi\in[0,1]} \quad (1+\beta)\lambda_{r1} h_r Z_r + \beta p(1-\phi)(\lambda_{r2}-\lambda_{r1}) h_r Z_r - \alpha Y_{r1}(1-\phi) \tag{1}$$

1. The local ruler chose not to reformation, namely $\phi^* = 1$, if

$$\beta p(1-\phi)(\lambda_{r2}-\lambda_{r1}) h_r Z_r - \alpha Y_{r1}(1-\phi) \leq 0$$

2. The local ruler chose to reform, and pick $\phi \neq 1$, if

$$\beta p(1-\phi)(\lambda_{r2}-\lambda_{r1}) h_r Z_r - \alpha Y_{r1}(1-\phi) > 0$$

[5]

$$\lambda_{r2} > (1 + \frac{\alpha}{\beta p})\lambda_{r1} \tag{2}$$

3. given restriction (2), ϕ^* is the solution of (1).

4. the maximization problem could be transformed into

$$\begin{aligned} & \max_{\phi} \quad \beta p(1-\phi)(\lambda_{r2} - \lambda_{r1}) - \alpha(1-\phi)\lambda_{r1} \\ \Rightarrow \quad & \max_{\phi} \quad \beta p\left[\lambda_{r2} - \lambda_{r1}\right] - \alpha\lambda_{r1} + \phi\left[\alpha\lambda_{r1} + \beta p(\lambda_{r1} - \lambda_{r2})\right] \end{aligned}$$

if $\alpha\lambda_{r1} + \beta p(\lambda_{r1} - \lambda_{r2}) \geq 0$, namely $\lambda_{r2} \leq (1 + \frac{\alpha}{\beta p})\lambda_{r1}$

$$\phi^* = \overline{\phi} = 1$$

which is a contradiction to the restriction (2) generated from $\phi \neq 1$.

if $\alpha\lambda_{r1} + \beta p(\lambda_{r1} - \lambda_{r2}) < 0$,namely $\lambda_{r2} > (1 + \frac{\alpha}{\beta p})\lambda_{r1}$ inline with restriction (2), then

$$\phi^* = \underline{\phi} = 0$$

1.3 Optimal Decision of Local Ruler

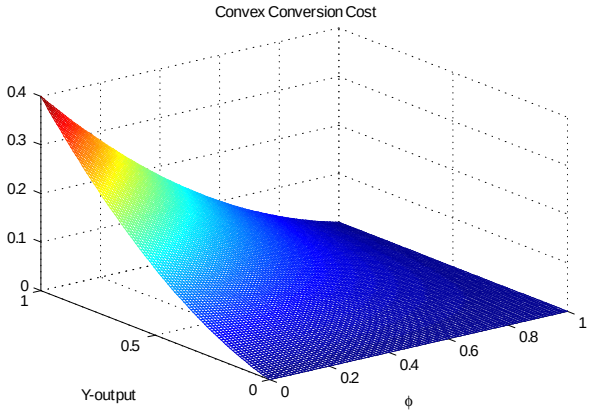
To conclude, the optimal decision of the local ruler, is

$$\begin{cases} \phi^* = 1 \quad \text{if } 0 < \lambda_{r2} \leq (1 + \frac{\alpha}{\beta p})\lambda_{r1} & \text{the ruler's region stays in Catholicism.} \\ \phi^* = 0 \quad \text{if } \lambda_{r2} > (1 + \frac{\alpha}{\beta p})\lambda_{r1} & \text{the ruler's region converts fully into Protestanism.} \end{cases} \tag{3}$$

[5] where

$$\begin{aligned} \beta p(1-\phi)(\lambda_{r2} - \lambda_{r1})h_r Z_r &> \alpha(1-\phi)\lambda_{r1}h_r Z_r \\ \beta p(1-\phi)(\lambda_{r2} - \lambda_{r1}) &> \alpha(1-\phi)\lambda_{r1} \end{aligned}$$

Figure 1: Convex Denomination Conversion Cost



2. Model Variation: Convex Quadratic Cost

The maximization problem

$$\max_{\phi} \quad \lambda_{r1}h_rZ_r + \beta\left\{(1-p)\lambda_{r1}h_rZ_r + p\left[\phi\lambda_{r1}h_rZ_r + (1-\phi)\lambda_{r2}h_rZ_r\right]\right\} \tag{4}$$
$$-\left[\alpha Y_{r1}(1-\phi) + \kappa Y_{r1}^2(1-\phi)^2\right]$$
$$s.t. \quad : \qquad \phi \in [0,1] \quad \text{with} \quad \alpha > 0,\ \kappa > 0,\ \beta p - \alpha > 0$$

[6]

here I use $C = \alpha Y_{r1}(1-\phi) + \kappa Y_{r1}^2(1-\phi)^2$ as the denomination convertion cost, which is convex in ϕ and Y_{r1}.[7] [8] Figure 1 visulize the denomination conversion cost. With two

[6] Note: $\kappa > 0$ and $\beta p - \alpha > 0$ are important parametric restrictions.

[7]
$$\frac{\partial C}{\partial \phi} = -\left[\alpha Y_{r1} + 2\kappa Y_{r1}^2(1-\phi)\right] < 0$$
$$\frac{\partial^2 C}{\partial \phi^2} = 2\kappa Y_{r1}^2 > 0$$

[8] One practical issue is to restrict $Y_{r1} \in [0,1]$, which would place the convex cost function in reasonable numeric region.

inequality constraints, $\phi <= 1$ and $\phi >= 0$, one can set the Lagrangian, as

$$\begin{gathered} L = \lambda_{r1} h_r Z_r + \beta \left\{ (1-p)\lambda_{r1} h_r Z_r + p\left[\phi \lambda_{r1} h_r Z_r + (1-\phi)\lambda_{r2} h_r Z_r\right]\right\} \\ - \left[\alpha Y_{r1}(1-\phi) + \kappa Y_{r1}^2 (1-\phi)^2\right] + \mu_1 \phi + \mu_2 (1-\phi) \\ \mu_1 \phi = 0 \\ \mu_2 (1-\phi) = 0 \\ \mu_1 >= 0 \\ \mu_2 >= 0 \end{gathered} \tag{5}$$

where

$$\frac{\partial L}{\partial \phi} = 0 \Rightarrow \phi^* = 1 + \frac{\beta p}{2\kappa \cdot Y_{r1}} + \frac{(\alpha - \beta p)\lambda_{r2}}{2\kappa \cdot \lambda_{r1} Y_{r1}} + \frac{\mu_1 - \mu_2}{2\kappa \cdot \lambda_{r1} Y_{r1}} \tag{6}$$

1. Interior Solution

   if $\phi \in (0,1)$, $\mu_1 = 0$ and $\mu_2 = 0$,

   $$\phi^*_{interior} = 1 + \frac{\beta p}{2\kappa \cdot Y_{r1}} + \frac{(\alpha - \beta p)\lambda_{r2}}{2\kappa \cdot \lambda_{r1} Y_{r1}} \tag{7}$$

   the related parameter restriction is

   $$-1 < \frac{\beta p}{2\kappa \cdot Y_{r1}} + \frac{(\alpha - \beta p)\lambda_{r2}}{2\kappa \cdot \lambda_{r1} Y_{r1}} < 0 \tag{8}$$

2. Upper bound $\overline{\phi} = 1$

   when

   $$\frac{\beta p}{2\kappa \cdot Y_{r1}} + \frac{(\alpha - \beta p)\lambda_{r2}}{2\kappa \cdot \lambda_{r1} Y_{r1}} \geq 0 \tag{9}$$

   $\phi^*_{interior} \geq 1$, which would triger $\mu_2 > 0$, and with $\mu_1 = 0$.

   $$\overline{\phi}^* = 1 + \frac{\beta p}{2\kappa \cdot Y_{r1}} + \frac{(\alpha - \beta p)\lambda_{r2}}{2\kappa \cdot \lambda_{r1} Y_{r1}} - \frac{\mu_2}{2\kappa \cdot \lambda_{r1} Y_{r1}} = 1 \tag{10}$$

3. Lower bound $\underline{\phi} = 0$

when

$$\frac{\beta p}{2\kappa \cdot Y_{r1}} + \frac{(\alpha - \beta p)\lambda_{r2}}{2\kappa \cdot \lambda_{r1} Y_{r1}} \leq -1$$

$\phi^*_{interior} \leq 0$, which would triger $\mu_1 > 0$, and with $\mu_2 = 0$.

$$\underline{\phi}^* = 1 + \frac{\beta p}{2\kappa \cdot Y_{r1}} + \frac{(\alpha - \beta p)\lambda_{r2}}{2\kappa \cdot \lambda_{r1} Y_{r1}} + \frac{\mu_1}{2\kappa \cdot \lambda_{r1} Y_{r1}} = 0 \tag{11}$$

after some algebra,

$$\phi^* = \begin{cases} 1 & \text{if} \quad \lambda_{r2} \leq (1 + \frac{\alpha}{\beta p - \alpha})\lambda_{r1} \\ 1 + \frac{\beta p}{2\kappa Y_{r1}} - \frac{(\beta p - \alpha)}{2\kappa Y_{r1}} \frac{\lambda_{r2}}{\lambda_{r1}} & \text{if} \quad (1 + \frac{\alpha}{\beta p - \alpha})\lambda_{r1} < \lambda_{r2} < (1 + \frac{\alpha}{\beta p - \alpha})\lambda_{r1} + \frac{2\kappa Y_{r1}}{\beta p - \alpha}\lambda_{r1} \\ 0 & \text{if} \quad \lambda_{r2} \geq (1 + \frac{\alpha}{\beta p - \alpha})\lambda_{r1} + \frac{2\kappa Y_{r1}}{\beta p - \alpha}\lambda_{r1} \end{cases}$$

here, under the assumption of an agrarian-Malthusian Economy, the regional population is purely determined by the output and a common-across all subsistence level of consumption

$$N_{r1} = \frac{Y_{r1}}{\chi} \Rightarrow N_{r1} = \frac{\lambda_{r1} h_r Z_r}{\chi} \Rightarrow \lambda_{r1} = \frac{N_{r1}\chi}{h_r Z_r}$$

one can use existing exogenous variables (e.g., N_{r1}, χ, h_r, Z_r) to demonstrate the institutional setting parameter of Catholicism (λ_{r1}). The final soluion of equilibrium Catholic-Protestant distribution ϕ^* can be shown as

$$\phi^* = \begin{cases} 1 & \text{if} \quad \lambda_{r2} \leq (1 + \frac{\alpha}{\beta p - \alpha}) \cdot \frac{N_{r1}\chi}{h_r Z_r} \\ 1 + \frac{\beta p}{2\kappa Y_{r1}} - \frac{(\beta p - \alpha)}{2\kappa Y_{r1}} \frac{\lambda_{r2}}{\lambda_{r1}} & \text{if} \quad (1 + \frac{\alpha}{\beta p - \alpha}) \cdot \frac{N_{r1}\chi}{h_r Z_r} < \lambda_{r2} < (1 + \frac{\alpha}{\beta p - \alpha}) \cdot \frac{N_{r1}\chi}{h_r Z_r} + \frac{2\kappa}{\beta p - \alpha} \cdot \frac{N_{r1}^2 \chi^2}{h_r Z_r} \\ 0 & \text{if} \quad \lambda_{r2} \geq (1 + \frac{\alpha}{\beta p - \alpha}) \cdot \frac{N_{r1}\chi}{h_r Z_r} + \frac{2\kappa}{\beta p - \alpha} \cdot \frac{N_{r1}^2 \chi^2}{h_r Z_r} \end{cases} \tag{12}$$

From the above equilibrium Catholic-Protestant distribution ϕ^*, one important message is revealed:

Conditional on the same level of agricultural productivity (h_r) across regions, a region with small population (N_{r1}) and large land area (Z_r) will have higher probability in converting into Protestantism from Catholicism (in results of (12), $\frac{N_{r1}\chi}{h_r Z_r}$ becomes smaller and the cutoff level for $\phi^* \neq 1$ also turns smaller). Under certain parametric restrictions (that guarantees the interior solution on ϕ), such as $(1+\frac{\alpha}{\beta p-\alpha})\cdot\frac{N_{r1}\chi}{h_r Z_r} < \lambda_{r2} < (1+\frac{\alpha}{\beta p-\alpha})\cdot\frac{N_{r1}\chi}{h_r Z_r} + \frac{2\kappa}{\beta p-\alpha}\cdot\frac{N_{r1}^2\chi^2}{h_r Z_r}$, Catholicism and Protestantism could coexist in the same region, with Catholic fraction $\phi_{Catholic} = 1 + \frac{\beta p}{2\kappa Y_{r1}} - \frac{(\beta p-\alpha)}{2\kappa Y_{r1}}\frac{\lambda_{r2}}{\lambda_{r1}}$. [9]

Region with small population (N_{r1}) and large land area (Z_r) will have higher probability in Protestantism transformation, from individuals/households perspective, such region can be categorized as **high-background risk region**. Suppose a common weather disaster occurs across regions (e.g. flood), in such region it is more difficult to formulate a risk-sharing mechanism among people, thereafter the indiviudals/households living in the region are facing larger background risk compared with others, which could be sourced as the fundemental cause for higher magnitude of risk aversion observed in such region.

[9] Suppose the cost parameter α depends on the distance to Vatican City and Wittenberg City ($\alpha(D) = \frac{\alpha_0}{\text{(dist. to Vantican-City)}} + \alpha_1(\text{dist. to Wittenberg})$), one could also generate a heterogeneous Catholic-Protestant distribution across regions.

REFERENCES

Curuk and Smulders, 2014 Working Draft, "Protestantism as a Rational Choice"