Quest University

Religious people do not discount the future less

Assignment

in

Data Science A

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Abstract

Carter et al. (2012) found that religious people discount future rewards more than non-religious people. Controversial whether Thornton, Stokes, and Helms (2015) nor Benjamin, Choi, and Fisher (2010) found such a relationship. In this study I found that religion is positively related to future discounting, indicating that religious people discount future payments more than non-religious people. However, this result is just marginally significant.

1 Introduction & Methods

As shown by McCullough and Carter (2013) religion is associated with several beneficial outcomes such as longer life, fewer depressive symptoms and higher school achievements. One possible beneficial real life outcome of religion could be the postponement of gratification (Carter et al. 2012). Delay gratification could be encouraged by religion as many religions emphasize future rewards instead of immediate gratification such as reincarnation, resurrection and immorality (Carter et al. 2012). Furthermore, patience has an important role in many religions (Carter et al. 2012). Socialization in a religious environment might therefore lead to a more patient behavior, resulting in a preference for a higher later reward instead of a instant gratification (Carter et al. 2012).
In line with the economic literature the trade-off between instant and delay gratification can be modeled through an intertemporal choice experiment. In an intertemporal choice experiment participants have to decide between an amount x now and a higher amount $x + y$ later, where y is positive.

To my knowledge three papers have investigated the relationship between religion and future discounting so far. On the one hand,Carter et al. (2012) found that religious people discount future payments more than their non-religious counterparts. On the other hand, neither Thornton, Stokes, and Helms (2015) nor Benjamin, Choi, and Fisher (2010) observed such a relationship between religion and discounting of future rewards.

Based on the contradictory findings as well as the scarcity of the previous research more research is needed to clarify the relationship between religion and the discounting of future rewards.
Beside this, all three studies have major drawbacks. Carter et al. (2012) and Benjamin, Choi, and Fisher (2010) use undergraduate students from the United States as their participants. According to Henrich, Heine, and Norenzayan (2010) undergraduate students from "Western, Educated, Industrialized, Rich and Democratic" (WEIRD) societies - especially form the USA - are the least representative samples which substantially limits the generalization of this findings. Thornton, Stokes, and Helms (2015) take this drawback into consideration and recruited their participants on the online labour market M-Turk. Even though participants from M-Turk are a more representative sample than undergraduates they are not representative enough since people who work online are - as well as undergraduates - also just a small fraction of the whole population (Horton, Rand, and Zeckhauser 2011).

This study takes these drawbacks into consideration and uses a representative sample of the German population to investigate the relationship between future discounting and religion.[1] Based on the existing literature the research question for the following analysis is:

[1] For a detailed description of the data collection see Dohmen et al. (2010)

Hypothese 1: *Religious people discount the future less than non-religious people and have therefore a stronger preference for later payments as non-religious participants*

To measure future discounting each participant took part in an intertemporal choice experiment. For this purpose each participant received an intertemporal choice matrix with 20 rows.[2] For each row the participant had to decide between 100 euros "today" or a higher amount of Y in 12 months (Dohmen et al. 2010). For all rows the early payment was 100 euros but the future payment increased by each subsequent row.
The first time that a participant switched from the early payment to the later payment shows to which extent the participant discounts future rewards, indicated by the internal rate of return.[3] For participants who never switch from the early payment to the later one, a switching row of 21 is assumed.

The response variable is the switching row, which indicates how strong a participant discounts future rewards. A higher switching row indicates that the participant discounts future payments stronger since he/she demands a higher return to give up the immediate payment for the reward in 12 months.
The explanatory variable is the religious affiliation of a participant. Religious affiliation is coded as a dummy variable with 1 when the participant belongs to a religious community and with 0 if this is not the case.
Control variables are extracted from the existing literature and are displayed in Table 1.[4]

Table 1: Control variables

Gender	1 = male and 0 = female
Age	Age in years

In the first step the data is visualized to get an overview and observe whether the response variable switching row is normally distributed. Checking the normality provides the basis on which statistical tests can be applied. In a second step a Welch two-sample t-test is applied to compare the means of switching row between religious and non-religious people as the variances of these two groups are not equal. A Welch two-sample t-test is appropriate as switching row is approximately normally distributed. [5] Although a Welch t-test is sufficient a nonparametric test (Wilcoxon-Mann-Whitney test) is conducted to verify the previous results. In a third step a linear regression model is fitted to the data. This allows to control for variables that may have an influence on intertemporal decision making and detect whether religion still has an influence on the switching row after controlling for these variables. Forth, an analysis of variance (ANOVA) is performed to compare two regression models and decide whether the model with more variables fits the data better than the model with less variables. Finally, I carry out a regression diagnostic and check whether the assumptions normality of residuals and homoscedasicity are met within the linear regression.

Results are interpreted in light of the conventional 5 % significance level. For the interpretation of the linear regression the ceteris paribus clause pertains and is not mentioned again.

[2] Table 3 in the Appendix displays intertemporal choice matrix
[3] A detailed description of the internal rate of return can be found by brealey2013principios
[4] The exact coding of the control variables can be found in the R-script
[5] For a detailed description why switching row is normal distributed see the Result Section

2 Results & Discussion

53.8 % of the participants are female and 46.2 % are male with a mean of age of 46 (range: 14 - 90). Participants belong to a wide range of religious communities (Protestant: 34.8%, Catholic: 31.4 %, member of a different Christian denomination or religious community: 2.6%, Islamic: 2.2%, another religious community: 0.2%, no religious community: 28.8%).

Visualizing the data with a histogram (Figure 1) shows that switching row is not normally distributed since the data is highly left skewed. A Q-Q Plot as well as a Shapiro-Wilk test support this result of a non-Normal distribution of switching row (p-value < 0.001).[6]

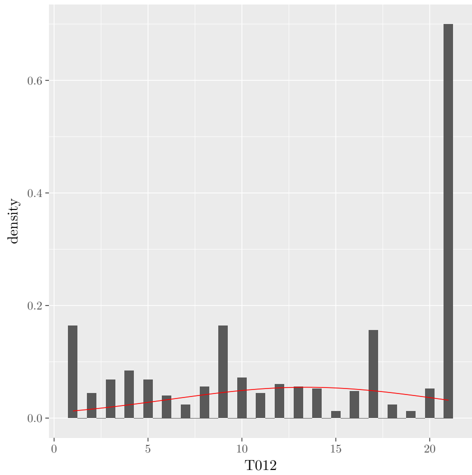

Figure 1: Histogramm of switching row with a normal distribution

Applying various transformation to the the variable does not result in a normal distribution of switching row and are therefore not utilized.[7]
According the the Central Limit Theorem (CLT), samples with a sufficient large size are approximately normal distributed and therefore parametric tests are suitable. Moreover, normality is not a requirement to fit a linear regression since just the coefficients estimates $\hat{\beta}$ have to be normal to compute confidence intervals and perform tests (Lumley et al. 2002). As $\hat{\beta}$ is a weighted sum of the response variable, "the CLT guarantees that it will be normally distributed if the sample size is large enough, and so tests and confidence intervals can be based on the associated t-statistic" (Lumley et al. 2002). However, it is questionable if the CLT applies and which sample size would be "large enough" as my sample is extremely non-Normal with a highly left skewness. Lumley et al. (2002) show for extremely non-Normal public health data that a sample is sufficiently large when the sample size is around 500. As my data set has a sample size of 500 observations and I see no reason why there should be a substantial difference between highly non-Normal data from the health care sector and my data parametric tests as well as a linear regression are appropriate.

[6]Q-Q Plot can be found in the Appendix
[7]Logarithm, Arcsine, Square-root, Square, Reciprocal, Antilog transformations are applied and can be found in the R-script

The mean switching row for religious participants is 13.81 (sd = 7.1) and for non-religious people 12.45 (sd = 7.63). Comparing the two means with a Welch t-test shows that the two means are not significantly different and that religious people do not have a higher switching row than their non-religious counterparts (p-value: 0.066). This is supported by a 95% confidence interval which does include a mean difference of zero. Also a Wilcoxon-Mann-Whitney test indicates that the switching rows of religious participants are likely not shifted left or right with respect to switching row of the non-religious participants (p-value: 0.081).

The results of the linear regression are shown in Table 2. The intercept of first the regression model indicates the expected switching row for the non-religious participants is 12.45 (p-value < 0.0001). The estimator for the dummy variable religion shows that that the expected switching row for religious participants is 1.36 higher than the switching row of non-religious participants. However, this result is not statistically significant but very close to the 5% mark (p-value: 0.058). The F-test displays that the model statistically does not fit the data since the estimator religion is not different from zero (p-value: 0.058). The adjusted R^2 implies that the model explains 0.05% of the variance of switching row but this is not statistically significant.

The second model controls for age and gender. The intercept of 12.44 is the expected switching row for non-religious females (p-value < 0.001). The estimator religion shows that the expected switching row for religious participants is 1.386 higher than the expected switching row for non-religious participants. Again, this is not statistically significant (p-value: 0.054). The estimator age implies that if we increase age by one year the expected switching row increases by 0.006. Though, this is not significant (p-value: 0.732). The F-test indicates that the model does not fit the data since all the coefficients are not different from zero (p-value: 0.197).

Comparing the two models with an ANOVA also shows that we should not keep the additional variables in the model as the reduction in the sum of squared residuals of 46.066 is not statistical significant and the two models are therefore not significantly different (p-value: 0.645).

Table 2: Regression Results

	Dependent variable:	
	Switching row	
	(1)	(2)
Religio	1.363* (0.717)	1.386* (0.717)
Male		−0.562 (0.651)
Age		0.006 (0.018)
Constant	12.451*** (0.605)	12.436*** (1.069)
Observations	500	499
R^2	0.007	0.009
Adjusted R^2	0.005	0.003
Residual Std. Error	7.257 (df = 498)	7.250 (df = 495)
F Statistic	3.618* (df = 1; 498)	1.564 (df = 3; 495)
Note:		*p<0.1; **p<0.05; ***p<0.01

As the two models are not statistically different I use the first regression model to analyze the assumptions of the linear regression. The regression residuals are not normally distributed since they substantially deviate form the straight line which represents a normal distribution.[8] Also a histogram shows that the residuals are not normally distributed as the residuals do not follow the curve of the normal distribution.

[8] Diagnostic plots (Figure 2 and Figure 3) can be found in the Appendix

Non-normality of the residuals is further supported by a Shapiro-Wilk test (p-value < 0.001).

To investigate whether the variance is constant (homoscedasticity) a Breusch-Pagan test is conducted.[9] The Breusch-Pagan test shows that we fail to reject the null hypothesis that the variance is constant (p-value: 0.069). The p-value is very close to 5% therefore a more detailed analysis of the variance of regression residuals is necessary.[10] Nevertheless, this is not the scope of this paper and is not further investigated.

The descriptive statistics as well as the linear regression shows that the switching row for religious participants is higher than the switching row of non-religious participants. This implies that religious participants discount the future more than their non-religious counterparts. All these results are not statistically significant at the conventional 5% significance level but are very close to the 5% mark. Hence, results could be interpreted as marginally significant. A positive relationship between religion and future discounting is controversial to the previous literature. One possible explanation could be that I use a representative sample instead of undergraduates or online laborers. More research is needed to clarify the relationship between religion and future discounting.

This paper is not without limitations. First, the data is extremely left skewed. Although the CLT should apply it could be that the sample size is not large enough and descriptive statistics as well as linear regression are misleading. Second, the adjusted R^2 is very small indicating that other variables could explain switching rows better. Third, for 35 % of the participants a switching row of 21 is assumed as they never switch from the immediate to the later payment. This limits the validity of my analysis because I do not know the real switching row of these participants and just assume 21 as their switching row. A proper analysis should therefore just analyze the first 20 rows.
Future research should conduct the experiment with a larger sample size to make sure that the CLT applies. Moreover, future experimental design should increase the amount of switching rows as well as vary the extent of the discount rates to avoid extremely skewed data. Another potential application could be to fit more complex regression models such as Tobit model (controlling for censored data), robust regression methods or non-linear models to increase the fit of the linear regression. Additionally, theoretical research is needed to explain, why religion could foster immediate gratification. Finally, future work should control for more variables such as income, credit constraints, Big Five, education or cognitive ability as these variables are associated with intertemporal decision making.

[9] For a detailed description of the Breusch-Pagan test see Wooldridge (2015)
[10] Another instrument to detect heterscedasticity is the White test

References

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Appendices

Table 3: Pay-off matrix for intertemporal choice experiment

	today	or	in 12 months
1	100.00		102.50
2	100.00		105.10
3	100.00		107.60
4	100.00		110.20
5	100.00		112.80
6	100.00		115.50
7	100.00		118.20
8	100.00		121.00
9	100.00		123.70
10	100.00		126.50
11	100.00		129.30
12	100.00		132.20
13	100.00		135.10
14	100.00		138.00
15	100.00		141.00
16	100.00		144.00
17	100.00		147.00
18	100.00		150.00
19	100.00		153.10
20	100.00		156.20

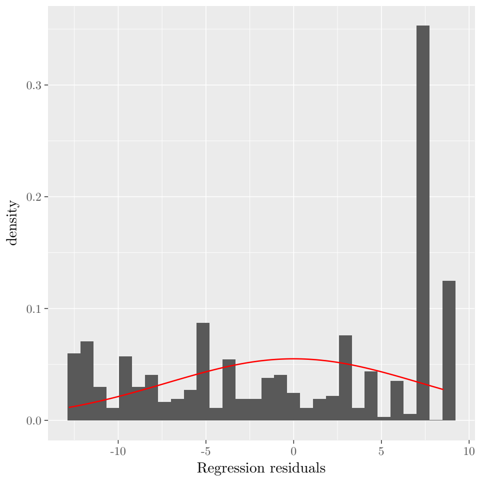

Figure 2: Histogram of regression residuals with normal distribution

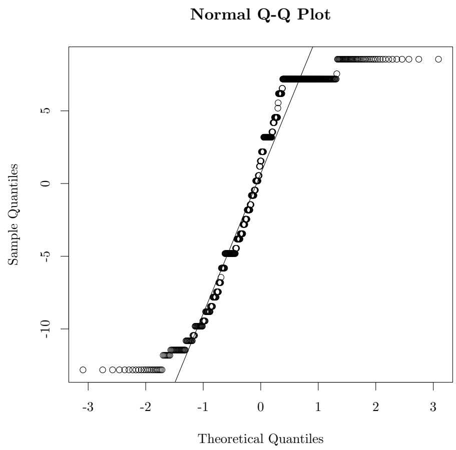

Figure 3: Q-Q Plot of regression residuals