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## Black Swans in Churches: Tails and Biases in Religious Giving.

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## INTRODUCTION

In 2007, Nassim Nicholas Taleb published a groundbreaking book, *The Black Swan: The Impact of the Highly Improbable*.<sup>1</sup> Since then, interest in the subject both inside and outside academia has been increasing exponentially. Nobel laureate and researcher in human cognitive biases in probability judgment, Daniel Kahneman, has said, “Taleb has changed the way many people think about uncertainty, ... His book, *The Black Swan*, is an original and audacious analysis of the ways in which humans try to make sense of unexpected events”.<sup>2</sup> Previously, the term, “Black Swan,” had been used by philosophers of science to illustrate the problem of induction. Originally Europeans thought all swans were white, until they discovered Australia. Hence, the first black swan that they saw down-under had refuted the all-swans-are-white theory that was based on hundreds of years of empirical confirmation. In *The Black Swan*, Taleb talks about the dangers that arise when (a) we are faced with rare-probability events and (b) we attempt to explain them. In a nutshell, a Black Swan situation happens when three things come together – a rare event, a severe outcome, and a flawed explanation. According to Taleb, the world we live in is becoming more intertwined and complex and the rare events in economics, finance, and the business world are occurring with a higher frequency. On the other hand, human beings’ natural curiosity always demands an explanation when an extremely rare or never-before-occurred phenomenon takes place. Unfortunately, as Daniel Kahneman has repeatedly demonstrated,<sup>3</sup> our explanations of probability are often biased and highly inaccurate. Nassim Taleb’s *The Black Swan* opened a Pandora’s box of research into the subject and its application in different areas. In this paper, I apply it to religious giving.

Previous research shows that average church contribution amounts vary between denominations.<sup>4</sup> It has also been demonstrated that the giving distributions are skewed to the right.<sup>5</sup> On the other hand, recent history has

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<sup>1</sup> Nassim Taleb, *The Black Swan: The Impact of the Highly Improbable* (Random House, 2007).

<sup>2</sup> Daniel Kahneman, *Foreign Policy*, July/August 2008.

<sup>3</sup> Amos Tversky and Daniel Kahneman, "Judgment under uncertainty: Heuristics and biases," *Science New Series* 185, no. 4157 (1974): 1124-1131.

<sup>4</sup> Charles E. Zech, "Generational differences in the determinants of religious giving," *Review of Religious Research* 41, no. 4 (2000): 545-559.

<sup>5</sup> Dean Hoge, "Introduction: The problem of understanding church giving," Special issue, *Review of Religious Research* 36, no. 2 (1994): 101-110. Charles E. Zech, Patrick H. McNamara, Michael J. Donahue, and Dean R. Hoge, *Money matters: Personal giving in American churches* (Westminster: John Knox Press, 1996). Laurence R. Iannaccone, "Skewness explained: A rational choice model of religious giving," *Journal for the Scientific Study of Religion*, 36, no. 2 (1997): 141-157.

uncovered numerous financial misdemeanors in churches.<sup>6</sup> I will add to the existing research by examining the distributions of giving amounts in churches within a more rigorous statistical framework. I will also consider the giving distribution's behavior, together with a biased perception of probability, as possible contributing factors to the crisis.

I will begin by estimating the exact statistical distributions of the five denominations in our study. I will show that the distributions are statistically different between the denominations. I will point out the flaws in the cognitive perception of the giving probabilities from the severity and frequency perspectives and its implication to the embezzlement in churches.

## DATA

The religious contributions data is from the *American Congregational Giving Study, 1993*. The data provides the individual church members' answers to the following question: "During the last year, approximately how much money did your household contribute to your church, in regular giving (not including school tuition or contributions to a capital campaign)? Include the value of material goods, as well as monetary gifts." The following five denominations' members were questioned: Assemblies of God, Southern Baptist Convention, Roman Catholic Church, Evangelical Lutheran Church of America, and the U.S. Presbyterian Church. A total of 125 congregations from each of the five denominations, and 30 randomly selected members from each of the 625 congregations contributed to the survey.

## A SHORT REVIEW OF CHURCH GIVING

In the United States, 90% of the people annually give money to charity, with personal giving growing faster than the gross domestic product (GDP) in the last decade.<sup>7</sup> Today private giving represents more than 2% of the GDP.<sup>8</sup> About a third of the total money contributed to charity is given to religious organizations<sup>9</sup>.

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<sup>6</sup> David Gibson, "Keeping an eye on the collection plate: The Catholic Church tries better financial oversight," *Wall Street Journal*, January 26, 2007.

<sup>7</sup> John J. Havens, Mary A. O'Herlihy, and Paul G. Shervish, "Charitable giving: How much, by whom, to what, and how?" *The non-profit sector: A research handbook*, ed. Walter W. Powell & Richard Steinberg, 542-567 (New Haven: Yale University Press, 2006).

<sup>8</sup> Ross Gittell and Edinaldo Tebaldi, "Charitable giving: Factors influencing giving in U.S. states," *Nonprofit and Voluntary Sector Quarterly* 35 (2006) 721-736.

<sup>9</sup> GivingUSA Foundation, press release, June 25, 2007.

In 1994 Dean Hoge summarized the research in religious giving in the following five key points: “1) Religious giving is a rational behavior and can be modeled using existing sociological and economic methods. 2) People strongly committed to God and God's promises will give more to the church. 3) Church members who have more discretionary income will, on average, give more to the church. 4) The distribution of the amount of money given by members of any church is highly skewed—the majority of a church's money comes from a minority of its members. 5) The amount of money potentially available to churches from members is a variable, not a fixed sum”.<sup>10</sup> Moreover, it has been found that middle income individuals give less than the poorest and the wealthiest when the contributions are measured as a percentage of income.<sup>11</sup>

As has already been noted, giving amounts differ between denominations.<sup>12</sup> However, no inference was made from a statistical point of view as to the differences between the distributions of giving among the denominations. I invoke the Kolmogorov-Smirnov (KS) two-sample test<sup>13</sup> in order to test the hypothesis that the denominational distributions are in fact different. The KS test results are presented in Table 1. They show that there is no statistical evidence, based on the 99.9% level of confidence, that regular contribution amounts at stake were sampled from the same distribution—i.e., that the giving amounts are identically distributed for the five denominations in our study.

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<sup>10</sup> Dean Hoge, "Introduction," 102-103.

<sup>11</sup> Paul G. Schervish and John J. Havens, "Explaining the curve in the U-shaped curve," *Volunta* 3, no. 2 (1995): 205-225. James N. Russell III and Deanna L. Sharpe, "The nature and causes of the U-shaped charitable giving profile," *Nonprofit and Voluntary Sector Quarterly* 36, no. 2 (2007): 218-238.

<sup>12</sup> Charles E. Zech, "Generational differences in the determinants of religious giving," *Review of Religious Research* 41, no. 4 (2000): 545-559.

<sup>13</sup> Stephens, M. A., "EDF statistics for goodness of fit and some comparisons," *Journal of the American Statistical Association* 69 (1974): 730-737.

Table 1 Two-sample Kolmogorov-Smirnov test statistics

	Southern Baptist	Catholic	ELCA	Presbyterian
Assemblies of God	1.989	13.957	10.096	8.072
Southern Baptist		11.902	7.943	5.884
Catholic			4.635	6.936
ELCA				2.388
Level of significance	0.05	0.025	0.01	0.001
Critical values	1.36	1.48	1.63	1.95

Moreover, although it has been repeatedly pointed out by other studies<sup>14</sup> that the distribution of individual giving is skewed to the right, this aspect did not provide for the exact statistical character of the giving distribution. In this paper I estimate a statistical distribution that best describes the giving data. It is true that the amount given is highly correlated with income. Hence it is tempting to assume that the giving and income distributions will have similar shapes. However, because the share of income given in churches is not constant, but increases with income over a certain amount,<sup>15</sup> the distribution of giving will be heavier-tailed than the distribution of income. In order to estimate the statistical distribution of the giving amounts, I fit non-negative distributions to the data via the maximum likelihood method. The MathWave EasyFit 3.3 software allows for fitting the following non-negative and advanced densities: Erlang, exponential, fatigue life, Frechet, gamma, inverse Gaussian, log-logistic, lognormal, Pareto, Rayleigh, Weibull, generalized extreme value, generalized logistic, generalized pareto, and Wakeby. The goodness-of-fit Kolmogorov-Smirnov and Anderson-Darling tests (the Anderson-Darling values provided by MathWave are fixed for all distributions) both show that Wakeby distribution fits the data best. In fact, it is

<sup>14</sup> Dean Hoge, "Introduction"; Zech, et. al., *Money Matters*; R. Iannaccone, "Skewness explained: A rational choice model of religious giving," *Journal for the Scientific Study of Religion*, 36, no. 2 (1997): 141-157.

<sup>15</sup> Schervish and Havens, "Explaining the curve in the U-shaped curve"; Russell and Sharpe, "The nature and causes of the U-shaped charitable giving profile."

the only distribution with any non-rejection hypothesis results (see Tables 2 and 3).

Table 2 (a) Kolmogorov-Smirnov goodness of fit statistics

Distribution	Assemblies of God		Southern Baptist		Catholic		ULCA		Presbyterian	
	Statistic	Rank	Statistic	Rank	Statistic	Rank	Statistic	Rank	Statistic	Rank
Wakeby	0.0357	1	0.0330	1	0.0441	1	0.0385	1	0.0374	1
Gamma	0.0469	2	0.0463	4	0.1032	9	0.0572	4	0.0812	8
Gen. Extreme Value	0.0502	3	0.0506	6	0.0611	4	0.0572	5	0.0522	3
Weibull	0.0513	4	0.0456	3	0.0934	7	0.0501	3	0.0647	6
Gen. Logistic	0.0555	5	0.0618	8	0.0535	2	0.0680	8	0.0599	5
Gen. Pareto	0.0614	6	0.0464	5	0.0822	5	0.0455	2	0.0551	4
Exponential	0.0635	7	0.0412	2	0.0964	8	0.0591	7	0.0844	9
Log-Logistic	0.0746	8	0.0603	7	0.0581	3	0.0584	6	0.0442	2
Lognormal	0.1102	9	0.0912	9	0.0825	6	0.0824	9	0.0686	7
Inv. Gaussian	0.1278	10	0.1148	10	0.2293	12	0.1028	10	0.1383	11
Fatigue Life	0.1412	11	0.1425	11	0.1311	10	0.1203	11	0.1309	10
Frechet	0.1730	12	0.1753	12	0.1562	11	0.1401	12	0.1542	12
Rayleigh	0.1978	13	0.2297	13	0.2628	13	0.2738	13	0.2875	13

Table 2 (b) Anderson-Darling goodness of fit statistics

Distribution	Assemblies of God		Southern Baptist		Catholic		ULCA		Presbyterian	
	Statistic	Rank	Statistic	Rank	Statistic	Rank	Statistic	Rank	Statistic	Rank
Wakeby	1.3265	1	1.3978	1	2.2131	1	1.7521	1	4.7721	2
Gen. Extreme Value	5.4768	2	5.8528	2	3.6712	3	8.3287	2	4.5248	1
Gen. Logistic	7.0090	3	8.6078	3	2.7074	2	12.035	3	6.4212	3
Weibull	42.764	4	72.985	5	78.291	8	78.254	4	86.557	4
Exponential	44.079	5	72.149	4	74.753	5	80.522	6	93.444	7
Log-Logistic	61.388	6	93.994	7	68.467	4	93.763	7	88.695	5
Lognormal	70.429	7	100.40	8	76.728	6	99.138	8	93.471	8
Gamma	42.514	8	73.877	6	77.165	7	80.338	5	91.499	6
Fatigue Life	105.69	9	152.03	9	125.41	9	140.06	9	164.32	9
Frechet	137.37	10	171.40	10	162.81	10	177.83	10	186.66	11
Inv. Gaussian	147.14	11	203.67	12	210.61	11	252.14	12	178.08	10
Rayleigh	262.34	12	368.76	13	421.06	12	597.50	13	656.06	13
Gen. Pareto	303.78	13	199.08	11	508.22	13	241.10	11	403.88	12

Table 3 Wakeby distribution ML goodness of fit tests' results

Denomination	Sample size	Goodness of fit test*	Test statistic	Critical values by level of significance			
				0.15	0.1	0.05	0.01
Assemblies of God	1,673	K-S	0.03570	0.02787	0.02983	0.03325	<b>0.03985</b>
		A-D	1.32650	<b>1.60240</b>	<b>1.92860</b>	<b>2.50180</b>	<b>3.90740</b>
Southern Baptist	1,650	K-S	0.03299	0.02806	0.03003	<b>0.03348</b>	<b>0.04013</b>
		A-D	1.39780	<b>1.60240</b>	<b>1.92860</b>	<b>2.50180</b>	<b>3.90740</b>
Catholic	1,966	K-S	0.04406	0.02571	0.02751	0.03067	0.03676
		A-D	2.21310	1.60240	1.92860	<b>2.50180</b>	<b>3.90740</b>
ULCA	2,214	K-S	0.03852	0.02423	0.02593	0.02890	0.03464
		A-D	1.75210	1.60240	<b>1.92860</b>	<b>2.50180</b>	<b>3.90740</b>
Presbyterian	2,205	K-S	0.03735	0.02428	0.02598	0.02896	0.03471
		A-D	4.77210	1.60240	1.92860	2.50180	3.90740

\* K-S (Kolmogorov- Smirnov)  
A-D (Anderson-Darling)

The Wakeby distribution is most easily defined as an inverse distribution function:

$$x(F) = \zeta + \frac{\alpha}{\beta} (1 - (1 - F)^\beta) - \frac{\gamma}{\delta} (1 - (1 - F)^{-\delta})$$





Applying this logic to churches, this means that if there is a donor who gives over  $M$  dollars, the expected amount by which his actual donation is greater than  $M$  is going to increase as we assume larger and larger  $M$ . Whatever our intuition expects the actual amount donated to be, it is likely to be higher, as we assume higher conditional value—i.e., when it rains, it pours.

The above observations have pointed out the counter-intuitive situation regarding the size of the potential donation. Now we will see that the frequency of the occurrence of tail events can also be severely misjudged due to the cognitive biases. In a paper published in 1974, Tversky and Kahneman provide a list of cognitive biases that make our judgment of probability inadequate. Two observations from that paper are applicable to our scenario: the sample size bias and the disjoint event bias. According to Tversky and Kahneman, “The similarity of a sample statistic to a population parameter does not depend on the size of the sample. Consequently, if probabilities are assessed by representativeness, then the judged probability of a sample statistic will be essentially independent of sample size.”<sup>20</sup> This means that humans will erroneously expect the same probabilities of tail events, regardless of the size of the sample. Church members will expect voluntary giving income in small congregations to deviate similarly to that in large congregations. Actually, it will be more likely for the voluntary giving income to spike in smaller congregations than in larger ones. Church administrators should anticipate this phenomenon, especially because the spike size or the actual amount of the excessive donation, as I showed previously, is counter-intuitive and is likely to be much larger than expected. The lack of awareness of such peculiarities of giving behavior in smaller congregations creates an environment in which spiked income, unaccountable by intuition, can be hard to trace.

Another cognitive bias discussed by Tversky and Kahneman deals with our evaluation of conjunctive and disjunctive events. An example of a conjunctive event would be drawing a red marble seven times in a row with replacement from a bag containing 90% red and 10% white marbles. A disjunctive event would be drawing a red marble at least once in seven successive trials from a bag containing 10% red and 90% white marbles. It has been demonstrated that people tend to overestimate the probability of conjunctive events and to underestimate the probability of disjunctive events.<sup>21</sup> If we apply this conclusion to churches, we can state that in larger congregations, people will underestimate the probability of having at least one high giving donor. Because the probability of having one high

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<sup>20</sup> Amos Tversky and Daniel Kahneman, "Judgment under uncertainty: Heuristics and biases," *Science New Series* 185, no. 4157 (1974): p. 1125.

<sup>21</sup> *Ibid.*

giver is small, people erroneously "anchor" the negligent chance and discard the number of trials. The probability of the occurrence of a substantially large donation will be underestimated in the congregation. This creates a gap between the expected number of high givers and the actual number, for which the difference is unaccountable by intuition.

In a survey by the Center for the Study of Church Management at Villanova's School of Business, 85% of U.S. Catholic dioceses responding said they had uncovered embezzlement schemes over the past five years. More than 10% reported the amounts stolen exceeded half a million dollars.<sup>22</sup> The main issues believed to be responsible for financial mismanagement inside churches are lack of transparency and lack of internal controls.<sup>23</sup> However, in the fat-tailed stochastic environment prone to cognitive biases, transparency and internal controls alone are not sufficient to solve the financial problems. In a poor-transparency environment, the excess of the actual amount donated over the amount intuitively expected is unaccountable by the books; in a robust-transparency environment, it is unaccountable by intuition. The Black Swans in churches are the situations of extremely high amounts of giving, whose expected size and probability are severely misjudged due to cognitive biases. The lack of awareness of such phenomenon in church congregations creates an opacity which has the full potential to disguise money misappropriations.

## CONCLUSION

In situations where income is highly stochastic, as it is in churches, it is vital to have an idea of the statistical distribution that can describe the underlying stochastic process. Previous studies have shown that giving amounts in churches differ between denominations, and that the giving distributions are skewed to the right. To these observations I add that the giving distributions are different between denominations, and that they are best described by a fat-tailed Wakeby.

Cognitive biases also play an important role in the stochastic environment. I show that applying the conclusions presented by Tversky and Kahneman<sup>24</sup> regarding the intuitive heuristics to churches will expose gaps between the

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<sup>22</sup> David Gibson, "Keeping an eye on the collection plate: The Catholic Church tries better financial oversight," *Wall Street Journal*, January 26, 2007.

<sup>23</sup> John B. Duncan, "Internal control systems in US churches, an examination of the effect of church size and denomination on systems of internal control," *Accounting, Auditing & Accountability Journal*, 12, no. 2 (1999): 142-163.

<sup>24</sup> Amos Tversky and Daniel Kahneman, "Judgment under uncertainty: Heuristics and biases," *Science New Series* 185, no. 4157 (1974): 1124-1131.

expected and actual probabilities of spiked income in small congregations, and between the expected and actual number of potential high-givers in large congregations. The fat tails of the donation amounts' distribution make the true probabilities of large donations counter-intuitive as well. In the stochastic environment, such as in churches' cash flows, transparency will not prevent intuition from making judgment errors; thus, transparency alone will not solve the financial problems. Therefore, awareness should be raised regarding the possibility of Black Swan situations, which emerge due to the nature of the giving distribution and the human bias in probability judgment.