AN EMPIRICAL ANALYSIS OF THE PERFORMANCE OF U.S. SIN STOCKS

by

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ABSTRACT

SEBASTIAN GRODS DOESSING. An Empirical Analysis of the Performance of U.S. Sin Stocks. (Under the direction of DR. PAUL GAGGL)

This thesis examines the extent to which a sin premium exists in the U.S. stock market in the period 2000 to 2023 on AMEX, NASDAQ, and NYSE. That is, whether positive risk-adjusted returns are harvestable by investing in equities that are classified as being sinful, which is defined as stocks within the alcohol, tobacco, gun, and gaming industries. By running OLS regressions on value-weighted portfolios net of the risk-free interest rate and net of a group of comparable stocks, while controlling for well-known factor returns, there is strong evidence for sin investing yielding a positive alpha. When excluding the gun industry from the sin portfolio, the results remain intact in the former, whereas, in the latter, alpha turns statistically insignificant after controlling for an adequate number of factor exposures. In general, the findings are less robust when implementing an equal-weighted portfolio construction methodology. By running Fama-MacBeth regressions, evidence for the sin anomaly is lacking. Once controlling for sufficiently many firm-specific characteristics, the sin indicator variable is insignificant, both from a stock-by-stock and from an industry portfolio perspective, despite the point estimates being consistently positive. Hence, from the factor model regressions, the thesis finds that sin stocks do outperform non-sin stocks on a risk-adjusted basis, but the results from the Fama-MacBeth regressions are less convincing. The robustness checks echo the fact that methodological inconsistencies provide a plausible explanation for the absence of consensus as to whether a sin anomaly exists.

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CHAPTER 1: INTRODUCTION

Social norms wield a profound influence over our daily lives and choices, shaping the boundaries of our behavior and consumption to the very manner in which we allocate our financial resources. In the realm of investments, socially responsible investing has experienced exponential growth, and, in 2023, the number of sustainable funds in the U.S. was just below 600. Now representing more than $300 billion in assets, it has increased roughly 250% compared to a decade ago (Morningstar, 2024). On the flip side, a fascinating and contentious phenomenon has emerged, namely sin investing, which is the practice of investing in companies traditionally viewed as morally and socially controversial. Initially, this phenomenon was applied to The Triumvirate of Sin, being stocks within the alcohol, tobacco, and gaming industries, but more industries have subsequently been added to the umbrella of sin, thus extending the definition. For instance, The Sextet of Sin, which adds the adult entertainment, gun, and nuclear power industries to the definition of sin stocks (Blitz & Fabozzi, 2017).

The question is if doing good is doing bad, and whether abnormal returns can be generated by sin stock investing, as empirical research has shown that investors, who are subject to the neglect effect, pay a financial cost. That is, they earn lower returns by refraining from investing in stocks that promote human vice, which indicates that sin is a priced risk factor (Fabozzi et al., 2008; Hong & Kacperczyk, 2009), even though definite consensus is lacking in academia about the existence of a risk-adjusted sin stock premium (Adamsson & Hoepner, 2015; Blitz & Fabozzi, 2017). To shed light on sin investing, this thesis builds upon the, although limited, existing literature on investing in companies that promote vice, in particular the seminal work of Hong and Kacperczyk (2009). Due to the rapid changes in the area of socially responsible investing, the inconclusive evidence about whether abnormal returns can be earned by sinning as well as the methodological inconsistencies in academia, it gives merit to up-to-date empirical research, which this thesis contributes to the literature with.

1.1 Problem Statement

Following the limited, outdated, and inconclusive empirical evidence on the sin stock premium, this thesis investigates the extent to which the sin phenomenon exists contemporarily in the U.S. stock market by answering the following research question:

Do sin stocks outperform non-sin stocks on a risk-adjusted basis in the U.S.?

To thoroughly answer the research question outlined, the thesis unfolds as follows. Chapter 2 equips the readers with the literary perspective, both in terms of theory and empirical evidence, where the latter is limited to findings from the U.S. stock market because this is the focus of the thesis. Chapter 3 outlines the data collection, cleaning and filtering process, and the methodological approaches employed in the analysis. In chapters 4 and 5, the findings are analyzed and concluded upon, respectively.

CHAPTER 2: LITERATURE REVIEW

The purpose of the literature review is two-fold. Section 2.1 provides the readers with the theoretical toolbox required to understand why a sin premium may exist by outlining the main arguments of seminal researchers. In section 2.2, the findings of the existing research on the sin premium are presented, focusing on the shortcomings of the prevailing empirical evidence to identify and address the gaps in the literature.

2.1 Theoretical Framework

Multiple theories have been put forward as to why sin investing can yield abnormal risk-adjusted returns. In terms of portfolio theory, financial market participants that negatively screen sin stocks, in particular being norm-constrained institutional investors, limit their investable universe, consequently reducing their ability to diversify. As shown by Hong and Kacperczyk (2009), institutional investors do, to a greater extent, shun sin stocks, which has two major implications. Firstly, the relative presence of retail investors in such equities is higher, which can induce irrationality. Secondly, financial analysts are less incentivized to conduct bottom-up research on sin stocks since fewer institutional investors hold positions in them. Combined, this neglect effect limits arbitrage and causes pricing inefficiency, and, due to limited risk sharing, CAPM does not hold. So, in addition to systematic risk, idiosyncratic risk matters, causing a reputation risk premium to be harvestable (Fabozzi et al., 2008).

It has also been postulated that sin stock industries exhibit monopolistic traits and that they are exposed to greater litigation risk for which investors should be rewarded, both of which might translate into higher returns (Blitz & Fabozzi, 2017). Kim and Venkatachalam (2011) argue for sin stocks' high-quality financial reporting, which makes them appealing to a broad range of investors and analysts, hence concluding that they do not expose investors to higher information risk vis-a-vis non-sin stocks. Sagbakken and Zhang (2021) propose that sin stocks are more predictable than other stocks due to the fact many sin stocks, by definition, promote goods that are considered addictive. This argument implies that they are more resistant to fluctuations in the economic cycle and perform relatively better during economic downturns, which has also been documented empirically by Richey (2017) as well as by Salaber (2009).

2.2 Empirical Evidence

Examining The Triumvirate of Sin on AMEX, NASDAQ, and NYSE from 1965 to 2006, Hong and Kacperczyk (2009) do, in their seminal paper about sin stock investing, conclude that an equal-weighted portfolio long sin stocks and short comparable stocks, being the foods, soda, fun, and meals industries, yields an abnormal return of approximately 3% on an annual basis, ex-post accounting for factor exposures in up to a four-factor model. Statman and Glushkov (2009) do, after controlling for factor loadings, document an alpha of -2% to -3% annually from 1992 to 2007 in an equal-weighted portfolio that is long non-sin stocks and short sin stocks, while Han et al. (2021) even find an annualized seven-factor alpha of roughly 5% in an equal-weighted portfolio that is long alcohol, tobacco, gun, and gaming stocks from 1963 to 2018.

Despite several papers documenting sizable risk-adjusted returns, the empirical evidence is inconclusive. Adamsson and Hoepner (2015) criticize the methodology of Hong and Kacperczyk (2009), arguing that the premium is a product of constructing equal-weighted portfolios of sin stocks, which is a research design shared by Statman and Glushkov (2009) as well as Han et al. (2021), implying that the abnormal returns might be driven by small and illiquid stocks. In practice, due to transaction costs and price impact, investing in equal-weighted portfolios is an unimplementable strategy, and the methodological weaknesses, which Adamsson and Hoepner (2015) correct in their paper, may reconcile why the authors fail to document any sin premium. Blitz and Fabozzi (2017) support this by stating that the sin anomaly is fully explained by sin stocks' factor exposures captured in prevailing asset pricing models. Hoepner and Zeume (2014) find that the sin mutual fund, The Vice Fund, yields a risk-adjusted return that is statistically indistinguishable from zero, while Lobe and Walkshäusl (2016) document that a value-weighted portfolio long The Sextet of Sin and short socially responsible stocks does not outperform the market on a risk-adjusted basis.

As pointed out by Trinks and Scholtens (2017), classifying a stock as sinful is problematic because sin does not represent a basis for industry classification, which may yield an incomplete representation of the universe of stocks and provide an explanation for the lack of consensus in academia regarding the existence of a sin premium. For instance, some studies only consider The Triumvirate of Sin, whereas others include more industries, and studies also tend to utilize different industry classification and portfolio weighting schemes. Further, as already emphasized, the methodological inconsistencies are a plausible cause for the rather outdated inconclusive evidence, and this gives merit to this paper, which fills the methodological and recency gaps prevailing in the academic literature in terms of the performance of U.S. sin stocks. Specifically, this thesis provides new evidence by expanding the definition of sin, by conducting robustness tests as to whether the premium found in literature is a result of equal-weighting instead of the more practically implementable approach of value-weighting, by analyzing exposures to a broader set of factors, and by running Fama-MacBeth regressions, the latter which is lacking in research on the sin anomaly.

CHAPTER 3: DATA & METHODOLOGY

To investigate the performance of sin stocks from a portfolio perspective through factor model regressions, as well as from a stock-by-stock and industry standpoint through Fama-MacBeth regressions, multiple datasets have been merged. All company-specific data is gathered from Wharton Research Data Services, being from Compustat (2024a), Compustat (2024b), and CRSP (2024). Data on factor returns is from French (2024) as well as AQR (2024), while business cycle data is from OECD (2024). The sample period is restricted to span from January 1, 2000, to December 31, 2023.

3.1 Data Collection

3.1.1 Security Data

This is monthly data from CRSP (2024), which includes all constituents of AMEX, NASDAQ, and NYSE. The variables are CRSP's unique security identifier (PERMNO), end-of-month stock price (PRC), holding period return (RET), share code (SHRCD), number of shares outstanding (SHROUT) as well as number of shares traded (VOL). The variables are outlined in Appendix A and the constructed ones in Appendix B.

3.1.2 Accounting & Segments Data

From Compustat (2024a), all the annual accounting data has been gathered, where Appendices A and B provide an overview. The variables are common equity (CEQ), company name (CONM), Compustat's unique security identifier (GVKEY), NAICS' industry classification codes (NAICS), preferred stock capital (PSTK), SIC's industry classification codes (SIC), and deferred taxes and investment tax credit (TXDITC). Importantly, this data is collected at the end of a company's fiscal year, which, subsequently, has been converted to the end-of-calendar year such that it was possible to merge it with the CRSP data. Effectively, this means that, for a stock in a given year, the same accounting data will appear in each of the 12 months. Data on business segments, using NAICS (NAICS1) and SIC (SIC1) codes, is from Compustat (2024b).

3.1.3 Factor Data & Industry Classification

To conduct the factor model regressions, vectors of value-weighted factor returns have been downloaded from Kenneth French's data library (French, 2024) and the global investment management company, AQR Capital Management (AQR, 2024). From the former, the factors are Conservative-Minus-Aggressive (CMA), High-Minus-Low (HML), Market Excess Return (MKT), Momentum (MOM), Risk-Free Interest Rate (RF), Robust-Minus-Weak (RMW) as well as Small-Minus-Big (SMB), whereas the Betting-Against-Beta (BAB) factor is retrieved from the latter. To sort stocks into industries, the definition of 48 industries, constructed by French (2024), has been utilized, augmented by a gaming industry, which is elaborated on in section 3.2.

3.1.4 Business Cycle Data

Macroeconomic data is collected from OECD (2024), where the variable collected is the OECD Composite Leading Indicator (CLI), which is used as a proxy for business cycles. A score of 100 signifies that the economy is in line with its long-term growth trend, where this paper classifies a value below 100 as contractionary and a value above or equal to 100 as expansionary. Subsequently, a dummy variable (CON), which is equal to one in contractionary periods, has been constructed. Value-weighted industry betas on this indicator variable are then calculated to control for the economic climate in the Fama-MacBeth regressions. Appendix B shows the computations conducted.

3.2 Data Filtering & Cleaning

Having collected the data, the CRSP (2024) and Compustat (2024a) datasets were merged using the security identifiers, PERMNO and GVKEY, through a linking dataset from WRDS (2024). Data on factor returns and business cycles was added by merging on date. To construct the remaining variables required to perform the analysis, the methodology of Hong and Kacperczyk (2009) has been followed closely. Following the somewhat extensive nature of this process, Appendix B outlines all the computations performed. To classify the observations into 49 industries, a two-step approach has been adopted. Firstly, a classification has been performed based on SIC codes for industries 1 through 48, whereas industry 49, which is the gaming industry, has been classified based on NAICS codes since no specific SIC code exists for gaming stocks. In the second step, to take into account that stocks may be classified in a certain industry but have business segments in other industries, historical business segment data on the sin stock industries from Compustat (2024b) has been combined with the main SIC and NAICS variables that were pulled from Compustat (2024a). Hence, multiple steps have been taken to get the most accurate sample of sin stocks possible. Sin stocks are defined as stocks in the alcohol, tobacco, gun, and gaming industries, and, using the same methodology, a portfolio of comparable stocks has been constructed, consisting of stocks in the foods, soda, fun, and meals industries.

Following the general methodology within empirical finance, and in line with Hong and Kacperczyk (2009), stocks operating within the financial industry have been filtered away. As is also standard practice, only stocks with share codes 10 and 11 are included in the dataset, meaning that, for instance, ADRs and REITs are excluded. Following the methodology of the aforementioned, all observations that do not possess the key requisite financial data to perform the empirical analysis have been discarded. The final sample of the total number of sin stocks by year is shown in Appendix C.

3.3 Methodology

To thoroughly assess the performance of sin stocks, multiple methods are employed. These are outlined in subsections 3.3.1 and 3.3.2.

3.3.1 Factor Models

The first analytical section performs time-series regressions based on various commonly employed factor models. This analysis is purely performance-based since it aims at tracking and explaining the performance of the sin portfolio. In this section, two stances are taken. The first approach is to define the dependent variable as the value-weighted return of the sin stock portfolio net of the yield of the one-month U.S. Treasury Bill, the latter being compiled from French (2024). This is the most common technique in empirical finance literature when running factor model regressions but, to benchmark against the findings of Hong and Kacperczyk (2009), the second approach is to utilize the net return of a portfolio that is long the value-weighted sin portfolio and short the value-weighted portfolio of a group of comparable stocks. Consequently, the monthly value-weighted portfolio return is computed as follows:

$$r_{i,t} = \sum_{i=1}^{N} \frac{mv_{i,t}}{\sum_{i=1}^{N} mv_{i,t}} r_{i,t} \tag{3.1}$$

To consider the impact of methodological choices in terms of portfolio construction and the computation of returns, the regressions are also conducted excluding the gun industry and by using equal-weighted returns, as done by Hong and Kacperczyk (2009), instead of value-weighting, where the vector of portfolio returns is given by:

$$r_{i,t} = \frac{1}{N} \sum_{i=1}^{N} r_{i,t} \tag{3.2}$$

In all OLS regressions, the dependent variable is regressed onto the vectors of factor returns from subsection 3.1.3. Newey and West (1987) standard errors with a floored lag of $(1/3)T^{1/3} - 1$ is used to account for heteroscedasticity and autocorrelation. With r_x being the position that is net off, the regressions conducted can be stated as:

$$r_{i,t} - r_{x,t} = \alpha_i + \beta_{1i} F_{1,t} + \beta_{2i} F_{2,t} + ... + \beta_{Ni} F_{N,t} + \epsilon_{i,t} \tag{3.3}$$

By running these regressions, the performance is investigated by examining whether the portfolio's return can be explained by its factor loadings. This means that, if a regression coefficient, beta, is significant, the portfolio has a significant exposure to that factor. If the intercept, alpha, is insignificant, the model is able to explain the excess return of the portfolio. Contrarily, if alpha is significantly greater than zero, the portfolio earns an excess return above and beyond what can be explained by its factor loadings, while the opposite holds if it is significantly negative. It means that a significantly positive alpha is evidence of the sin anomaly, while an insignificant or significantly negative alpha implies a lack of evidence in support of the phenomenon.

3.3.2 Fama-MacBeth

The second analytical section examines sin performance by conducting Fama and MacBeth (1973) regressions, which is a regression approach that computes the coefficients as the means of repeated cross-sectional OLS estimates (Cochrane, 2005). Hence, this entails running cross-sectional regressions every month, and, subsequently, taking the average of the monthly coefficients to get the final coefficient estimates. Since the Fama-MacBeth method requires variables to vary cross-sectionally, the variables used are firm-specific characteristics. This is possible to do when assuming that these act as risk factors themselves, as done by, for instance, Fama and French (1993). The Fama-MacBeth regressions are constructed as follows:

$$r_{i,t} - rf_t = \gamma_0 + \gamma_1 \hat{\beta}_{1i,t} + \gamma_2 \hat{\beta}_{2i,t} + ... + \gamma_N \hat{\beta}_{Ni,t} + \epsilon_{i,t} \tag{3.4}$$

The analysis will primarily be done on a stock-by-stock basis, as done by, among others, Fama and French (1992), consequently estimating the effect on excess stock returns for a unit of a risk factor, holding other risk factors in the model constant. The traditional application of the Fama-MacBeth methodology is also applied by regressing on value-weighted, as well as on equal-weighted as a robustness check, industry portfolio returns, and, subsequently, using a sin dummy variable. This makes it possible to break down the sin effect to an industry level, even though the sin portfolio is not disaggregated into four separate industries due to idiosyncratic risk exposure. The latter approach allows for disentangling the return impact from investing in the constructed portfolio of sin stocks instead of the average effect across all the sin stocks. As with the factor model regressions, the Fama-MacBeth regressions are conducted both including and excluding the gun industry from the sin definition.

In the Fama-MacBeth regressions, the intercept estimates the risk premium, controlling for other risk factors. The variable of primary interest is the sin dummy, which estimates the effect on excess returns, denoted the risk premium, from investing in sin stocks. If the coefficient is significantly positive, it speaks in favor of the sin stock anomaly, while the opposite holds if it is insignificant or significantly negative.

CHAPTER 4: RESULTS

This chapter presents the empirical findings. Section 4.1 shows the summary statistics, sections 4.2 and 4.3 analyze the results from the factor model and Fama-MacBeth regressions, respectively, while section 4.4 discusses the implications of the findings.

4.1 Summary Statistics

Based on the SIC and NAICS industry classifications, Figure 1 computes the value-weighted market betas of each industry in the sample period from 2000 to 2023. The graph also plots the sin portfolio, the comparable portfolio, and the residual portfolio, where the latter is comprised of all stocks not in the two aforementioned portfolios. The sin, alcohol, tobacco, gun, and gaming industries are highlighted in bold.

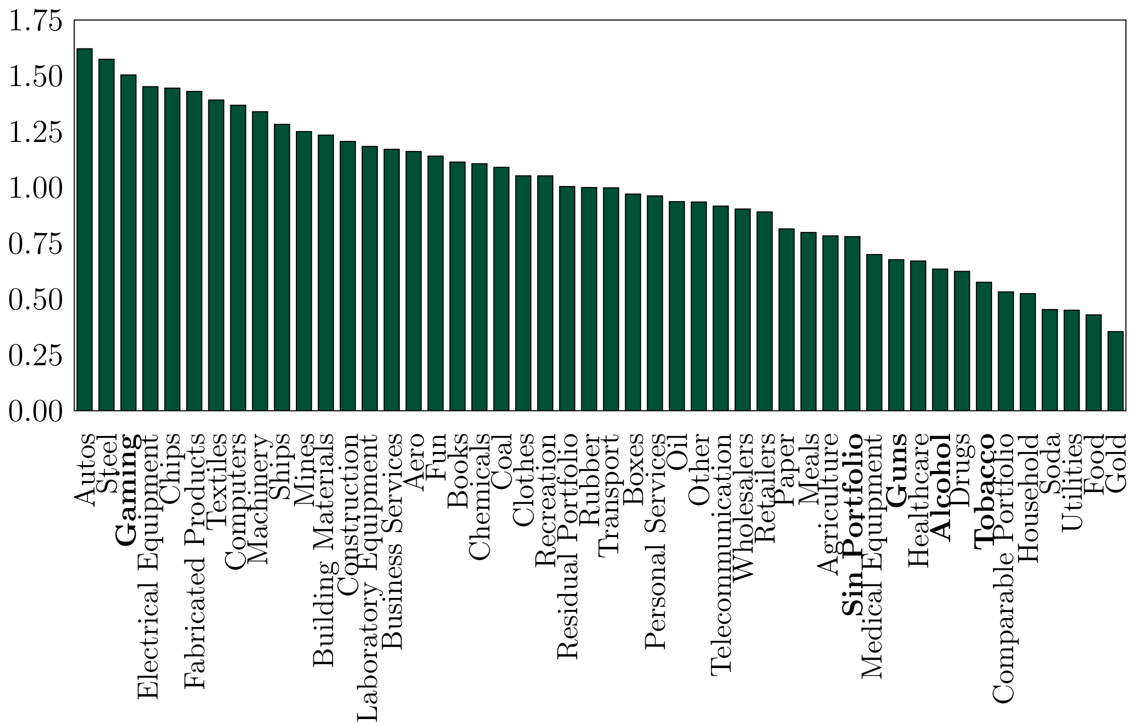

Figure 1: Market Betas by Industry

As seen from the figure, beta varies considerably by industry. The auto industry is most sensitive to market movements with a beta of 1.62, while the food and soda industries, which comprise two of the industries in the comparable portfolio, are among those with the lowest beta of roughly 0.45. Of key interest is the beta of the sin portfolio as well as those of the alcohol, tobacco, gun, and gaming industries. Among those, gaming has the highest beta of 1.50, meaning that, when the market moves by 1.00%, gaming stocks move by 1.50%, followed by gun, tobacco, and alcohol with relatively low betas of 0.68, 0.63, and 0.58, respectively. Henceforth, gaming stocks tend to be more volatile than the market, whereas the three other sin industries, generally, tend to be less volatile than the market. The overall sin portfolio, which is a value-weighted average of the constituents in the four sin industries, is roughly 22% less volatile than the market. These findings support prior empirical research.

Having examined the variation in market volatility among the different industries, Figure 2 calculates value-weighted excess returns of $1 invested on January 1, 2000. The returns have been compounded on a monthly basis until December 31, 2023.

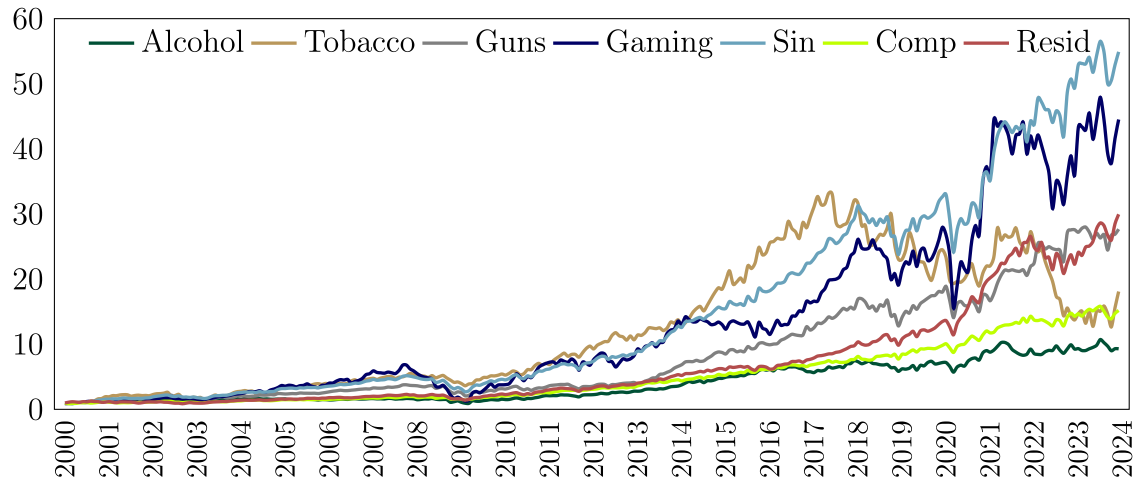

Figure 2: Compounded Excess Return by Portfolio

The compounded excess return differs widely among the different portfolios formed. The light blue line is the value-weighted excess return of the sin portfolio, which is comprised of stocks within the alcohol, tobacco, gun, and gaming industries. As can be seen, it has a considerably higher excess return than all other portfolios depicted in the graph, and the fact that the compounded excess return is higher than those of the constituent industries clearly shows the power of diversification. It also considerably outperforms the comparable portfolio and the residual portfolio, as shown by the lime-colored line and the red line, respectively. From the dark green line, it is clear that the alcohol industry has underperformed vis-a-vis the other industries, whereas the performance of the gun industry more or less is in line with the performance of the residual portfolio, the former which is depicted by the gray line. The tobacco industry has performed really well until around 2018, after which it has declined considerably. The gaming industry is, by far, the best-performing industry but, as was shown in Figure 1, it is also the most volatile one, implying that it exhibits the greatest market risk exposure. Consequently, Figures 1 and 2 give a clue in terms of the risk-return profile of the sin portfolio and the contribution of the four industries constituting it.

To shed additional light on the risk-return profile across the industries that comprise the sin portfolio, Table 1 shows the monthly summary statistics for the market, alcohol, tobacco, gun, gaming, and sin portfolios. The statistics are value-weighted.

Table 1: Monthly Summary Statistics by Sin Industry

	Market	Alcohol	Tobacco	Guns	Gaming	Sin
Excess Return	0.0055	0.0094	0.0127	0.0131	0.0177	0.0152
Standard Deviation	0.0463	0.0572	0.0718	0.0545	0.0969	0.0500
Market Correlation	1.0000	0.5139	0.3710	0.5750	0.7183	0.7217
Market Beta	1.0000	0.6345	0.5755	0.6765	1.5040	0.7797
Sharpe Ratio	0.1188	0.1643	0.1769	0.2404	0.1827	0.3040
Treynor Ratio	0.0055	0.0148	0.0221	0.0194	0.0118	0.0195
Market Cap $bn	N/A	19.4123	83.1906	46.9379	17.2566	52.6562
Number of Firms	N/A	10.2361	3.7361	14.9201	35.0069	63.8993
Portfolio Weight	N/A	0.1084	0.2866	0.3638	0.2412	1.0000
Skewness	−0.4706	1.0990	0.1409	−0.2488	1.5922	−0.0650
Kurtosis	3.6965	16.5565	5.1836	4.5138	18.0615	4.9041

As expected from Figure 2, there is a significant variation in the excess return among the portfolios. For instance, the gaming portfolio, on average, outperforms the alcohol industry by $((0.0177/0.0094) - 1) * 100 = 88.30\%$ on a monthly basis, while the performance of the tobacco and gun portfolios is roughly between that of the two former portfolios. The sin portfolio, which is a weighted average of all stocks in the four aforementioned portfolios, performs well. On an annualized basis, ex-ante adjusting for risk exposures, it yields an excess return of $(0.0152 * 12) * 100 = 18.24\%$, which is way above the annualized excess market return of $(0.0055 * 12) * 100 = 6.60\%$. In terms of portfolio diversification, there is also a clear benefit from investing in the sin portfolio from the perspective of the risk-return trade-off, as the standard deviation of the sin portfolio is only slightly above that of the market portfolio, amounting to $(0.0500 * \sqrt{12}) * 100 = 17.32\%$ annualized, thus exhibiting the best Sharpe ratio, while it increases significantly if solely investing in one of the sin industries, in particular gaming. The diversification benefit is also evident by looking at the average number of firms, where only the combined sin portfolio provides an adequate level of diversification, even though the caveat, despite being relatively dispersed across the four industries, is that an investor would only be long in four different industries. Confirming Figure 1, the alcohol, tobacco, and gun industries are low-beta ones, while the gaming industry is a high-beta one. Thus, the sin portfolio has a low beta, and, combined with its high excess return, a high Treynor ratio.

Summarizing, a pattern appears. Combining that sin stocks realize a higher return than the comparable portfolio and the market, and because the market beta for sin stocks is lower than that of the market, it suggests that they may provide investors with an opportunity to earn abnormal returns. However, it has also been established that the sin industries differ in terms of risk, return, and size profile, which is important to bear in mind when adjusting the sin portfolio's excess returns for risk.

4.2 Factor Models

To investigate the performance of the constructed sin portfolio, three different analytical perspectives are taken. In subsection 4.2.1, the excess return of the value-weighted sin stock portfolio net of the risk-free interest rate is regressed onto the factor returns outlined in subsection 3.1.3. In subsection 4.2.2, the same analysis is employed, though the dependent variable is not the excess portfolio return but the return of a value-weighted portfolio that is long the sin portfolio and short the group of comparable stocks. Subsection 4.2.3 performs robustness checks of the results.

In Table 2, factor-specific characteristics are shown for each of the regression variables that are employed in the factor model regressions. The mean is computed as the time-series average of the vectors of factor returns, the median as the median value of those vectors, while sigma is the standard deviation of the returns of the factors.

Table 2: Factor-Specific Characteristics

	Mean	Median	Sigma
$r_{SIN} - rf$	0.0152	0.0160	0.0500
$r_{SIN} - r_{COMP}$	0.0051	0.0064	0.0348
r_{MKT}	0.0055	0.0113	0.0463
r_{SMB}	0.0024	0.0016	0.0312
r_{HML}	0.0021	−0.0003	0.0351
r_{MOM}	0.0014	0.0043	0.0519
r_{CMA}	0.0028	0.0000	0.0224
r_{RMW}	0.0045	0.0045	0.0294
r_{BAB}	0.0075	0.0070	0.0391

The sin portfolio yields an excess return of 1.52% per month, which, as already has been pointed out, is considerably higher than that of the market portfolio. Furthermore, as was also hinted at in Figure 1, it is only slightly more volatile than the market with a standard deviation of 5.00%, compared to that of the market of 4.63%, and the excess return is statistically different from zero with a t-statistic equaling

$t = (0.0152 - 0)/(0.0500/\sqrt{288}) = 5.16$. Compared to the rest of the factor returns from AQR (2024) and French (2024), the sin portfolio yields a higher monthly excess return, both when measured by the mean and median, even though it is the second most volatile one. In accordance with the results of Hong and Kacperczyk (2009), the sin portfolio outperforms the comparable portfolio by 6.12% on an annual basis, which is a difference that is significantly different from zero at a 5% level with a t-statistic of $t = (0.0051-0)/(0.0348/\sqrt{288}) = 2.49$. However, to get the full picture of the performance of the sin portfolio, the returns must be adjusted for risk exposures.

4.2.1 Sin Portfolio Net of the Risk-Free Interest Rate

Table 3 reports the results from the factor model regressions conducted on a portfolio that is long the value-weighted sin portfolio net of the one-month U.S. T-Bill.

Table 3: Factor Models – Long Sin Net Risk-Free Rate

	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0109***	0.0100***	0.0101***	0.0070***	0.0070***	0.0065***
β_{MKT}	0.7797***	0.7986***	0.7885***	0.8812***	0.8614***	0.8612***
β_{SMB}		−0.0651	−0.0618	0.1296*	0.1404**	0.1282*
β_{HML}		0.4627***	0.4564***	0.2539***	0.2251***	0.2012***
β_{MOM}			−0.0220		−0.0525	−0.0909*
β_{RMW}				0.4722***	0.4823***	0.3943***
β_{CMA}				0.1620	0.1888	0.1772
β_{BAB}						0.1457**

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

In model (1), running a CAPM regression, the portfolio yields a monthly risk-adjusted excess return of 1.09%, which is significant at a 1% level. It also loads significantly and positively on the MKT factor, suggesting that, as the market moves up by 1.00%, the excess portfolio return increases by 0.78%, thus supporting the previous finding that the sin portfolio is less volatile than the market. Adding the SMB and HML factors in model (2), thus turning towards a Fama-French three-factor model, both alpha and the MKT factor remain positive and highly statistically significant. Further, the SMB factor is negative but statistically insignificant, while the HML factor is positive and statistically significant at a 1% level. This implies that sin stocks are value stocks, thus having a high book-to-market value. In the Carhart four-factor model, which is model (3), the impact of adding the MOM factor to the regression is negligible. In model (4), the positive and significant RMW factor indicates that the sin portfolio is composed of stocks with robust earnings, whereas the CMA factor is positive but statistically indistinguishable from zero. Controlling for these two factors lowers the loading on the HML factor, which has decreased from roughly 0.46 to about 0.25 but without altering its significance. In addition, the SMB factor has turned positive and statistically significant at a 10% level, now suggesting that sin stocks tend to be smaller value stocks with robust earnings. In model (5), the Fama-French five-factor model, the changes are relatively modest. Even in the most extensive regression, which is model (6), alpha remains positive and highly statistically significant at a 1% level, amounting to approximately 7.80% annualized. The BAB factor is positive and statistically significant at a 5% level, suggesting that low-beta sin stocks are associated with higher returns than what is justifiable from their exposure to systematic risk, whereas high-beta sin stocks are compensated less than what the security market line predicts.

In sum, there is strong evidence of positive risk-adjusted excess returns being harvestable from investing in sin stocks, as alpha is positive and statistically significant. In contrast to Blitz and Fabozzi (2017), who value-weight the sin portfolio return for the same four industries but net of the market portfolio, sin stocks' abnormal return cannot adequately be explained by their exposure to the factors not included in the seminal paper of Hong and Kacperczyk (2009), which implemented equal-weighting.

4.2.2 Sin Portfolio Net of the Comparable Portfolio

To compare the findings of the previous subsection with those of Hong and Kacperczyk (2009), this subsection reiterates the analysis but, instead of regressing on the value-weighted excess sin portfolio return, the dependent variable is the return of a value-weighted portfolio long the sin portfolio and short the comparable portfolio. Table 4 shows the results of the six regressions.

Table 4: Factor Models – Long Sin Short Comparable

	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0037**	0.0029**	0.0031**	0.0028*	0.0029*	0.0029*
β_{MKT}	0.2474***	0.2234***	0.2025***	0.2182***	0.2026***	0.2026***
β_{SMB}		0.1520**	0.1587**	0.1877**	0.1963**	0.1975**
β_{HML}		0.3025***	0.2894***	0.3310***	0.3082***	0.3105***
β_{MOM}			−0.0454		−0.0416	−0.0380
β_{RMW}				0.0697	0.0777	0.0860
β_{CMA}				−0.1272	−0.1059	−0.1048
β_{BAB}						−0.0138

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Compared to the results in subsection 4.2.1, the majority of the factor exposures have decreased considerably. This can be rationalized by the fact the exposure from being long the sin portfolio is offset by being short the comparable portfolio but, despite that, a lot of the coefficients remain statistically significant. Across the six regressions, the loadings on the MKT, SMB, and HML factors are positive and statistically significant at either a 1% or a 5% level. This means that, despite being long the sin portfolio and short the comparable portfolio, the former has a significantly higher market risk exposure, a greater weight on smaller stocks, and loads more positively on the value premium than the latter. Hong and Kacperczyk (2009) likewise find a significant positive loading on the HML factor but, despite the point estimates also being positive on the MKT factor when extending the regression beyond the CAPM, their MKT loadings are far from statistically significant. Adding more factors than in model (2) does not increase the explanatory power of the model because the additional factors, the MOM, RMA, CMA, and BAB factors, are statistically insignificant.

Alpha remains positive and statistically significant in all regressions, either at a 10% or a 5% level, suggesting that abnormal returns can be earned by going long the sin portfolio and short the comparable portfolio. Once controlling for more factor exposures, as done in models (4) through (6), alpha remains only borderline statistically significant, but these results still provide evidence for the sin stock anomaly. Stated differently, there is a significant difference between the abnormal returns earned by the sin portfolio and the comparable portfolio, which indicates that, from a risk-adjusted perspective, investors are better off investing in the former than in the latter, despite the fact that they risk going against the social norm of investing responsibly. This conforms to the results of Hong and Kacperczyk (2009), who document that a long-short portfolio investment strategy yields significant positive risk-adjusted returns.

4.2.3 Robustness Checks

As robustness checks, the same analyses as in subsections 4.2.1 and 4.2.2 are performed without including the gun industry in the sin portfolio, as this is done by, e.g., Hong and Kacperczyk (2009). Further to this, the regressions are also reiterated, both with and without the gun industry, using equal-weighted excess portfolio returns as the dependent variable instead of value-weighted ones. This is a major difference, and it is important to emphasize that this approach creates an inconsistency because equal-weighted excess portfolio returns are regressed onto factors that have been constructed on a value-weighted basis. Despite the equal-weighted approach is not very applicable in practice, several academic papers have utilized it. Henceforth, the only reason for performing these regressions is to benchmark against these studies. The results from all regressions are reported in Appendix D in Tables D1 through D6.

Reiterating Table 3 by regressing the value-weighted excess portfolio return net of the risk-free interest rate and excluding the gun industry from the sin portfolio, as done in Table D1, the changes are modest. The loading on the market beta has slightly increased, now being within the 0.84 to 0.97 range. This makes sense because the gun industry, which is a low-beta industry, has been excluded from the portfolio, meaning that the weight on the three other industries in the sin portfolio, including the high-beta gaming industry, has increased. Further, the significance of the HML factor also disappears in models (5) and (6), suggesting that the loading on the value premium primarily was driven by stocks within the gun industry. Of main interest is alpha, which remains positive and highly statistically significant at a 1% level in all six regressions, thus suggesting that the results are robust to the definition of sin.

When computing excess returns as equal-weighted, the results change considerably. Investing in a portfolio that is long sin stocks net of the risk-free interest rate yields a positive and statistically significant alpha in models (1), (2), (3), and (5), as shown in Table D3. In addition to this, the loading on the MKT factor suggests that the sin stock portfolio is now roughly as risky as the overall market, signifying the effect of lowering the weight on larger stocks and increasing the weight on smaller ones. The loading on the value premium is still evident with a positive and significant exposure to the HML factor, although it disappears in models (5) and (6), but the loading on the SMB factor has also turned highly significant. However, one must be careful interpreting the loading on the SMB factor since it is constructed using a value-weighted approach, meaning that, when comparing against excess portfolio returns on an equal-weighted basis, it creates an exposure to the SMB factor that, almost by default, loads positively on a strategy that is long small stocks and short large ones, as the former is overweighted and the latter underweighted relative to it. In model (4), when running a Fama-French Five-Factor Model by regressing on the MKT, SMB, HML, CMA, and RMW factors, alpha drops by almost 54% and turns insignificant, which is a pattern that holds for models (5) and (6) as well, though alpha turns borderline significant again in model (5). Thus, when adjusting for an adequate number of factors, there is no evidence that sin stocks compensate investors above and beyond what is justifiable given the risks imposed. Table D5 shows that the results are robust to excluding the gun industry from the portfolio of sin stocks, as alpha remains similar across the different models from a statistical perspective. Contrary to when value-weighting the excess returns, the results are now in line with the argument of Blitz and Fabozzi (2017), stating that sin stocks' superior risk-adjusted performance is attributable to accounting for an inadequate set of factor exposures.

Implementing the long-short investment strategy, as done in Table D2, and excluding the gun industry from the sin portfolio, the results do change slightly. Despite alpha is positive and significant in models (1) and (3), and the coefficients are quantitatively similar to Table 4 in models (2), (4), (5), and (6), the borderline significant alpha discovered in Table 4 has vanished. Consequently, the long-short portfolio does not provide overwhelming evidence of the existence of a positive alpha, which implies that the definition of sin stocks seems to matter for this investment strategy.

Running the long-short regressions equal-weighted in Table D4, the results are similar to Table 4. In fact, the only change that is considerable is that the loading on the SMB factor is no longer statistically significant. The key thing of interest is that alpha is still positive and highly statistically significant in models (1) through (3), while it remains statistically significant at a 10% level in models (4) through (6). This resembles the pattern from the value-weighted factor model regression including the gun industry in Table 4. However, once excluding the gun industry from the sin portfolio in Table D6, alpha turns insignificant, exactly as was the case for the value-weighted long-short regressions, indicating that the positive alpha discovered is driven by the gun industry. It is sensible that the exclusion of the gun industry has a major impact, as it comprises roughly one-fourth of the portfolio under the equal-weighted methodology, and, because this approach weighs all stocks equally, the portfolio changes drastically. However, it is intriguing that Table D6, which presents the regressions that are closest to resembling those of Hong and Kacperczyk

(2009), are the regressions furthest apart from supporting their findings.

To sum up, it seems that, when investing in the sin portfolio net of the risk-free interest rate, the weighting methodology matters in terms of realizing a positive alpha. If value-weighting excess returns, alpha remains positive and statistically significant in all models, independent of whether the gun industry is included in the sin portfolio or not. If equal-weighting, alpha disappears when controlling for an adequate number of factor exposures, both including and excluding gun stocks as constituents in the sin portfolio. On the contrary, once implementing a long-short investment strategy, the definition of the sin portfolio is paramount in the pursuit of earning a positive alpha, as alpha is positive and statistically significant once including gun stocks in the sin portfolio, while it vanishes once excluding them from the portfolio, irrespective of implementing a value-weighted or an equal-weighted portfolio construction methodology.

4.3 Fama-MacBeth

This section takes a different, and less widely adopted, angle on sin performance. Rather than analyzing factor exposures, firm-specific characteristics are used as risk measures in Fama-MacBeth regressions, on a stock-by-stock basis in subsection 4.3.1 and on a portfolio basis in subsection 4.3.2, using a dummy to examine the sin effect. In all the regressions conducted, the dependent variable is the monthly excess return. Table 5 shows the firm-specific characteristics used in the models, where the mean is computed as the time-series average of the cross-sectional means, the median as that of the cross-sectional means, while sigma is the standard deviation of the time-series of the cross-sectional means. The variables are defined and described in Appendix B.

Table 5: Firm-Specific Characteristics

	Mean	Median	Sigma
$r_i - rf$	0.0090	0.0084	0.0676
β_{MKT}	1.0045	1.0040	0.0233
β_{CON}	-0.0020	-0.0021	0.0003
$\ln(SIZE)$	6.2309	6.3152	0.5721
$TURN$	0.2326	0.2012	0.1253
$\ln(MB)$	0.7922	0.8324	0.2079
$\ln(AGE)$	2.5449	2.5692	0.1475

The average stock yields a monthly excess return of 0.90%, and it has a market capitalization of $e^{6.2309} = \$508.21m$. Similar calculations show that the average market-to-book ratio is roughly 2.21, the age is 12.74 years, and the monthly share turnover is 23.26%. As expected, the average firm has a market beta close to 1.00, while the beta on the OECD (2024) CLI economic cycle variable, β_{CON}, is -0.0020. Since the median values, in general, are close to the mean values, it implies that there are no significant outliers in the time series of means, which likewise is suggested by the modest standard deviations for all the variables except the monthly excess return.

4.3.1 Stock-by-Stock

Table 6 presents the results obtained from the Fama-MacBeth regressions conducted on a stock-by-stock basis. The main coefficient of interest is the dummy variable, SIN, which captures the average effect of being a sin stock on the excess stock returns, while simultaneously holding constant the other explanatory variables.

Table 6: Fama-MacBeth – Stock-by-Stock

	(1)	(2)	(3)	(4)	(5)	(6)
γ_0	0.0089**	0.0090**	0.0091**	−0.0172***	−0.0189***	−0.0355***
γ_{SIN}	0.0033	0.0039*	0.0039*	0.0004	0.0023	0.0018
γ_{CON}		0.0017	0.0059	0.0060	−0.0185	0.0370
γ_{COMP}			−0.0014	−0.0020	−0.0007	0.0000
$\gamma_{ln(SIZE)}$				0.0042***	0.0021***	0.0021***
$\gamma_{\beta_{MKT}}$					0.0035	0.0029
$\gamma_{ln(MB)}$					0.0147***	0.0140***
γ_{TURN}						0.0405***
$\gamma_{ln(AGE)}$						0.0034***
$\gamma_{SIN*CON}$		−0.1720	−0.1762	0.0491	0.1134	0.2892

Note: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

In model (1), excess stock return is regressed on the dummy variable, SIN, which indicates whether a stock is a sin stock or not. The intercept is statistically significant, while the coefficient on the sin stock dummy variable is insignificant, meaning that the latter is not able to explain the variation in cross-sectional excess returns. Interestingly, in model (2), when the business cycle beta is included, the sin indicator variable turns statistically significant at a 10% level, even though the gamma coefficient for the cycle variable and the interaction term are statistically insignificant. Consequently, model (2) suggests that, once controlling for a proxy of the business cycle, sin stocks do provide a risk premium, even though there is no statistically significant effect on excess returns from investing in a sin stock in a contractionary economic period. Furthermore, the coefficient on β_{CON} is positive, suggesting that the risk premium increases in economic downturns. When adding the comparable stock dummy variable, COMP, in model (3), the sin variable remains significant, while the point estimate for the comparable portfolio is negative, which could indicate that such stocks equip investors with a negative risk premium. Despite the fact that the latter coefficient is statistically insignificant, it is interesting that the point estimate is positive for the sin dummy variable and negative for the comparable dummy variable.

In model (4), the logarithm of market capitalization, ln(SIZE), is added to the regression. The variable is positive and statistically significant at a 1% level, estimating that a 1% increase in market capitalization increases the risk premium by $(0.0042/100) * 100 = 0.0042\%$. The market beta, β_{MKT}, and the logarithm of the market-to-book ratio, ln(MB), are included in model (5). The former is statistically indistinguishable from zero, while the latter has a strong effect on excess stock returns, as it is positive and statistically significant at a 1% level. The coefficient suggests that a 1% increase in the market-to-book ratio increases the risk premium by 0.0147%, and the inclusion of the market-to-book ratio variable weakens the size effect considerably. Despite being statistically insignificant, it is also noticeable that the point estimate for the sin dummy has increased from 0.0004 in model (4) to 0.0023 in model (5), thus suggesting a stronger effect once controlling for more factors. In model (6), when including share turnover, TURN, and the logarithm of age, LN(AGE), both variables are statistically significant at a 1% significance level. The coefficient on age is positive and statistically significant at a 1% level, estimating that the risk premium increases by 0.0034% for a 1% increase in age, thus implying a positive premium from investing in mature stocks. The sin dummy remains statistically insignificant and slightly lower than in the previous model, still failing at capturing a real sin effect.

Reconciling these results, the indication is that, to capture a pure sin effect, it is necessary to control for a host of different stock characteristics that may correlate with sin status. By doing so, the sin premium disappears, which is a pattern that is contrary to that of Hong and Kacperczyk (2009), who solely document a significant positive sin effect once holding an adequate number of stock characteristics constant. Hence, the Fama-MacBeth regressions provide limited support for the sin anomaly.

4.3.2 Industry Portfolios

Reverting back to the portfolio approach, Table 7 shows the results from running Fama-MacBeth regressions on a vector of value-weighted industry portfolio returns as defined by French (2024). The sin portfolio is not split into the four industries that constitute the portfolio, which is due to the fact that it would expose the portfolio to significant non-systematic risk following the lack of diversification. The same applies to the combined portfolio of comparable industries, but not for all the other industries.

Table 7: Fama-MacBeth – Industry Portfolios

	(1)	(2)	(3)	(4)	(5)	(6)
γ_0	0.0133***	0.0132***	0.0133***	0.0201**	0.0161**	0.0184**
γ_{SIN}	0.0020	0.0022	0.0021	0.0030	0.0005	0.0021
γ_{CON}		−0.0663	−0.0658	−0.0752	−0.1216	−0.1547*
γ_{COMP}			−0.0032	−0.0025	−0.0029*	−0.0014
$\gamma_{ln(SIZE)}$				−0.0008	−0.0017***	−0.0015**
$\gamma_{\beta_{MKT}}$					0.0052	0.0028
$\gamma_{ln(MB)}$					0.0069***	0.0047***
γ_{TURN}						0.0179
$\gamma_{ln(AGE)}$						−0.0007

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Model (1) regresses the excess industry portfolio return on the sin industry indicator variable. Despite the coefficient being statistically insignificant, the point estimate is positive, suggesting that investors get a positive risk premium from investing in the sin industry portfolio vis-a-vis the comparable industry portfolio and all other industries defined in French (2024). The results are similar in regressions (2) through (4), where none of the coefficients included are statistically significant except the intercept, which merely means that the models are incapable of explaining the cross-section of excess industry portfolio returns. In model (5), when controlling for market beta and market-to-book ratio, the results change. Despite the coefficient of the sin indicator variable drops in magnitude from 0.0030 to 0.0005, it remains statistically indistinguishable from zero. It is worth noting that the comparable industry indicator variable has turned negative and statistically significant at a 10% level, suggesting that investing in the value-weighted comparable industry portfolio yields a negative risk premium of approximately 3.48% on an annual basis. In addition, the size variable is now also statistically significant at a 1% level, estimating that there is a negative size premium, while the positive and statistically significant coefficient for the market-to-book ratio variable means that the risk premium is increasing in that ratio. The results are quantitatively similar in model (6), which adds turnover and age to the regression model, despite the comparable industry portfolio indicator variable has turned statistically insignificant again. Hence, even though the point estimates for the sin indicator variable are consistently positive, there is no unequivocal evidence of a sin stock anomaly, therefore supporting the results from subsection 4.3.1.

4.3.3 Robustness Checks

Like subsection 4.2.3, this subsection examines whether the results obtained in subsection 4.3 are robust to changing the weighting methodology and altering the definition of sin stocks. Note that the choice between value-weighted returns and equal-weighted returns solely applies to the industry portfolio regressions, as the stock-by-stock Fama-MacBeth regressions, by construction, apply identical weights to all observations. Appendix E presents the results from the robustness checks.

Table E1 reiterates the stock-by-stock Fama-MacBeth regressions, which is Table 6, but it excludes the gun industry from the definition of sin stocks. The changes are negligible, as all coefficients except those for the sin stock dummy variable, which now lacks statistical significance in all models, are almost quantitatively identical. Further, there does not seem to be any clear pattern, as the point estimate for the sin dummy is higher in some models and lower in others, even though it remains similar.

Conducting robustness tests on the results in subsection 4.3.2, being Table 7, the only noteworthy change when excluding the gun industry from the sin industry portfolio in Table E2 is that the sin dummy turns significant at a 10% level in model (4), but this evidence is weak because it is insignificant in the five other models. In terms of utilizing an equal-weighted rather than a value-weighted methodology, as done in

Tables E3 and E4, there is no difference in terms of providing support for the sin phenomenon, no matter whether choosing to include or to exclude the gun industry.

To sum up, despite the point estimates of the sin indicator variable being consistently positive in the regressions conducted, both in the stock-by-stock and in the industry Fama-MacBeth regressions, the statistical significance is, generally, lacking. Consequently, in contrast to the factor model regressions in section 4.2, there is hardly any support for sinning yielding a statistically significant risk premium, irrespective of the excess portfolio return weighting methodology as well as the definition of sin.

4.4 Implications of Findings & Avenues for Future Research

From the empirical evidence, it is clear that the existence of the sin stock anomaly, to a great extent, depends on the methodology employed. The outcomes differ tremendously in terms of whether the portfolio returns are computed value-weighted or equal-weighted, and, particularly if the latter is the case, the definition of sin stocks.

Even though this paper makes the sin investing strategy more practically realistic by value-weighting the portfolio returns, investors must bear in mind that there is no specific industry classification code to use as a basis for sinning. Despite constructing a sin industry based on industry classification codes, it yields a binary outcome by virtue of classifying stocks as either being sinful or not. For instance, it may very well be the case that the majority of the abnormal returns from sinning, as discovered in this paper, are harvestable without investing in sin stocks that are considered particularly sinful, thus paving the way for weighting the sin portfolio by finding a proxy for sinfulness. By value-weighting, sinfulness is an increasing function of stocks' market capitalization, while, by equal-weighting, all stocks are considered equally sinful. Neither of these may be exact. From a risk-adjusted perspective, it may be worthwhile for investors, who are not comfortable holding sin stocks in their portfolios, to proxy the sin performance by weighting their investments towards the comparable portfolio or portfolios with similar factor exposures to avoid the reputational risks of sin investing, even though investors might end up leaving positive alpha on the table.

Another interesting strategy is to examine whether it is probable to construct zero-beta portfolios or zero-investment portfolios. Finding that alpha is positive and statistically significant when going long the sin portfolio net of the risk-free interest rate, whereas alpha still remains such, though to a lesser extent, in a long-short strategy, raises the question of whether investors could weight the long-short portfolio in a way that makes the market beta exposure or the equity investment zero, even though doing so probably would require shorting the comparable portfolio to a considerable extent. Further, this strategy may be expensive after taking into account transaction costs and potential price impacts, henceforth ending up eradicating a positive alpha.

Investors must also bear in mind that the findings are only applicable to the U.S., meaning that they might not be generalizable to other markets. The views on sinning and, in that respect, ethical investing are certainly not homogeneous across countries, and this can also be a reason why academia has yet to settle on an unequivocal definition of what a sin stock is. This paves the way for future researchers to extend the findings and explore whether the sin anomaly exists in markets outside the U.S.

CONCLUSION

In this thesis, the phenomenon of sin stock investing has been investigated by answering the following research question: "*Do sin stocks outperform non-sin stocks on a risk-adjusted basis in the U.S.?*". By conducting an extensive set of factor model and Fama-MacBeth regressions, the question was approached from multiple perspectives, finding evidence of a sin stock anomaly and suggesting that the lack of consensus in academia may be attributable to the consequences of different methodological choices.

Factor model regressions were conducted using well-known factor returns to examine whether sin investing yields a positive alpha. By value-weighting monthly rebalanced portfolios, the thesis found evidence of sin stocks outperforming on a risk-adjusted basis net of the risk-free interest rate and using a long-short strategy. Despite it may be a safer bet for investors to invest in the comparable portfolio, its factor exposures do not adequately mimic that of the sin portfolio, meaning that investors would risk leaving positive alpha on the table. Conducting Fama-MacBeth regressions on a stock-by-stock basis, the sin indicator variable was significant when solely controlling for the economic climate but, once controlling for a host of stock characteristics to capture a pure sin effect, the risk premium vanishes. From an industry perspective, there was neither any unequivocal evidence for the sin phenomenon, implying that the results are considerably less convincing when using the Fama-MacBeth approach. Robustness tests showed that the weighting methodology and definition of sinning matter significantly, so, if engaging in sin investing, investors need to carefully consider how to define and weight the sin constituents in their portfolios to maximize the risk-return tradeoff from risking being considered socially and morally irresponsible.

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APPENDIX A: DATA GATHERED

TABLE A1: Data Gathered

Name	Variable	Source
BAB	Betting-Against-Beta	AQR (2024)
CMA	Conservative-Minus-Aggressive	French (2024)
HML	High-Minus-Low	French (2024)
MKT	Market Excess Return	French (2024)
MOM	Momentum	French (2024)
RF	Risk-Free Interest Rate	French (2024)
RMW	Robust-Minus-Weak	French (2024)
SMB	Small-Minus-Big	French (2024)
CEQ	Common Equity	Compustat (2024a)
CONM	Company Name	Compustat (2024a)
GVKEY	Unique Global Company Key	Compustat (2024a)
NAICS	North American Industry Classification System	Compustat (2024a)
PSTK	Preferred Stock Capital	Compustat (2024a)
SIC	Standard Industrial Classification Code	Compustat (2024a)
TXDITC	Deferred Taxes & Investment Tax Credit	Compustat (2024a)
NAICS1	Business Segment NAICS Code	Compustat (2024b)
SIC1	Business Segment SIC Code	Compustat (2024b)
PERMNO	Unique Permanent Security Identifier	CRSP (2024)
PRC	Closing Price End of Month	CRSP (2024)
RET	Holding Period Return	CRSP (2024)
SHRCD	Share Code	CRSP (2024)
SHROUT	Common Shares Outstanding	CRSP (2024)
VOL	Trading Volume	CRSP (2024)
CLI	Composite Leading Indicator	OECD (2024)

APPENDIX B: CONSTRUCTION OF VARIABLES

TABLE B1: Construction of Variables

Variable	Formula	Description
β_{MKT}	$Cov_{(\sum_{i=1}^{N} \frac{mv_{i,t}}{\sum_{i=1}^{N} mv_{i,t}} r_{i,t} - RF), r_{MKT}} / Var_{r_{MKT}}$	Industry market β
β_{CON}	$Cov_{(\sum_{i=1}^{N} \frac{mv_{i,t}}{\sum_{i=1}^{N} mv_{i,t}} r_{i,t} - RF), CON} / Var_{CON}$	Industry business cycle β
CON	$1 \; if \; CLI < 100, 0 \; if \; CLI \geq 100$	Dummy for contractionary
COMP	$1 \; if \; foods, soda, fun \; or \; meals, 0 \; if \; not$	Dummy for peer stocks
ln(AGE)	$\ln(1 + Last \; Observation - First \; Observation)$	Ln stock age
ln(SIZE)	$\ln(PRC * SHROUT)$	Ln market capitalization
ln(MB)	$\ln((PRC * SHROUT)/(CEQ + TXDITC - PSTK))$	Ln market-to-book
SIN	$1 \; if \; alcohol, tobacco, gun \; or \; gaming, 0 \; if \; not$	Dummy for sin stocks
TURN	$VOL/SHROUT$	Share turnover

APPENDIX C: UNIQUE SIN STOCKS YEAR-BY-YEAR

TABLE C1: Unique Sin Stocks Year-by-Year

	Alcohol	Tobacco	Guns	Gaming	Total
2000	19	5	18	58	100
2001	17	5	22	53	97
2002	16	4	22	50	92
2003	17	4	20	49	90
2004	15	5	18	46	84
2005	14	5	19	45	83
2006	13	6	17	43	79
2007	14	4	18	40	76
2008	12	6	19	38	75
2009	12	6	16	38	72
2010	12	5	16	32	65
2011	12	5	14	32	63
2012	12	4	14	30	60
2013	13	4	15	29	61
2014	12	4	13	29	58
2015	12	2	14	26	54
2016	12	3	14	26	55
2017	13	2	13	27	55
2018	13	3	13	29	58
2019	12	3	13	30	58
2020	9	2	12	27	50
2021	13	2	18	33	66
2022	13	2	20	29	64
2023	9	2	10	18	39
Total	30	13	40	98	181

APPENDIX D: FACTOR MODELS – ROBUSTNESS CHECKS

TABLE D1: Factor Models Ex Guns – Long Sin Net Risk-Free Rate

	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0109***	0.0101***	0.0104***	0.0067***	0.0069***	0.0063***
β_{MKT}	0.8690***	0.8778***	0.8376***	0.9650***	0.9197***	0.9194***
β_{SMB}		−0.0139	−0.0010	0.2091**	0.2341**	0.2202**
β_{HML}		0.4268***	0.4017***	0.2118***	0.1456	0.1185
β_{MOM}			−0.0871		−0.1206*	−0.1643***
β_{RMW}				0.5348***	0.5580***	0.4578***
β_{CMA}				0.1286	0.1903	0.1770
β_{BAB}						0.1659**

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

TABLE D2: Factor Models Ex Guns – Long Sin Short Comparable

	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0037*	0.0029	0.0034*	0.0026	0.0028	0.0027
β_{MKT}	0.3366***	0.3026***	0.2517***	0.3020***	0.2608***	0.2608***
β_{SMB}		0.2032**	0.2196**	0.2673**	0.2900***	0.2894***
β_{HML}		0.2666***	0.2347***	0.2890***	0.2288**	0.2277**
β_{MOM}			−0.1106*		−0.1097*	−0.1114*
β_{RMW}				0.1324	0.1535	0.1496
β_{CMA}				−0.1605	−0.1044	−0.1050
β_{BAB}						0.0064

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

TABLE D3: EW Factor Models – Long Sin Net Risk-Free Rate

	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0062***	0.0047**	0.0056***	0.0026	0.0030*	0.0020
β_{MKT}	1.1025***	1.0055***	0.9044***	1.0454***	0.9573***	0.9568***
β_{SMB}		0.5465***	0.5790***	0.7458***	0.7944***	0.7694***
β_{HML}		0.3333***	0.2700***	0.2661***	0.1375	0.0888
β_{MOM}			−0.2194**		−0.2344**	−0.3129***
β_{RMW}				0.4465***	0.4916***	0.3118**
β_{CMA}				−0.1785	−0.0587	−0.0824
β_{BAB}						0.2976***

Note: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

TABLE D4: EW Factor Models – Long Sin Short Comparable

	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0035**	0.0030**	0.0032**	0.0028*	0.0028*	0.0030*
β_{MKT}	0.1996***	0.1858***	0.1650***	0.1827***	0.1674***	0.1675***
β_{SMB}		0.0868	0.0935	0.1434	0.1518	0.1552
β_{HML}		0.1642***	0.1512***	0.1923***	0.1698**	0.1764**
β_{MOM}			−0.0452		−0.0409	−0.0303
β_{RMW}				0.1148	0.1226	0.1469
β_{CMA}				−0.1611	−0.1402	−0.1370
β_{BAB}						−0.0402

Note: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

TABLE D5: EW Factor Models Ex Guns – Long Sin Net Risk-Free Rate

	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0050*	0.0034	0.0044**	0.0012	0.0016	0.0005
β_{MKT}	1.1867***	1.0848***	0.9708***	1.1264***	1.0275***	1.0269***
β_{SMB}		0.5768***	0.6135***	0.7945***	0.8490***	0.8228***
β_{HML}		0.3928***	0.3214***	0.3263***	0.1818	0.1306
β_{MOM}			−0.2477*		−0.2633**	−0.3457***
β_{RMW}				0.4860***	0.5366***	0.3478**
β_{CMA}				−0.2109	−0.0763	−0.1012
β_{BAB}						0.3126***

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

TABLE D6: EW Factor Models Ex Guns – Long Sin Short Comparable

	(1)	(2)	(3)	(4)	(5)	(6)
α	0.0023	0.0017	0.0020	0.0013	0.0014	0.0015
β_{MKT}	0.2837***	0.2651***	0.2313***	0.2638***	0.2376***	0.2376***
β_{SMB}		0.1171	0.1280	0.1921*	0.2065	0.2086
β_{HML}		0.2238***	0.2026***	0.2524***	0.2142**	0.2183**
β_{MOM}			−0.0734		−0.0697	−0.0631
β_{RMW}				0.1543	0.1677	0.1829
β_{CMA}				−0.1935	−0.1578	−0.1558
β_{BAB}						−0.0253

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

APPENDIX E: FAMA-MACBETH – ROBUSTNESS CHECKS

Table E1: Fama-MacBeth Ex Guns – Stock-by-Stock

	(1)	(2)	(3)	(4)	(5)	(6)
γ_0	0.0089**	0.0090**	0.0091**	−0.0172***	−0.0188***	−0.0356***
γ_{SIN}	0.0026	0.0031	0.0030	−0.0009	0.0003	0.0039
γ_{CON}		−0.0005	0.0038	0.0060	−0.0185	0.0365
γ_{COMP}			−0.0014	−0.0020	−0.0008	0.0001
$\gamma_{ln(SIZE)}$				0.0042***	0.0021***	0.0021***
$\gamma_{\beta_{MKT}}$					0.0034	0.0030
$\gamma_{ln(MB)}$					0.0147***	0.0140***
γ_{TURN}						0.0405***
$\gamma_{ln(AGE)}$						0.0033***
$\gamma_{SIN*CON}$		−0.0816	−0.0859	0.1885	0.3256	0.0621

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table E2: Fama-MacBeth Ex Guns – Industry Portfolios

	(1)	(2)	(3)	(4)	(5)	(6)
γ_0	0.0132***	0.0132***	0.0133***	0.0202**	0.0158**	0.0179**
γ_{SIN}	0.0025	0.0031	0.0030	0.0041*	0.0003	0.0015
γ_{CON}		−0.0652	−0.0645	−0.0746	−0.1186	−0.1572**
γ_{COMP}			−0.0032	−0.0025	−0.0027*	−0.0015
$\gamma_{ln(SIZE)}$				−0.0008	−0.0016***	−0.0015**
$\gamma_{\beta_{MKT}}$					0.0053	0.0028
$\gamma_{ln(MB)}$					0.0066***	0.0047***
γ_{TURN}						0.0186
$\gamma_{ln(AGE)}$						−0.0005

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table E3: EW Fama-MacBeth – Industry Portfolios

	(1)	(2)	(3)	(4)	(5)	(6)
γ_0	0.0096**	0.0096**	0.0097**	−0.0079	−0.0135	−0.0386***
γ_{SIN}	0.0026	0.0028	0.0027	0.0013	0.0009	0.0002
γ_{CON}		−0.0202	−0.0188	0.0232	0.0256	0.0191
γ_{COMP}			−0.0019	−0.0020	−0.0025	−0.0002
$\gamma_{ln(SIZE)}$				0.0029***	0.0022*	0.0021**
$\gamma_{\beta_{MKT}}$					0.0043*	0.0050**
$\gamma_{ln(MB)}$					0.0093***	0.0090***
γ_{TURN}						0.0250*
$\gamma_{ln(AGE)}$						0.0069***

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table E4: EW Fama-MacBeth Ex Guns – Industry Portfolios

	(1)	(2)	(3)	(4)	(5)	(6)
γ_0	0.0097**	0.0097**	0.0098**	−0.0089	−0.0141	−0.0366***
γ_{SIN}	0.0018	0.0021	0.0020	0.0008	0.0002	0.0012
γ_{CON}		−0.0282	−0.0265	0.0185	0.0189	0.0242
γ_{COMP}			−0.0020	−0.0021	−0.0027*	−0.0002
$\gamma_{ln(SIZE)}$				0.0030***	0.0023**	0.0020*
$\gamma_{\beta_{MKT}}$					0.0041	0.0051**
$\gamma_{ln(MB)}$					0.0094***	0.0087***
γ_{TURN}						0.0244*
$\gamma_{ln(AGE)}$						0.0064***

Note: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$