Sinners and Saints: An Alternative Approach to Evaluating the Investment Performance of Sin Funds Versus Sinless Funds

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We investigate the relative performance of sin versus sinless mutual funds by employing the propensity score matching (PSM) estimator and the bias-adjusted nearest-neighbor matching estimator (NNM) as alternatives to traditional matched-pair analysis. Sin funds generally outperform their sinless cohorts, and the return difference is related positively to the proportion of sin stocks in the portfolio. A notable exception occurs in the financial crisis period of 2007-2009, during which the opposite result holds.

INTRODUCTION

Mutual fund performance has been an ongoing and sometimes controversial topic in financial economics. An abundance of literature exists in the area of corporate social responsibility and socially responsible investing (e.g., Hamilton et al., 1993; Goldreyer et al., 1999; Statman, 2000; Shank et al., 2005; Bauer et al., 2005, 2007; Girard et al., 2007; Gil-Bazo et al., 2010; Nofsinger & Varma, 2014). Literature dedicated to "Sin Investing" mutual funds however remains limited (e.g., Hoepner & Zeume, 2009; Chang and Krueger, 2013, among others). Most sin stock studies find that sin stock returns outperform the various benchmarks employed (e.g., Fabozzi, et al., 2008; Hong & Kacperczyk, 2009; Kumar and Page, 2014). Hoepner and Zeume (2009) and Chang and Krueger (2013) find that the "only sin-focused" mutual fund, VICEX, failed to outperform benchmarks. Given inconsistent findings and limited research on the performance of sin funds vis a vis sinless funds, we investigate the issue using comprehensive U.S. equity mutual fund data over the period of 2003-2016.

We use the propensity score matching (PSM) estimator first published by Rosenbaum and Rubin (1983) and the bias-adjusted nearest-neighbor matching estimator (NNM) (Abadie and Imbens, 2006) to study sin and sinless mutual fund return differences. Both methods mitigate the curse of dimensionality as the number of matching factors increases, ensuring that the outcome difference (i.e., return difference)

in each matched pair (sin versus sinless fund) is caused only by the treatment's effect (defined as sin holding), and not by observable differences between pairs. Abadie and Imbens (2006, 2011) show that nearest-neighbor matching estimators are not consistent when matching on two or more continuous covariates (matching variables), and they propose a bias-corrected estimator that we employ.

We show sin funds generally outperform their sinless cohort in our sample of U.S. equity funds for the period 2003-2016. An exception occurs during the period 2007-2009, during which sin funds underperformed sinless funds. While our results are consistent with much of the extant literature, we find the 2007-2009 result puzzling in that one might expect demand inelastic "sin" products to be somewhat "recession proof". Sin stock fund underperformace during the financial crisis may be investor reaction to one or more categories of sin stocks that perform poorly in economic downturns. Whatever the cause, financial advantages enjoyed by sin stock funds disappear in the financial crisis and resulting economic downturn. We also find that the percentage of sin holding is positively related to the performance of sin funds in general. This relationship reverses during the financial crisis period of 2007 – 2009.

The remainder of the paper is organized as follows. We review relevant literature, and follow with descriptions of the data and empirical methodology. We then present and discuss empirical findings. We conclude with some closing remarks.

LITERATURE REVIEW

Most empirical studies suggest that socially responsible investment (SRI) mutual funds either fail to exhibit performance differences from conventional funds (e.g., Hamilton et al., 1993; Goldreyer et al., 1999; Statman, 2000; Shank et al., 2005; Bauer et al., 2005, 2007), or they underperform conventional funds (e.g., Girard et al., 2007). Gil-Bazo et al. (2010) find that US SRI funds outperform conventional funds with similar characteristics over the period 1997-2005. Their results are driven almost exclusively by those SRI funds managed by specialized SRI firms. Nofsinger and Varma (2014) show that SRI mutual funds underperform during non-crisis periods, but they outperform during market crises compared to matched-sample conventional funds.

Other financial economists have examined the efficacy of investment in the so-called "sin" stocks. Fabozzi et al. (2008) find substantial returns to vice or sin stocks that significantly outperform common benchmarks. Salaber (2008) finds that sin stocks earn an excess return relative to the overall market during the period 1926-2005, but the abnormal performance disappears when sin stocks are compared to a comparable industry portfolio. She further concludes that sin stocks outperform other stocks during market downturns, but not during market upswings. Hong and Kacperczyk (2009) show that sin stocks earn higher than expected average returns due to their relative neglect by institutional investors upholding social norms. Their finding is consistent with the 'neglected stock' theory of Merton (1987), in which firms with a smaller investor base will be followed by fewer analysts and thus provide a higher return for investors. Recently, Kumar and Page (2014) provide evidence that norm-constrained investors earn relatively high abnormal returns when they choose to hold sin stocks.

Most evidence suggests that sin stocks generally outperform their benchmarks. However, there are few papers dedicated to examining the performance of sin stock mutual funds. Hoepner and Zeume (2009) study sin investing using the Vice fund, a mutual fund that derives a significant portion of its portfolio from sin stocks. They find that the Vice fund fails to earn abnormal returns. Chang and Krueger (2013) examine the performance of the Vice Fund Investor Class (VICEX), and find that the VICEX fund does not always outperform a variety of benchmarks. The VICEX underperformed relative to other funds during the 2008-2009 financial crisis period. The apparent inconsistency between the performance of the VICEX fund and individual sin stocks remains an interesting puzzle.

Matched-pair analysis is a popular technique employed to compare SRI mutual fund performance to conventional funds (e.g., Bauer et al., 2005; Gregory et al., 1997; Kreander et al., 2005; Statman, 2000; Nofsinger & Varma, 2014). Gil-Bazo et al. (2010) use the matching estimator methodology of Abadie and Imbens (2006) in an attempt to overcome two limitations of matched-pair analysis. The first is the "curse

of dimensionality" that results as the number of matching factors increases, and the second is the potential for bias caused by observable differences between pairs rather than the "treatment" variable. The Propensity Score Matching estimator and the Nearest Neighbor Matching estimator are becoming more common in financial economics research (for example, Cheng, 2003; Li & Zhao, 2006; Acharya, 2012; Chernenko & Sunderam, 2012). We employ both the PSM estimator and bias-corrected NNM estimator in examining sin stock fund performance.

DATA

We obtain monthly data on mutual fund returns, holdings, total net assets, fees, turnover and other fund characteristics over the period of 2003-2016 from the Center for Research in Security Prices (CRSP) Survivor-Bias-Free US Mutual Fund Database. Our sample begins in 2003, the first year that fund characteristics and portfolio holding data are available in the CRSP mutual fund database. We select U.S. equity funds using the Morningstar classification, resulting in a total 6415 distinct funds (CRSP fundno) for 2003-2016.

We create the lists of sin stocks as follows. First, we follow Hong and Kacperczyk (2009), defining sin stocks as those in the alcohol, tobacco, or gaming industries. They are identified by SIC (Standard Industrial Classification) codes of 2100-2199 and 2080- 2085, and NAICS (North American Industry Classification System) codes of 7132, 71312, 713210, 71329, 713290, 72112, and 721120. Second, we add the stocks within the GICS (Global Industry Classification Standard) classification of Aerospace and Defense which actually manufacture weapons or munitions to our lists. Finally, we perform cross-checks of the lists with searches of other literature and various online sources such as sinstocks.com to confirm the accuracy of our lists. The resulting lists include 173 sin stocks spanning the four major sin categories of alcohol, tobacco, gaming and defense.

METHODOLOGY

Sin Funds

All sample funds contained at least a small proportion of sin stocks as defined by our comprehensive lists. We define a sin fund as one that holds a minimum of five percent of its portfolio in sin stocks for ninety percent of sample holding observations. Conversely, we define a sinless fund as one that holds less than five percent of its portfolio in sin stocks for ninety percent of sample holding observations.

Risk Adjusted Return

We use the Carhart (1997) four-factor model to obtain the risk-adjusted return to compare the performance of sin funds with that of their sinless cohort. The risk-adjusted returns of funds are thus estimated using the following specification:

$$r_{it} = \alpha_i + \beta_{RMRFi}RMRF_t + \beta_{SMBi}SMB_t + \beta_{HMLi}HML_t + \beta_{MOMi}MOM_t + \epsilon_{it} \qquad (1)$$

where r_{it} is fund i's return in month t in excess of one-month Treasury bill rate (from Ibbotson Associates), $RMRF_t$ is the market portfolio return in excess of the risk-free rate, SMB_t and HML_t denote the monthly premium of the size factor (*SMB*) and monthly premium of the book-to-market factor (*HML*), and MOM_t is the monthly momentum.[1] ϵ_{it} represents a generic error term that is uncorrelated with all other independent variables and $E[\epsilon_{it}] = 0$.

Performance Comparison between Sin Funds and Sinless Funds

We obtain the performance difference between sin funds and sinless funds using both the propensity score matching (PSM) estimator and the bias-corrected nearest-neighbor matching (NNM) estimator. Matching variables used in the study are total net asset (TNA), management fee (Mgt), turnover ratio (Tur), and institutional fund dummy (Int). For the implementation of PSM, we use a logistic model to predict each fund's propensity score, using covariates (matching variables) TNA, Mgt, Tur, and Int.

Funds in the sin group are then matched to those in the sinless group based on the estimated propensity score. For the NNM, the nearest is calculated by Mahalanobis distance through a weighted function of the covariates (matching variables) for each fund, in which the weights are based on the inverse of the covariates' variance–covariance matrix. The matching variables chosen incorporate continuous variables, and in view of studies by Abadie and Imbens (2006, 2011) we implement their bias-correction procedure in the NNM. The bias correction circumvents the problem that nearest-neighbor matching estimators are not consistent when matching on two or more continuous covariates. In both matching methods, we use matching with replacement, that is, we allow a fund to be used as a match more than once.[2]

The Impact of Sin Investing on Sin Funds

As a robustness check, to determine whether increases in sin holding would favorably affect the return difference, we redefine the treated group (sin funds) with a larger "treated dose", percentage of sin stock holding. The difference in mean returns is again obtained using the PSM estimator and the NNM estimator.

RESULTS AND DISCUSSION

Table 1 reports summary statistics of the funds in our sample.

TABLE 1
SUMMARY STATISTICS OF FUNDS (MONTHLY)

	Funds with sin holding			Funds without sin holding		
	Mean	SD	Median	Mean	SD	Median
TNA	488.101	2768.741	16.315	662.992	3513.366	45.856
Turnover	0.421	0.300	0.300	0.739	0.805	0.578
Net Return (Raw)	0.004	0.002	0.004	0.005	0.002	0.005
Management fee	0.172	1.218	0.537	0.250	2.727	0.600
Institutional funds	0.392	0.484	0.000	0.406	0.487	0.000

TNA is total net asset values reported in millions of US dollars. Turnover is the fund's turnover ratio calculated as minimum (of aggregated sales or aggregated purchases of securities) divided by the average 12-month total net assets of the fund. Management fee is the ratio obtained as management fee divided by average net assets. Net return is the monthly fund return reported by CRSP. Institutional funds are specified by a binary variable that takes the value of one if a fund belongs to an institutional fund, and zero otherwise. SD denotes standard deviation.

The performance difference between sin funds and sinless peers over the sample period of 2003-2016 obtained through the PSM estimator and the NNM estimator is reported in Table 2. Sin funds outperform sinless funds by 0.008% monthly, significant at 0.05 level, and by 0.012% monthly, significant at 0.05 level, as estimated by PSM and NNM respectively. The superior performance of sin funds over sinless funds supports the hypothesis that investing in sin stocks yield higher-than-expected average returns (see for example, Fabozzi, Ma, & Oliphant, 2008; Hong & Kacperczyk, 2009; Kumar & Page, 2014).

TABLE 2
RETURN DIFFERENCE OF SIN FUNDS OVER SINLESS FUNDS
USING PSM AND NNM
(2003 – 2016)

Monthly Return	PSM Coefficient	NNM Coefficient
Sin vs Sinless	8.47e-05**	0.000117**
	(4.16e-05)	(4.56e-05)
Observations	3,748	3,748

Standard errors in parentheses. Matching variables are total net assets, management fee, turnover ratio, and institutional fund dummy.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

We further investigate the persistence of superior performance of sin funds over sinless funds by examining the performance difference in three subsample periods: the pre-crisis period from January 2003 through September 2007, the financial crisis period from October 2007 through March 2009, and the post-crisis period from April 2009 through December 2016.[3] The performance difference between sin funds and sinless peers for each subsample period obtained through the PSM estimator and the NNM estimator is reported in Table 3. Both in the pre-crisis period and the post-crisis period, sin funds perform better than their sinless cohorts. In the pre-crisis period (Panel A), sin funds outperform sinless funds by 0.023% monthly, significant at 0.05 level, and by 0.029% monthly, significant at 0.01 level, as estimated by PSM and NNM respectively. In the post-crisis period (Panel C), sin funds outperform sinless funds by 0.015% monthly, significant at 0.05 level, and by 0.022% monthly, significant at 0.01 level, as estimated by PSM and NNM respectively.

In the financial crisis period (Panel B), the results from both PSM and NNM indicate that sin funds underperform sinless funds. Sin funds underperform sinless funds by 0.064% monthly, significant at 0.05 level, and by 0.058% monthly, significant at 0.1 level, as estimated by PSM and NNM respectively. This is consistent with Chang and Krueger (2013) who showed that the VICEX fund (only vice-focused mutual fund) unperformed others over the 2008-2009 financial crisis period, and Nofsinger and Varma (2014) who showed that socially responsible investing mutual funds outperformed the VICEX fund. This finding contradicts Salaber (2008) who found that sin stocks outperformed other stocks during market downturns. We conjecture that investors and fund managers may selectively reduce exposure to certain segments of sin stocks in market downturns. For example, it could be that gaming activities may have been curtailed by liquidity problems during the 2007-2009 financial crisis period, substantially lowering returns in those stocks. The performance of sin funds with holdings of those stocks would thus be adversely affected.

TABLE 3
RETURN DIFFERENCE OF SIN FUNDS OVER SINLESS FUNDS
USING PSM AND NNM
(Subsample Periods)

Panel A: Pre-crisis Period (Jan. 2003 - Sept. 2007)		
	PSM	NNM
Monthly Return	Coefficient	Coefficient
Sin vs Sinless	0.000227**	0.000289***
	(9.60e-05)	(9.58e-05)
Observations	1,976	1,976

Panel B: Financial Crisis Period (Oct. 2007 - Mar. 2009)		
	PSM	NNM
Monthly Return	Coefficient	Coefficient
Sin vs Sinless	-0.000639**	-0.000577*
	(0.000313)	(0.000349)
Observations	2,342	2,342

Panel C: Post-crisis Period (Mar. 2009 - Dec. 2016)		
	PSM	NNM
Monthly Return	Coefficient	Coefficient
Sin vs Sinless	0.000145**	0.000219***
	(6.69e-05)	(7.13e-05)
Observations	3,746	3,746

Standard errors in parentheses. Matching variables are total net assets, management fee, turnover ratio, and institutional fund dummy.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Robustness Check

We redefine the sin fund criterion and repeat our analysis on the altered sin fund sample. Specifically, a sin fund must now hold a six percent or greater composition of sin stocks for ninety percent of the sample period. The sinless fund sample is not altered. Table 4 Panel A, shows that with a 1% increase in the "treated dose", i.e., sin stock holding percentage, we find that, over the full sample period of 2003-2016, the performance difference between sin funds and sinless funds increases from 0.0117% monthly (significant at 5% level) to 0.0122% monthly (significant at 5% level) estimated by NNM. From Panel B in Table 4, we find that, during the financial crisis period, the performance difference between sin funds and sinless funds changes from -0.058% monthly (significant at 0.1 level) to -0.122% monthly (significant at 0.05 level) estimated by NNM. Results show that increases in sin stock holdings would increase the contrast in the performance between sin funds and its cohort. Higher sin stock holding generally improve the performance of sin funds (Panel A), while the underperformance of sin funds in the financial crisis period might be increased as the percentage of sin holding increases (Panel B).

TABLE 4
IMPACT OF PERCENTSGE OF SIN HOLDING ON SIN FUND PERFORMANCE
USING PSM AND NNM

Panel A: Full Sample Period (Jan. 2003 - Dec. 2016)

| | Sin holding at least 5% | | Sin holding at least 6% | |
	PSM	NNM	PSM	NNM
Monthly Return	Coefficient	Coefficient	Coefficient	Coefficient
Sin vs Sinless	8.47e-05**	0.000117**	7.64e-05	0.000122**
	(4.16e-05)	(4.56e-05)	(5.44e-05)	(5.93e-05)
Observations	3,748	3,748	3,535	3,535

Panel B: Financial Crisis Period (Oct. 2007 - Mar. 2009)

| | Sin holding at least 5% | | Sin holding at least 6% | |
	PSM	NNM	PSM	NNM
Monthly Return	Coefficient	Coefficient	Coefficient	Coefficient
Sin vs Sinless	-0.000639**	-0.000577*	-0.000491	-0.00122**
	(0.000313)	(0.000349)	(0.000549)	(0.000568)
Observations	2,342	2,342	2,213	2,213

Standard errors in parentheses. Matching variables are total net assets, management fee, turnover ratio, and institutional fund dummy.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

CONCLUSION

We compare the investment performance of sin funds and sinless funds using the PSM estimator and the NNM estimator using U.S. equity funds data over the period 2003-2016. We find evidence that sin funds outperform their sinless cohort. The superior performance is persistent in the subsample periods excluding the global financial crisis period. During the financial crisis period, sinless funds outperform sin funds. One explanation is that investors and fund managers may selectively reduce exposure to certain segments of sin stocks in market downturns. For example, we conjecture that gaming activities may have been curtailed by liquidity problems during the 2007-2009 financial crisis period, substantially lowering returns in those stocks. Consequently, the performance of sin funds investing in those stocks would be adversely affected. A possible extension of our work would be to examine the investment performance of funds containing differing proportions of sin stocks by category.

We find that increases in sin holdings generally improve the performance of sin funds. One caveat worth noting is that the opposite occurred in the market downturn of 2007-2009. Moreover, our results show that sin funds are adversely affected by increases in sin holding during the global financial crisis period of 2007-2009.

ENDNOTES

1. One-month Treasury bill rates, RMRF, SMB, HML and MOM are obtained from Dr. Kenneth R. French website http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.
2. As pointed out by Abadie et al. (2004), compared with matching without replacement, matching with replacement generally lowers the bias but increases the variance.
3. We use the specification of the financial crisis period defined in Nofsinger and Varma (2014), Socially responsible funds and market crises, Journal of Banking and Finance, 48, 180-193.

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