Vice and Value:
Three Decades of Sin Stock Returns

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Abstract

This thesis studies the returns of publicly listed companies in controversial industries, commonly referred to as "sin stocks". Building on methods by Hong and Kacperczyk (2009) and extending the definition of sin stocks to include fossil fuels and defense, the analysis investigates abnormal returns of sin stocks in the financial markets in the US and developed Europe. Using daily return data from 1994 to 2025, the study implements time-series regressions using CAPM, Fama-French three-factor (FF3) and five-factor (FF5) models. Portfolios are constructed, which contain sin stocks in the long position and, in addition, sin stocks in the long position coupled with comparable industries in the short position. The result show positive abnormal returns for sin stocks in long-only and long-short portfolios across the two geographic regions. This finding challenges recent studies on sin stocks by Sagbakken and Zhang (2022) and Richey (2017) that provide evidence for non-significant abnormal returns using the Fama-French five-factor model. The results suggest that investor exclusion of sinful industries leads to market inefficiencies. Moreover, time variations in the sin stock premium indicate that these inefficiencies may be sensitive to exogenous factors such as economic and political conditions.

Keywords

Sin Stocks, Socially Responsible Investing (SRI), Environmental, Social, and Governance (ESG), Abnormal Returns, Market Efficiency.

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1 Introduction

In a time where environmental, social and governance awareness (ESG) is on the rise, socially responsible investing (SRI) has emerged as an important concept in contemporary financial markets. As concerns about ESG considerations are strengthened, investors are increasingly willing to put their money where their morals are. The global market for ESG assets is expected to increase to $40 trillion in value by 2030, comprising up to 25% of all assets under management by funds.[1] As increasing moral constraints raises a critical question: Does the ethical exclusion affect the asset prices of excluded stocks and is there a potential for abnormal return for the morally unconstrained investor?

This thesis is not the first attempt to seek an answer to this question. Early studies - such as those from Salaber (2007); Fabozzi, Ma and Oliphant (2008); and Hong and Kacperczyk (2009) - have found support for the existence of abnormal returns for so-called "sin stocks".[2][3][4] However, more recent studies performed after the creation of the Fama-French five-factor model have shown contrasting results. Richey 2017, Sagbakken and Zhang (2022), among others, observe no abnormal returns of sin stocks when controlling for profitability and investment factors.[5][6] Using foundational theories of market behavior and the effects of taste-based neglect, provided by Merton (1987) and Fama and French (2007) (among others), this thesis seeks to evaluate the existence of abnormal returns among sinful stocks.[7][8] The analysis is based on the most traditional definition of sinful industries: the "triumvirate of sin", and expand its scope to include the fossil fuel industry (oil and coal), and the defense industry. The study covers public companies in the US and developed Europe. Given extensive studies of the period before 2000, the period of focus in this thesis is more recent market dynamics. The analysis covers a 30-year time period from January 1994 to January 2025.

To determine whether sin stocks have yielded abnormal returns in the last three decades, this thesis builds on the methods of Hong and Kacperczyk (2009) and expands them, following the approaches of Sagbakken and Zhang (2022) and Richey (2017). The starting point for defining sinful industries is the "triumvirate of sin": alcohol, tobacco, and gambling. To capture a larger scope of negative screening associated with socially responsible investing, the definition is expanded to include fossil fuels and the defense industry. The broader definition of sinful industries allows the study of changing attitudes regarding moral investing. This study utilizes time-series regressions on equal-weighted portfolios as method similar to Hong and Kacperczyk (2009).

The public stock market of the United States and developed Europe in modern times is the empirical setting for this paper. These two markets are highly developed, with high liquidity and stringent disclosure requirements, which make them relevant in a study of taste-based exclusion. The use of daily data is a divergence from previous literature that typically uses monthly return data. The choice increases the statistical

power and allows for better ability to capture short-term variation and adjustment for autocorrelation of returns. The selected time period allows for examination of sin alpha in a time where ESG investing has become more popular.

The contributions of this study are the following. It provides updated results to the findings of Hong and Kacperczyk (2009) and finds support for preservation of sin across the two markets and over time. Using different factor models, the CAPM, Fama-French 3 factor model (FF3), and Fama-French 5 factor model (FF5), the analysis tests if the observed alpha is explained by the use of different risk factors, rather than from taste-based exclusion. If statistically significant alpha can be observed, potential support for norm-constrained investing causing real costs on the market is provided. If the sin alpha disappears with the use of more comprehensive risk factor models, it may support recent findings suggesting that the observed sin alpha is the result of omitted risk factors and not due to systematic neglect.

The empirical results of the thesis provide evidence for the existence of abnormal returns for sin stocks in financial markets. Across the CAPM, FF3, and FF5 factor models, statistically significant and positive alpha for both long-only and long-short portfolios is observed. These results hold not only for the traditional definition of sin industries - the triumvirate of sin - but also for the extended definition, which includes the fossil fuel and the weapons industry. These findings suggest exclusion of certain industries in socially responsible investing, continue to create pricing inefficiencies in the financial markets. We contribute to a discussion surrounding the ability of unconstrained investors to exploit these inefficiencies, by finding that statistically significant existence and the magnitude of abnormal sin stock returns vary over time. Temporal variation in the returns of sin stocks may suggest that a share of the sin alpha depends on economic and political conditions, such as regulatory changes.

The findings of this thesis confirm and challenge the results in the existing literature. The use of daily return data in a more recent time frame provides higher statistical power for finding a statistically significant alpha. The findings from the CAPM and FF3 model specifications are in line with the results by Hong 2009, Sagbakken and Zhang (2022) and Richey (2017). However, the findings of the FF5 model specification contrast with the observations of Sagbakken and Zhang (2022) and Richey (2017), both of whom report no statistically significant alpha in the FF5 model specification. Possible explanations for the divergence of results lie in our methodology - using daily return data, equal-weighted portfolios, and a narrower set of more "pure" sin companies may all lead to stronger signals of sin alpha. Potentially erroneous data and incorrectly defined comparable industries may also contribute to an under- or overestimation of the sin alpha. Given specific conditions, we find that commonly neglected stocks continue to generate abnormal returns.

The first theories regarding how discriminatory taste, whether willfully or through igno-

rance, affected financial markets were based on the work of national economists studying racial discrimination in the labor market.[4] Findings from e.g. Becker (1957) suggest that discrimination in hiring decisions results in financial costs for companies.[9] Building on this line of thought, Robert C. Merton (1987) examined how discrimination of stocks influences investor returns, and extended the capital asset pricing model to include the effects of discriminatory tastes. Merton showed that awareness of a company influenced an investor's decision to hold the company's securities in her portfolio. This finding is a violation of a key assumption of the standard CAPM model: an investor is able to hold a market portfolio and has complete information about all available stocks. A subsequent implication of Merton's findings is the observation that a company can decrease its cost of financing by increasing awareness of its existence to investors.[7] Merton's findings, despite his main focus on investor awareness, have become foundational in the field of research surrounding taste-driven, socially responsible investing. This thesis contributes to this paper by finding that neglected stocks - commonly excluded for ethical reasons - do provide abnormal returns.

Eugene Fama and Kenneth French (2007) contributed to the subject, and quantified the effects that disagreement, taste, and irrationality have on the efficiency of the market. A key finding is related to the delineation between market disagreement and tastes. In their view, disagreement about asset risks and returns is unlikely to distort market efficiency in the long run, as market trading typically resolves disagreements through trading. However, tastes are exogenous and cannot be solved by the market, resulting in a systematic distortion of asset prices. They used this observation as a potential explanation for the findings that some hedge fund managers generate negative alpha, even before fees. In their model, the source of alpha is related to how informed the asset manager is. The model adjusts for tastes and finds that informed investors generate a positive alpha, with misinformed investors generating a negative alpha.[8]

Fabozzi, Ma, and Oliphant (2008) provide another theory for the existence of sin stock alpha. Companies in sin-stock industries may provide alpha due to them facing greater litigation risks, resulting in systematic discounts in their valuation. However, they argue that this discount can be counteracted by structural advantages possessed by these firms. The sin industries, specifically in the triumvirate of sin, are monopolistic in nature. Heavy regulation and reputational risks provide a barrier of entry for new entrants, and survival in such industries should be rewarded by the market through monopolistic rents.[3] Factors such as these provide a theoretical foundation for the existence of a sin stock premium. Fabozzi's theory that litigation risk lower valuations, while barrier's of entry enable monopolistic rents, are driving sin stock alpha, provides a perspective on sin stock returns, which are unrelated of neglect-driven alpha. We contribute to Fabozzi's findings by finding positive abnormal returns for sin stocks in our period of study. However, it is not investigated whether the source of these returns is the result of litigation risk, structural advantages of firms, or taste-based exclusion.

Following the financial cost of discriminatory tastes, one theory behind the source of sin alpha is the voluntary exclusion of sinful stocks from institutional investors. This type of norm-constrained investing is one of the primary theories for the existence of sin premium laid out by Hong and Kacperzcyk (2009). Hong and Kacperzcyk also find that analyst coverage of sin stocks is lower than comparable industries, which supports the sin alpha being driven, in part, by a lack of investor awareness, as proposed by Merton.[4] The article is popular in the field of research surrounding abnormal returns of immoral industries, but due to its age, it does not include the Fama French five-factor model, which was created in 2015. This thesis contributes to this article by replicating the results (although using daily returns and a smaller time frame), and extends the analysis using the Fama-French five-factor model. Evidence is found of continued existence of abnormal returns of the triumvirate of sin in our more recent time period, and in the FF5 model specification.

After the creation of the Fama-French five-factor model in 2015, Richey (2017) applied the new model specification on sin stock returns. Richey expanded the definition of sinful industries beyond the triumvirate of sin by including defense, adult entertainment, and payday lenders. Using price-weighted portfolios, the results of the article show statistically insignificant abnormal returns of sinful industries, when using the FF5 model. This result implies that the previously observed sin alpha was the result of the absence of factors controlling for profitability and investment levels in sin industries.[5] The article "European sin stocks" by Sagbakken and Zhang (2022) follows the methods of Richey (2017). They used the FF5 model in a study of the European market and expanded the definition of 'sinful' industries to include environmentally harmful industries such as oil&gas, mining, and uranium. Using value-weighed portfolios, they see similar results to Richey (2017): statistically significant abnormal returns disappear for their defined sin industries in the FF5 specification. [6] Together, the results of Richey (2017) and Sagbakken and Zhang (2022) refute generalizations of the results of Hong and Kacperczyk (2009) on the broader financial markets. However, the findings in this study contrast with the two articles, as abnormal returns remain statistically significant for the FF5 model. Potential explanations for the contrasting findings may be the use of daily stock return data and the use of equal-weighted portfolios.

The rest of the thesis is structured as follows. Section 2 describes the methodology of the paper and the data used. It details the construction of sin portfolios and associated comparable portfolios, the use of asset pricing models, and gives an overview of data collection procedures. Section 3 presents empirical results for time series regressions on long-only and long-short portfolios for the three model specifications, segmented by industry and geography. In Section 4, robustness checks are performed to validate the findings. Section 5 discusses limitations to the methodology and data. In the final section, key insights are summarized and directions for future research are proposed.

2 Methodology and Data

2.1 Methodology

To find whether there is evidence of abnormal returns of commonly neglected industries, a time-series regression of daily returns of publicly listed stocks in the US and developed Europe is used. The public stock market is a suitable subject for analysis of investor behavior, as the ease of access to it and the information disclosure requirements demanded from publicly listed companies lower the risk of adverse selection problems and lower market inefficiency. Our research design is based on that of Hong and Kacperczyk (2009)[4], but the data collection differs slightly. The difference in methods is explained further in subsection 2.4. Despite differences in data collection methodology, comparability of results with those of Hong (2009), Richey (2017), and Sagbakken and Zhang (2022) is still possible.

To test for the existence positive alpha of stocks in industries considered morally questionable, we begin by replicating the methods used in Hong (2009). With our selection of sin stocks and comparable stocks, we create equal-weighted portfolios of the sinful industries. These portfolios are referred to as "long-only". We also create equal-weighted long-short portfolios which are long on sin stocks and short on comparable stocks. Equal-weighted portfolios are used due to their ability to better capture the average returns of the industry portfolio. However, a downside to equal weighting is that large swings of low-float stocks risk causing greater variation of the portfolio returns. We follow Hong and Kacperczyk (2009) and winsorise variable returns at the 1% level, to limit the effects of returns not representable for the industries.[4]

2.2 Asset pricing models

CAPM

In the methodology, three asset pricing models are used. The first model is the CAPM model, which is the result of contributions from Markovitz (1959), Sharpe (1964) and Lintner(1965).[10][11][12] This model utilizes market excess return as an independent variable, and the excess returns of the chosen portfolio of assets as the dependent variable. The regression yields an intercept, which should in an efficient market be equal to zero, and a beta coefficient, which is the asset return sensitivity to market returns. The model specification is defined in Equation 1.

The CAPM may have benefits in its simplicity but is not optimal to use as a standalone method to quantifying sin alpha. The model is only used to quantify non-diversifiable risk. When using it for a small subset of similar industries, i.e. a poorly diversified portfolio, it is likely to capture idiosyncratic risk as well. Further, as Merton (1987) showed, assumptions for the CAPM fail to fulfilled under conditions with taste-driven

investor neglect of stocks.[7]. Due to its simplicity and potential for omitted variable bias, the CAPM is displayed in the results, but not analyzed extensively.

3-Factor Fama-French

To counter the limitations of the CAPM model, Fama and French introduced two more risk factors into the asset pricing model: a size-related factor (SMB) and a book-to-market-related factor (HML). The choice to include these factors was based on Fama and French's previous findings e.g. that a firm's size can have long-run implications for its profitability. The findings support the usage of SMB and HML as systematic risk factors. Adding the two additional risk factors to the CAPM yields the Fama French 3 (FF3) factor model, which is described in equation 2.[13]

5-Factor Fama-French

After the creation of the FF3 model, the critique of it was the stationary nature of the model - the size and book-to-market ratio are not fixed for companies and will change over time. Fama and French complemented the FF3 model with a profitability factor (RMW) and an investment factor (CMA). Interestingly, they find that the addition of these two factors makes the book-to-market factor statistically redundant, as the effect of it is fully captured by the RMW and CMA factors.[14] The FF5 model is described in equation 3.

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_{\text{MKT},i}(R_{MKT,t} - R_{f,t}) + \varepsilon_{i,t} \tag{1}$$

$$\begin{aligned} R_{i,t} - R_{f,t} = \alpha_i &+ \beta_{\text{MKT},i}(R_{MKT,t} - R_{f,t}) \\ &+ \beta_{\text{SMB},i} SMB_t + \beta_{\text{HML},i} HML_t + \varepsilon_{i,t} \end{aligned} \tag{2}$$

$$\begin{aligned} R_{i,t} - R_{f,t} = \alpha_i &+ \beta_{\text{MKT},i}(R_{MKT,t} - R_{f,t}) \\ &+ \beta_{\text{SMB},i} SMB_t + \beta_{\text{HML},i} HML_t \\ &+ \beta_{\text{RMW},i} RMW_t + \beta_{\text{CMA},i} CMA_t + \varepsilon_{i,t} \end{aligned} \tag{3}$$

Where:

- $R_{i,t}$: Return of portfolio i at time t
- $R_{f,t}$: Risk free rate at time t

- $R_{MKT,t} - R_{f,t}$: Market excess return
- SMB_t: Small Minus Big
- HML_t: High Minus Low
- RMW_t: Robust Minus Weak
- CMA_t: Conservative Minus Aggressive
- α_i: Alpha (intercept term)
- $\beta_{\text{MKT},i}, \beta_{\text{SMB},i}, \beta_{\text{HML},i}, \beta_{\text{RMW},i}, \beta_{\text{CMA},i}$: Factor betas
- $\varepsilon_{i,t}$: Error term (vector)

For all models, rolling regressions are performed on a 252 day (approximately 1 year) window. This is sufficiently large to not lead to estimates characterized by noise, and sufficiently small to capture time-varying dynamics of any sin stock premium which may be found. Similarly to the method of Hong and Kacperczyk (2009), the rolling regressions are aggregated to a mean over larger time periods of interests. To handle autocorrelation of estimates, standard errors are Newey-West corrected using lags of 30 datapoints (trading days). After inspection of the autocorrelation of the residuals, this was deemed a sufficiently large choice of lags to obtain a small autocorrelation.

In each model, the component of interest is the intercept term, known as Jensen's alpha[15] Each vector in CAPM, FF3, and FF5 also has an error term, which is on average 0. Furthermore, the residuals should be normally distributed for statistical interference and the calculation of p-values. Checks for normality of residuals are therefore included as robustness tests in figure 3 and figure 4 in the Appendix. A description of how factor returns are calculated can be read in Section 2.4.

2.3 Data

2.3.1 Sin Stock Delineation

To determine which companies are in the scope of this thesis, to begin with companies belonging to the triumvirate of sin: alcohol, tobacco, and gambling are included. Companies belonging to the triumvirate of sin profit of addictive products with negative social implications and are the industries commonly defined (by western morals) as sinful. Subsequently, the triumvirate of sin has been the subject of much research, including, but not limited to, Hong and Kacperczyk (2009), Fabozzi, Ma, and Oliphant (2008), and Salaber (2007).[4][3][2] Therefore, using tobacco, alcohol, and gambling stocks as a starting point for the analysis of the effects of taste-based discrimination is

suitable.

The selection of sin stocks is extended by including weapons manufacturers and the fossil fuel industries. These two industries are commonly used when extending the definition of sinful industries, for example, by Fabozzi, Ma, and Oliphant (2008) and Richey (2017).[3][5]. However, there is still disagreement in the field about the degree of "sinfulness" these two industries are associated with. We base our inclusions of the fossil fuel industry on the increased prevalence of green funds, which typically exclude fossil fuel companies entirely. The Sustainable Investment Forum, an organization that reported in December 2024, reported that the current largest subject of negative screening by ESG funds is the fossil fuel industry, with tobacco being the second largest.[16] This supports the decision to include fossil fuel companies.

Our chosen fossil fuel companies are specifically related to the generation of coal or petroleum power. We deviate from Fabozzi's definition, as they also include natural gas. Our decision to omit natural gas is due to its potentially murky degree of sinfulness. Natural gas can be referred to as a "bridge fuel", helping to transition away from oil and coal, while powering the development of renewable energy.[17]

Regarding the sinfulness of the defense industry, there are degrees of sin related to different products, with controversial weapons, such as cluster munitions and nuclear weapons, considered the most sinful. In the literature, Richey (2017) includes manufacturers of "conventional" weapons and small arms, such as handguns.[5] Hong and Kacperczyk (2009) limit their definition of the weapons industry only to manufacturers of handguns with large portions of their revenue stemming from purchases of private citizens.[4] To increase the possibilities of capturing a sin stock alpha for weapons manufacturers, we have chosen industries that produce physical weapons and munitions, and excluded military software companies. Our decision to exclude military software companies is not aligned with that of Fabozzi, who chose to include them.[3] However, Fabozzi's article was published in 2008, and the military software industry has changed a lot since then. Software companies may in recent years also have seen abnormal returns due to the rapid development of artificial intelligence and other technology, not directly related to sinfulness. Including such returns in our sample could skew the results. The description of sin stock industries and sub-industries (with NAICS codes) is summarized in Table 1.

Table 1: Sin Stock Business Description

Sin Industry	**NAICS**	**Business Description**
Alcohol	312120	Breweries
	312130	Wineries
	312140	Distilleries
Tobacco	312230	Tobacco Manufacturing
	424940	Tobacco Product and E-Cigarette Merchant Wholesalers
gambling	713120	Amusement Arcades
	713210	Casinos (except Casino Hotels)
	721120	Casino Hotels
	713290	Other Gambling Industries
Fossil Fuels	211120	Crude Petroleum Extraction
	212114	Surface Coal Mining
	212115	Underground Coal Mining
	213111	Drilling Oil and Gas Wells
	213112	Support Activities for Oil and Gas Operations
	213113	Support Activities for Coal Mining
	324110	Petroleum Refineries
	424710	Petroleum Bulk Stations and Terminals
Weapons	332992	Small Arms Ammunition Manufacturing
	332993	Ammunition (except Small Arms) Manufacturing
	332994	Small Arms, Ordnance, and Ordnance Accessories Manufacturing
	336414	Guided Missile and Space Vehicle Manufacturing
	336415	Guided Missile and Space Vehicle Propulsion Unit and Parts Manufacturing
	336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
	336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing

2.3.2 Comparables Delineation

To construct a long-short portfolio, the chosen sin industries are matched with comparable industries. The optimal comparable industry is identical to its connected sin industry, except for products or services that are not considered sinful. Alas, no such exact comparable industry exists. Therefore, subjective assessment and assignment of comparable industries are necessary.

A benefit of using NAICS codes to determine which comparable companies are in the scope of data collection is the increased granularity. The soda industry is assigned as a comparable to alcohol and sweets and confectionary as comparable to tobacco. Hong and Kacperczyk (2009), which uses Fama French industry group definitions, assign group 3 "soda" as a comparable to alcohol but uses group 2 "food" as comparable to tobacco. The latter choice of comparable industry may be criticized, but Hong's decision to include the industry group may be due to the limitations of the Fama French industry classification. [4] Confectionary has been chosen as better comparable to tobacco than food, because it is a complement to nutrition and not a necessity. The chosen comparable industries to gambling are related to theme parks and hotels (without casino operations). Despite the NAICS system having increased granularity in industry definitions, it does not have a separate industry definition for the video game creation industry. The video game industry is by far the biggest form of entertainment, and not having a separate industry definition in NAICS is bizarre. The closest definition of the video game industry in NAICS could be "custom computer programming services", but this industry would likely include a wide range of software companies unrelated to entertainment. The lack of inclusion of the video game industry in the gambling comparable dataset is a limitation of this paper. Hong uses the industry group 7 "fun" and group 43 "meals and hotels".

In the assignment of comparable industries to the extended sin industries, fossil fuels and weapons, there is a lack of established praxis. Fabozzi, Ma, and Oliphant (2008) looked at the fossil and weapons industries but did not utilize a long-short portfolio and therefore did not define comparable industries. The non-sin comparable to fossil fuel industry is easily defined as the renewable energy generation industry. In this article, the renewable energy industry is defined as hydroelectric, wind, geothermal, and biomass power generation. In particular, the solar industry has been omitted. The foundation for this decision is based on the fact that a large share of the solar power companies in the dataset do not perform power generation on an industrial level, but produce and sell solar panels to consumers. The large share of private sales, and low degree of own power generation in the firms, speaks for the industry dynamics behaving more similarly to technological hardware manufacturers than energy companies.

For the weapons industry, choosing comparable industries is difficult due to the demand for defense products being dependent on geopolitical factors and government spending.

There is also the issue of many civilian companies being closely interconnected to the defense industry. To limit the risk of capturing possible sin effects among comparable companies, the chosen comparable industries are exclusively related to machine manufacturing, with strictly civilian purposes. However, the assessment of comparable companies constitutes a limitation in this article. The triumvirate of sin, fossil fuel, and weapons comparable to the NAICS codes can be seen in Table 11 in the appendix.

2.4 Data Collection Undertaking

Our data collection starts at 28 December 1993 and ends on 1 January 2025, as we employ a 1-year lag in our time-series regression. We begin our search for companies belonging to our selection of sinful industries using NAICS (North American Industry Classification System). This is a deviation from the method of Hong and Kacperczyk (2009), who used the Fama French industry classification and associated SIC.[4] The decision to choose NAICS is based on multiple factors. A limitation of the Fama French classification system is the lack of a specific gambling industry. Hong and Kacperczyk (2009) addressed this issue by using NAICS codes for gambling companies.[4] However, our industries comparable to fossil fuels also lack specific SIC codes and therefore require the use of NAICS. In addition, note that NAICS is manually reviewed and determined by analysts for Compustat, lending credibility to the industry designations being correct.

The data collection begun by manually reviewing the industry definitions of the NAICS codes, which resulted in the collection of companies in the sub-industries mentioned in Table 1. After finding our chosen sub-industries, these were compared to those chosen by Hong and Kacperczyk (2009), using a NAICS to SIC crosswalk. The chosen industries are aligned with those of Hong and Kacperczyk, but deviate in some cases. As NAICS industry classification is based on the primary activity of the company in our database, we are confident that this decision will not affect the accuracy of our results in a meaningful way.

The method deviate further from Hong and Kacperczyk (2009), in our decision to only include company-level screening and not also segment data as done by Hong. Our differing industry classification system and the company-only approach yield a list of companies that totals about half of what Hong and Kacperczyk (2009) has in their analysis.[4] Our choices of method for data collection have been performed with the aim of achieving high-level objectivity for a purer dataset. The final data set for the US includes 505 unique companies, and the number of unique companies for each year is shown in table 2 at the end of this section.

Lastly, daily factor data for the market return, the risk free rate, SMB, HML, RMW, and CMA are collected. The factor variables are taken from Kenneth R. French's own

website and are different for the US and developed Europe. The stock exchanges used to source the US data are the NYSE, AMEX, NASDAQ. For the European data, factors are calculated on aggregate of 16 countries belonging to "Developed Europe". The definition of developed Europe is not easily defined, but this article follows the same delineation used by French. The SMB returns are found by subtracting the returns of three portfolios of small companies with three portfolios of large companies. The HML factor returns are found by subtracting the returns of two portfolios of value stocks (high book-to-market) with two portfolios of growth stocks (low book-to-market). The RMW and CMA are calculated in equal fashion by subtracting portfolios of companies with strong profitability with weak profitability, and companies with high levels of investment with companies with low levels of investments, respectively. These factors are automatically calculated on the website. The Kenneth R. French website is the source of factor data for Hong and Kacperczyk 2009, which eliminates risk of omitted variable bias due to differences in factor calculation. Furthermore, the method for calculation of the SMB and HML factor variables differs in the FF3 and FF5 models, which yields differing returns for the same factors across the two models. We have taken caution in the collection of the factors and in the regressions of the two models, to limit the risk of the wrong factor returns being used.

For the data collection of European data, the countries in scope of the study are first defined. We follow the definition of developed Europe made by Kenneth R. French in his calculation of market and factor returns, as they are calculated separately for the US and Europe. French defines "developed Europe" as the 16 European countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. The procedure to find the chosen sin and comparable industries are the same as for the US, as NAICS codes are utilized as well. Although the NAICS system was developed for North America, almost all European stocks of interest in the Compustat database have NAICS codes. In an analysis using GICS sub-industries that did not make it to the final draft of this thesis, only 0. 66% of the European stocks in the relevant industries were not assigned a NAICS code. Since the factor returns for the Fama French 3 and 5 factor model specifications vary between markets, specific factor returns for developed Europe is gathered from Kenneth French's website. The European data set contains a total of 635 unique companies.

Table 2: US Unique Companies per Category at the Start of Each Year

	Alcohol	Tobacco	Gambling	Fossil	Weapons	Alcohol Comparable	Tobacco Comparable	Gambling Comparable	Fossil Comparable	Weapons Comparable	Total
1993	10	3	32	77	6	12	3	16	2	22	183
1994	10	3	32	77	6	12	3	16	2	22	183
1995	12	3	38	80	8	12	3	20	2	23	201
1996	16	3	39	80	8	13	3	27	2	24	215
1997	17	3	38	83	9	14	3	33	2	26	228
1998	20	3	37	84	9	14	3	31	2	25	228
1999	19	3	33	83	10	14	4	26	7	25	224
2000	18	4	31	78	11	14	4	22	7	23	212
2001	17	4	29	76	10	14	3	22	7	23	205
2002	16	4	28	69	10	14	3	22	6	23	195
2003	15	5	29	71	11	15	3	19	6	21	195
2004	16	5	28	70	11	14	3	20	6	21	194
2005	13	5	29	72	11	15	3	19	6	22	195
2006	12	5	26	77	11	14	3	16	7	23	194
2007	12	5	26	82	11	15	3	17	7	22	200
2008	12	5	23	87	10	15	3	16	8	22	201
2009	11	6	22	87	10	16	2	16	7	23	200
2010	12	6	23	83	9	16	2	18	7	23	199
2011	12	6	22	83	9	16	2	18	7	25	200
2012	12	7	22	88	8	16	2	19	7	24	205
2013	13	7	21	93	8	16	2	17	6	24	207
2014	13	7	20	102	8	14	2	20	7	24	217
2015	11	7	21	107	8	15	2	20	7	24	222
2016	12	6	21	106	7	15	2	19	7	25	220
2017	12	7	22	107	6	14	2	14	6	25	215
2018	12	6	21	111	7	14	2	15	5	25	218
2019	12	6	22	108	6	12	3	17	4	23	213
2020	11	6	19	104	6	13	3	16	4	23	205
2021	9	6	21	103	6	12	3	16	2	24	202
2022	12	6	21	104	9	14	3	15	2	30	216
2023	11	6	21	96	10	13	3	17	2	30	209
2024	12	7	21	98	9	14	3	18	2	31	215
Total	**28**	**9**	**60**	**229**	**18**	**25**	**5**	**65**	**12**	**54**	**505**

3 Results

The following section presents the results of the time-series regressions on long-only and long-short portfolios for the US and developed Europe. For the United States, analysis is performed on individual industries, and on the aggregated portfolios: triumvirate of sin, and the extended definition. The analysis is performed using the CAPM, FF3, and FF5 models for individual industries and aggregated portfolios. Reports of the results are followed by brief discussion that may refer to complementary figures and tables found in the Appendix. The sections of the results are structured as follows. Results for the US market long-only portfolios, results for the US market long-short portfolios, results for the European long-only portfolios, results for the European long-short portfolios, and additional robustness tests. Given that the main focus of the article is on the US market, the section on US results is more extensive. The European results function as a robustness test and as a basis for the generalization of the US results in the broader market.

3.1 US Market

3.1.1 US Portfolio with Long Position in Sin Stocks

Table 3: US Long-only triumvirate + all (1995-2025)

The table presents time series regression results for equal weighted long-only sin portfolios for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Portfolios: Triumvirate and All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00167***	0.00167***	0.00168***	0.00139***	0.00139***	0.00141***
	(0.00033)	(0.00033)	(0.00033)	(0.00020)	(0.00021)	(0.00021)
beta_MktRF	0.68601***	0.71342***	0.74410***	0.73942***	0.77152***	0.78407***
	(0.01185)	(0.00812)	(0.00696)	(0.01304)	(0.00799)	(0.00712)
beta_SMB		0.28429***	0.29555***		0.39491***	0.38276***
		(0.01123)	(0.01076)		(0.00931)	(0.00832)
beta_HML		0.14659***	-0.00636		0.27739***	0.12679***
		(0.01380)	(0.01367)		(0.01411)	(0.01374)
beta_RMW			0.00061			-0.04063**
			(0.01645)			(0.01592)
beta_CMA			0.25035***			0.16086***
			(0.02085)			(0.01823)

Table 3 shows statistically significant results for the existence of sin alpha in all model specifications for the triumvirate and extended sin industries. Although the extended definition of sin industries exhibits statistically significant alpha, it is lower than that of the triumvirate portfolio, suggesting that the addition of the fossil fuel and defense industries decreases abnormal returns. For the entire time period, the annualized abnormal returns for the triumvirate portfolio are 52.1% and 42.2% for the extended portfolio. The beta of the market excess return is less than 1, suggesting that sin stocks are less exposed to systematic risk. Our results for the FF5 specification is contrary to previous studies - both Sagbakken and Zhang (2022), and Richey (2017) see statistical significance disappear for abnormal returns under FF5. They hypothesize that the addition of the profitability and investment factors soaks up previously unexplained abnormal returns seen, e.g. in Hong (2009).[6][5] While the results in Table 3 show that the investment factor CMA is statistically significant for both the triumvirate and extended definition, the profitability factor is statistically insignificant for the triumvirate portfolio, but statistically significant for the extended one. The disappearance of statistical significance of the HML factor for the triumvirate is expected with the addition of the RMW and CMA factors.[14] However, it remains statistically significant for the FF5

model.

Table 4: US Long-only segmented sin industries (1995-2025)

The table presents time series regression results for the equal-weighted long-only portfolios of separate sin industries for the entire time period (1995-2025). Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Portfolios: Alcohol, Gambling, and Tobacco

Factor	Alcohol			Gambling			Tobacco		
	capm	ff3	ff5	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00392***	0.00394***	0.00394***	0.00068***	0.00071***	0.00077***	0.00040***	0.00037***	0.00033***
	(0.00101)	(0.00101)	(0.00101)	(0.00006)	(0.00006)	(0.00005)	(0.00007)	(0.00006)	(0.00006)
beta_MktRF	0.50986***	0.54055***	0.57150***	0.93541***	0.92576***	0.91199***	0.61276***	0.67396***	0.74882***
	(0.01361)	(0.01343)	(0.01302)	(0.01763)	(0.01100)	(0.00988)	(0.01205)	(0.01088)	(0.01037)
beta_SMB		0.12082***	0.13502***		0.67948***	0.66546***		0.05257***	0.08616***
		(0.01244)	(0.01437)		(0.01692)	(0.01509)		(0.01725)	(0.01795)
beta_HML		0.05833***	-0.03764**		0.25271***	0.09655***		0.12873***	-0.07798***
		(0.01799)	(0.01869)		(0.01868)	(0.01838)		(0.02037)	(0.01891)
beta_RMW			0.05379***			-0.09583***			0.04386
			(0.01862)			(0.02806)			(0.03147)
beta_CMA			0.25200***			-0.09580**			0.59486***
			(0.02635)			(0.03970)			(0.02901)

Portfolios: Fossil Fuel and Weapons

Factor	Fossil			Weapons		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00068***	0.00063***	0.00070***	0.00128***	0.00128***	0.00130***
	(0.00023)	(0.00023)	(0.00023)	(0.00010)	(0.00009)	(0.00009)
beta_MktRF	0.89597***	0.98944***	0.95538***	0.74311***	0.72787***	0.73268***
	(0.02168)	(0.01515)	(0.01304)	(0.01492)	(0.01118)	(0.01130)
beta_SMB		0.55110***	0.46782***		0.57056***	0.55933***
		(0.02048)	(0.01858)		(0.01217)	(0.01312)
beta_HML		0.78217***	0.60015***		0.16504***	0.05286**
		(0.04542)	(0.04473)		(0.01963)	(0.02100)
beta_RMW			-0.17094***			-0.03405
			(0.05009)			(0.02099)
beta_CMA			-0.01700			0.07026***
			(0.06236)			(0.02570)

Table 4 shows the segmented returns of the sin stock industry over the entire period of observation. The regression shows a high level of statistical significance for most variables. For all individual industries, the market excess return betas are all less than 1, suggesting that they are less exposed to systematic risk than the market proxy. For the triumvirate industries, a potential explanation for this finding is the possibility that the addictive nature of the products creates sticky demand that is more immune to economic downturns.[3] The excess market return beta for the fossil industry is close to 1. This result is not surprising, as the fossil industry has an effect on business profitability, and is in itself affected by the demand for oil stemming from business activity. The

weapons industry also has a market excess return beta of less than 1. Due to the different demand drivers of the weapon industry, demand being driven by geopolitical events and government spending, the industry could be expected to have lower exposure to systematic risk.

The intercept terms in the table show the "abnormal" returns of the industry. During the period, all industries saw positive abnormal returns, which is a first sign of potential sin alpha. The annualized (FF5) alphas of the industries are as follows: Gambling: 21.2%, Tobacco: 8.6%, Fossil: 18.5%, Weapons: 3.3%. The annualized alpha of the alcohol industry is 267.2%, which is significantly higher than in the other industries. The high returns of the US alcohol industry are discussed in more detail in Section 6. In table 13 and table 14 in the appendix, the segment results of the triumvirate and extended definition can be seen in 10-year intervals. The tables show, among other things, that the statistical significance of alpha changes over time.

In Table 13 in the appendix, we can observe how the alcohol industry has changed over time in 10-year intervals. From 1995 to 2005 the alcohol alpha was statistically insignificant. Between 2005 and 2015, the alcohol alpha is statistically significant with an annualized return of -85%, indicating that the alcohol portfolio underperformed the market dramatically. For the last period, between 2015 and 2025, the alcohol portfolio achieved a statistically significant alpha constituting a more than 61% annualized return. The large variance in returns over the two later periods can suggest changes in market conditions, stemming from the 2008 US recession and the 2020 Covid-19 pandemic. However, as seen in Table 8, alcohol does not exhibit as high an alpha for European countries, so errors in US alcohol data cannot be dismissed as an explanation for the high return. In figure 5, the alcohol alpha can also be seen already increasing in 2017, which strengthens the argument that the high alpha is explained by non-representative data. However, the effect of lifting restrictions during the Covid-19 pandemic can still be seen as an increase in abnormal alcohol returns between 2022 and 2023. The potentially non-representative alcohol returns also influence the triumvirate portfolio returns, and the extended sin definition returns, as is visible when comparing figure 5 and figure 6 in the Appendix. The potentially erroneous data is a limitation of this paper.

3.1.2 US Portfolio with a Long Position in Sin Stocks and a Short Position in Comparable Industries

Table 5: US Long-Short triumvirate + all (1995-2025)

The table presents time-series regression results for equal-weighted long-short sin portfolios for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Portfolios: Triumvirate and All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00123***	0.00123***	0.00124***	0.00195***	0.00195***	0.00196***
	(0.00021)	(0.00021)	(0.00021)	(0.00014)	(0.00014)	(0.00014)
beta_MktRF	0.01610***	0.01942***	0.02166***	0.04154***	0.04937***	0.04350***
	(0.00337)	(0.00420)	(0.00369)	(0.00263)	(0.00298)	(0.00280)
beta_SMB		-0.01177**	-0.01569***		0.02943***	0.01238***
		(0.00470)	(0.00458)		(0.00425)	(0.00406)
beta_HML		-0.00278	-0.02148***		0.03909***	0.02103***
		(0.00556)	(0.00663)		(0.00525)	(0.00647)
beta_RMW			-0.02284***			-0.04725***
			(0.00722)			(0.00764)
beta_CMA			0.04539***			0.00708
			(0.00879)			(0.00716)

Table 5 shows the results of the long-short triumvirate and extended sin portfolios in the different model specifications. Both portfolios show positive and statistically significant abnormal returns. The annualized return of the triumvirate portfolio is 36.4% and the annualized return for the extended sin portfolio is 63.2% for the FF5 specification. In contrast to Table 3, abnormal returns increase with the addition of the fossil fuel and weapons industries. A potential explanation for this occurrence is due to the high long-short abnormal returns of the fossil industry, which can be seen in table 6.

This table answers our research question - the triumvirate of sin, and the extended definition have both seen abnormal returns in the modern era. A placebo test is performed for this model specification, which is shown in figure 1, as well as a QQ-test of residuals shown in figure 3. The position of the FF5 alpha for the extended portfolio can be seen to be far out on the tail in the placebo test, providing robustness for these results. However, as can be seen in Table 15 in the Appendix, the alpha and statistical significance have changed over time. In panel a. the triumvirate saw a negative and statistically significant alpha for the FF5 specification, while the extended definition saw zero alpha and no statistical significance for the FF5 specification. In panel b, the triumvirate alpha is close to zero and statistically insignificant, while the extended is

positive and statistically significant. In panel c, both triumvirate and extended definition are positive and statistically significant. This trend is visible in figure 8 in the Appendix as well. The differences in alpha and statistical significance across the period give insight into the fact that sin alpha, adjusted for industry dynamics, is not guaranteed across all time periods.

Table 6: US Long-Short for segmented sin industries (1995-2025)

The table presents time-series regression results for the equal-weighted long-short portfolios of separate sin industries for the entire time period (1995-2025). Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Portfolios: Alcohol, Gambling, and Tobacco

Factor	Alcohol			Gambling			Tobacco		
	capm	ff3	ff5	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00334***	0.00336***	0.00336***	0.00019***	0.00020***	0.00022***	0.00014***	0.00012***	0.00013***
	(0.00062)	(0.00062)	(0.00062)	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00003)
beta_MktRF	-0.07438***	-0.07483***	-0.07431***	0.07348***	0.06350***	0.06148***	0.04921***	0.06958***	0.07781***
	(0.00515)	(0.00631)	(0.00625)	(0.00387)	(0.00383)	(0.00365)	(0.00567)	(0.00713)	(0.00722)
beta_SMB		-0.05297***	-0.05548***		0.10303***	0.10164***		-0.08538***	-0.09324***
		(0.00727)	(0.00741)		(0.00644)	(0.00608)		(0.01003)	(0.01014)
beta_HML		-0.00953	0.00398		-0.02033***	-0.05246***		0.02152**	-0.01596
		(0.00884)	(0.00903)		(0.00553)	(0.00653)		(0.01046)	(0.01221)
beta_RMW			0.01718			-0.02187**			-0.06384***
			(0.01233)			(0.00964)			(0.01225)
beta_CMA			0.02651*			-0.01876			0.12843***
			(0.01447)			(0.01238)			(0.01779)

Portfolios: Fossil Fuel and Weapons

Factor	Fossil			Weapons		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00569***	0.00570***	0.00574***	0.00036***	0.00034***	0.00035***
	(0.00028)	(0.00029)	(0.00028)	(0.00005)	(0.00005)	(0.00005)
beta_MktRF	0.27006***	0.29638***	0.26299***	-0.11065***	-0.10780***	-0.11046***
	(0.01009)	(0.00988)	(0.00908)	(0.00623)	(0.00636)	(0.00603)
beta_SMB		0.25116***	0.18847***		-0.06871***	-0.07947***
		(0.01228)	(0.01110)		(0.00664)	(0.00658)
beta_HML		0.27078***	0.20964***		-0.06699***	-0.04005***
		(0.02367)	(0.02487)		(0.01204)	(0.01264)
beta_RMW			-0.12754***			-0.04015***
			(0.02594)			(0.01369)
beta_CMA			-0.09690***			-0.00389
			(0.03161)			(0.01697)

In table 6 long-short portfolios have been constructed at the industry level. All industries, both those from the triumvirate and from the extended sin definition, show a positive and statistically significant alpha in all model specifications. This is strong support for the existence of a sin alpha for the triumvirate of sin, but determining if the alpha stems from "sin" is difficult for the fossil fuel and weapons industries. This

is discussed further in Section 6.

The annualized abnormal returns in the FF5 specification for alcohol, gambling, and tobacco are 231.3%, 5.6%, and 3.3%, respectively. Again, alcohol is significantly higher than the other triumvirate industries. For the fossil fuel and weapons industries, the annualized abnormal returns in the FF5 specification are 418.2% and 9.1% respectively. The high returns of the long-short portfolio for the fossil fuel industry may have several explanations. For the US market, the number of fossil fuel companies is 229, but the number of comparable companies is only 12. The fossil fuel comparables data set is more exposed to idiosyncratic performance, which could sway the alpha of the Long-Short portfolio in the favor of the fossil industry. Other explanations for the over performance of fossil fuel may also be due to other factors, such as political ones. The hostility towards renewable energy displayed by US president Donald Trump may have caused a worse performance of renewable energy. In the summary of the data set in table 2 the number of fossil fuel-comparable firms remains steady from 1999 to 2016 (when Donald Trump was elected). From 2016 onward, the number of US renewable energy firms decreases to only 2 at the beginning of 2025. Figure 7 in the appendix supports this hypothesis, as the fossil long-short alpha is high during Donald Trumps first presidency between 2016 and 2020. As Joe Biden entered office in 2020, his renewable energy-friendly policies may be the reason for the sharp drop of the fossil portfolio alpha. However, it is important to note that the long-short portfolio experienced high abnormal returns long before 2016. The final potential explanation for the high alpha of the Long-Short Fossil portfolio is found in comparison to the long-only fossil portfolio in table 4, which had an annualized abnormal return of only 18.5%. The large difference in returns between the long-only and long-short fossil fuel portfolios is indicative of the relative under-performance of the renewables industry as one force behind the high abnormal returns of the long-short fossil fuel portfolio.

3.2 Developed Europe

Following an analysis of the sin alpha for the US market, the same methodology is extended to observe the European markets as well. Testing the existence of sin alpha for the European market is in part a robustness test and enables us to conclude to a higher degree that the results found for the US market can be extended to the financial markets as a whole.

Table 7: Europe Long-only triumvirate + all (1995-2025)

The table presents time-series regression results for equal-weighted long-only sin portfolios for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Portfolios: Triumvirate and All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00033***	0.00035***	0.00036***	0.00047***	0.00050***	0.00052***
	(0.00003)	(0.00003)	(0.00003)	(0.00004)	(0.00004)	(0.00004)
beta_MktRF	0.30273***	0.29549***	0.28917***	0.35454***	0.35750***	0.34152***
	(0.00534)	(0.00729)	(0.00704)	(0.00624)	(0.00856)	(0.00776)
beta_SMB		-0.01582	-0.01776		0.05487***	0.05342***
		(0.01627)	(0.01631)		(0.01675)	(0.01652)
beta_HML		-0.07901***	-0.11840***		-0.00785	-0.00874
		(0.01003)	(0.01109)		(0.00948)	(0.01131)
beta_RMW			-0.07210***			0.03289**
			(0.01471)			(0.01595)
beta_CMA			-0.03810***			-0.07347***
			(0.01364)			(0.02043)

The methods used for the US are replicated for the data set of European companies. In table 7, positive and statistically significant alpha can be observed for all model specifications. The long-only triumvirate portfolio has an annualized abnormal return of 9.4%, while the extended industry has an annualized abnormal return of 13.9%. Positive and statistically significant abnormal returns for the triumvirate and extended definition lend support to the findings for the US market. A placebo test is performed for this model specification, which is shown in figure 2, as well as a QQ-test of residuals shown in figure 4.

Table 8: Europe Long-only segmented sin industries (1995-2025)

The table presents time-series regression results for the equal-weighted long-only portfolios of separate sin industries for the entire time period (1995-2025). Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Portfolios: Alcohol, Gambling and Tobacco

Factor	Alcohol			Gambling			Tobacco		
	capm	ff3	ff5	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00064***	0.00066***	0.00066***	0.00000	0.00006	0.00011**	0.00033***	0.00033***	0.00031***
	(0.00004)	(0.00004)	(0.00004)	(0.00005)	(0.00004)	(0.00004)	(0.00004)	(0.00004)	(0.00004)
beta_MktRF	0.23836***	0.24494***	0.23876***	0.36596***	0.42537***	0.39194***	0.30535***	0.21928***	0.23957***
	(0.00543)	(0.00712)	(0.00673)	(0.00791)	(0.01067)	(0.01010)	(0.00897)	(0.00792)	(0.00803)
beta_SMB		-0.00584	-0.00251		0.32525***	0.30589***		-0.36488***	-0.35520***
		(0.01061)	(0.01036)		(0.01818)	(0.01786)		(0.02662)	(0.02714)
beta_HML		-0.03019***	-0.04576***		-0.01787	-0.11708***		-0.18796***	-0.19635***
		(0.00880)	(0.01231)		(0.01613)	(0.01841)		(0.01904)	(0.02093)
beta_RMW			-0.01041			-0.24952***			0.03879
			(0.01446)			(0.02340)			(0.02456)
beta_CMA			-0.03103**			-0.20497***			0.12465***
			(0.01260)			(0.02090)			(0.02128)

Portfolios: Fossil Fuel and Weapons

Factor	Fossil			Weapons		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00096***	0.00101***	0.00101***	0.00055***	0.00061***	0.00063***
	(0.00012)	(0.00012)	(0.00012)	(0.00008)	(0.00008)	(0.00008)
beta_MktRF	0.52172***	0.52798***	0.49683***	0.33260***	0.35671***	0.33325***
	(0.00994)	(0.01378)	(0.01235)	(0.01717)	(0.02067)	(0.01897)
beta_SMB		0.18885***	0.18005***		0.10973***	0.13189***
		(0.02464)	(0.02397)		(0.02842)	(0.02791)
beta_HML		0.18319***	0.26878***		0.01145	0.04347
		(0.02229)	(0.02483)		(0.02544)	(0.03240)
beta_RMW			0.26966***			0.15404***
			(0.03676)			(0.04068)
beta_CMA			-0.17084***			0.03467
			(0.04493)			(0.04665)

Following the procedure for the US market, the industry segments are reported in table 8. The alpha is positive and statistically significant for almost all model specifications and industries. We observe a zero and close to zero alpha, statistically insignificant, alpha for the gambling industry in the CAPM and FF3 model specifications. For the FF5 specification, the gambling industry has a positive alpha, which is statistically significant at the 5% level. The annualized returns for the triumvirate industries in the FF5 specification are 17.9%, 2.8%, and 8.1% for alcohol, gambling, and tobacco respectively. The fossil industry saw an annualized abnormal return of 28. 7%, and the weapons industry saw an annualized return of 17. 1% for the FF5 specifications.

The abnormal returns observed for Europe differ from those for the United States.

A first inference from the table comparison between the separated long-only industry portfolios in 4 and table 8 is that the large difference in alcohol abnormal returns speaks for possible erroneous data in the US alcohol dataset. A second takeaway is that both fossil fuels and weapons see higher abnormal returns in Europe, which could indicate that they are associated with a higher degree of sin.

Table 9: Europe Long-Short triumvirate + all (1995-2025)

The table presents time-series regression results for equal-weighted long-short sin portfolios for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Portfolios: Triumvirate and All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00031***	0.00032***	0.00032***	0.00050***	0.00051***	0.00050***
	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00003)
beta_MktRF	0.02599***	0.00006	0.00631***	0.02368***	0.00215	0.00597***
	(0.00210)	(0.00256)	(0.00239)	(0.00246)	(0.00229)	(0.00222)
beta_SMB		-0.07439***	-0.07153***		-0.06741***	-0.06123***
		(0.00539)	(0.00525)		(0.00420)	(0.00411)
beta_HML		-0.02199***	-0.02202***		-0.01336**	0.00687
		(0.00497)	(0.00576)		(0.00535)	(0.00611)
beta_RMW			0.00338			0.06160***
			(0.00631)			(0.00544)
beta_CMA			0.03322***			0.04468***
			(0.00626)			(0.00640)

In table 9, the results of the long-short portfolios for the European triumvirate of sin, and extended industry definitions. Both the triumvirate industries and the extended industries see positive and statistically significant abnormal returns for the period. In the FF5 model specifications, the triumvirate portfolio has an annualized return of 8.4%, and the extended portfolio has an annualized return of 13.3%. The positive abnormal returns of European firms support the findings of the US market seen in table 5. However, the annualized returns observed in developed Europe are smaller in magnitude than those in the United States. This finding could indicate that the US market has higher taste-based neglect, but also increases the potential of the observed effects for the US market being explained by inconsistent data.

Table 10: Europe long-short segmented sin industries (1995-2025)

The table presents time-series regression results for equal-weighted long-short sin portfolios for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Portfolios: Alcohol, Gambling, and Tobacco

Factor	Alcohol			Gambling			Tobacco		
	capm	ff3	ff5	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00087***	0.00088***	0.00088***	0.00001	0.00003	0.00003	0.00005**	0.00005**	0.00005**
	(0.00008)	(0.00008)	(0.00008)	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)
beta_MktRF	-0.00125	-0.01602***	-0.00553	0.03894***	0.05078***	0.04692***	0.04058***	-0.03302***	-0.02142***
	(0.00307)	(0.00361)	(0.00339)	(0.00380)	(0.00429)	(0.00423)	(0.00560)	(0.00421)	(0.00461)
beta_SMB		-0.05182***	-0.04222***		0.08176***	0.08172***		-0.25156***	-0.25278***
		(0.00573)	(0.00575)		(0.00571)	(0.00555)		(0.01216)	(0.01237)
beta_HML		0.00120	0.00152		-0.05014***	-0.05371***		-0.01736	-0.01499
		(0.00684)	(0.01013)		(0.00650)	(0.00860)		(0.01303)	(0.01789)
beta_RMW			0.02959***			-0.02552**			0.00471
			(0.00940)			(0.01009)			(0.01611)
beta_CMA			0.07112***			-0.03672***			0.06172***
			(0.00774)			(0.00871)			(0.01411)

Portfolios: Fossil Fuel and Weapons

Factor	Fossil			Weapons		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00139***	0.00141***	0.00139***	0.00013***	0.00013***	0.00012***
	(0.00015)	(0.00015)	(0.00015)	(0.00004)	(0.00003)	(0.00003)
beta_MktRF	0.12213***	0.10804***	0.10130***	-0.14243***	-0.17018***	-0.15423***
	(0.00436)	(0.00502)	(0.00534)	(0.01186)	(0.01495)	(0.01316)
beta_SMB		-0.01698**	-0.00921		-0.15231***	-0.13286***
		(0.00776)	(0.00819)		(0.01593)	(0.01513)
beta_HML		0.03238**	0.10786***		-0.04761***	-0.02026
		(0.01549)	(0.01603)		(0.01167)	(0.01414)
beta_RMW			0.20144***			0.10495***
			(0.01777)			(0.01557)
beta_CMA			0.01477			0.17290***
			(0.01782)			(0.02085)

The results of the segmented long-short portfolios for developed Europe can be seen in Table 10. In the FF5 model, statistically significant alpha is observed for alcohol, fossil fuels, weapons, and tobacco, although at a 5% significance level for the latter. The highest annualized alpha of the portfolios is the fossil fuel industry at 41.5%. This return is lower than the US fossil fuel portfolio in table 6. The US and European results are consistent in the fact that the two industries see higher abnormal returns compared to the other segmented industries. The consistency across the two geographies strengthens the likelihood that taste-based neglect is an underlying factor in the over-performance of the fossil fuel industry in the US. However, the possible explanation that high abnormal returns of the fossil fuel long-short portfolio can be accredited to the under-performance of its comparable industry cannot be fully dismissed.

4 Robustness

To test the robustness of the results found in this thesis, two methods are presented in this section: placebo tests and QQ-plots of residuals. In Figure 1 and Figure 2 placebo tests are presented for the long-short portfolios containing all categories in the United States and Europe. For both geographies, the observed alpha lies on the far right tail of the distributions of alphas generated by the placebo portfolios. This supports the findings that the observed sin stock premium has not occurred by chance but by a systemic difference in abnormal returns between sin stocks and their comparable industries.

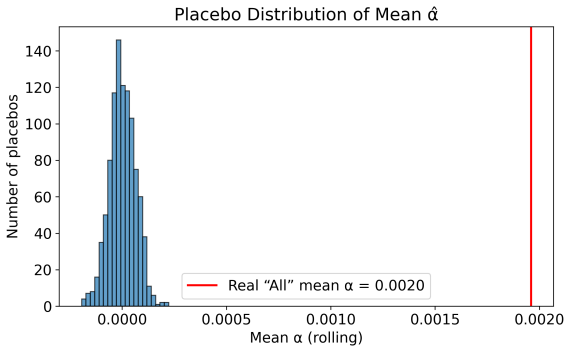

Figure 1: Placebo test based on the long-short equal-weighted portfolio for all categories for US using the FF5 model for the entire time period 1995-2025 (table 5). 1000 portfolios are generated with randomized assignment to one of the ten categories (Alcohol, Gambling, Tobacco, Fossil, Weapons, Alcohol Comparable, Gambling Comparable, Tobacco Comparable, Fossil Comparable, and Weapons Comparable).

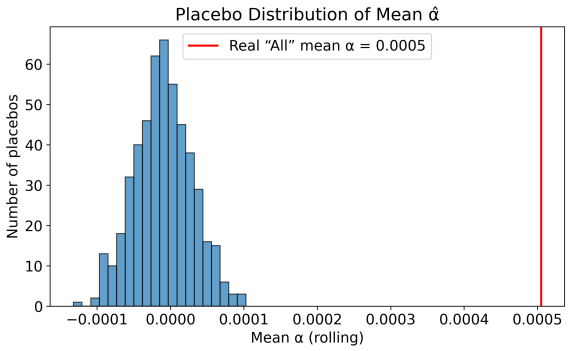

Figure 2: Placebo test based on the long-short equal-weighted portfolio for all categories for developed Europe using the FF5 model for the entire time period 1995-2025 (table 9). 500 portfolios are generated with randomized assignment to one of the ten categories (Alcohol, Gambling, Tobacco, Fossil, Weapons, Alcohol Comparable, Gambling Comparable, Tobacco Comparable, Fossil Comparable, and Weapons Comparable).

The QQ-plots for the equal-weighted long-short portfolios of all industries for the US

and Europe presented in Figures 3 and 4 are close to the line, but see some deviations from it in the tails, mostly to the right. This observation provides support for residuals that have a close-to, but not perfectly normal distribution. Normally distributed residuals are necessary for correct statistical inference and p-values in this case, and while the QQ-plots are not perfect and exhibit a few substantial outliers, the plots should provide enough robustness for correct inference.

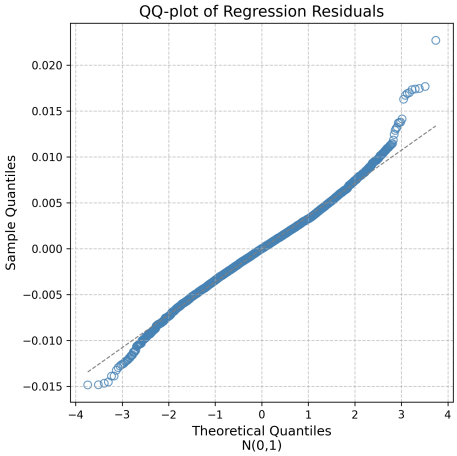

Figure 3: QQ-plot for US of residuals for Table 5, long-short portfolio with all categories and time period (1995-2025).

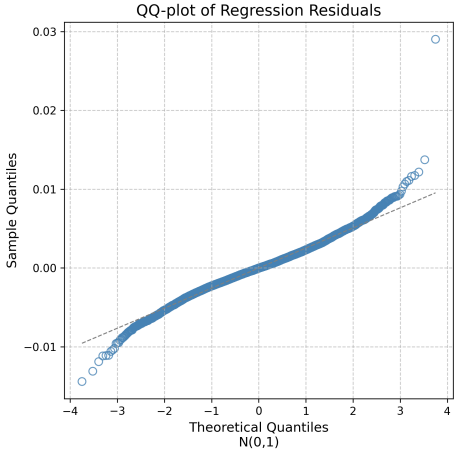

Figure 4: QQ-plot for Europe of residuals for Table 9, long-short portfolio with all categories and time period (1995-2025).

5 Limitations

Although high abnormal returns are observed in certain industries, most notably alcohol, there is a need to critically evaluate if these returns represent real inefficiencies in the market or if they are artifacts of limitations in the data. Several limitations of this study and its methods should be acknowledged. In line with Hong (2009), but contrary to more recent literature, such as Sagbakken and Zhang (2022), we use equal-weighted portfolios. This method reduces the influence of larger firms, but it also exposes the results to the movements of smaller illiquid and volatile firms. In periods with low stock counts and high volatility in the market, the effect of smaller firms may have been amplified.

The classification of sinful industries, and the non-sin comparable industries is also possible source of errors. Although we utilize NAICS codes, which are scientifically determined, and compare our chosen industries to those of Hong (2009) and Fabozzi, Ma, and Oliphant (2008), there remains subjectivity in defining which industries are inherently "sinful", especially for the fossil fuels and weapons industries. The definition of comparable industries is also a point of errors. The renewable sector, used in the long-short fossil fuel portfolio, contains a small number of firms for the US market and is then more exposed to idiosyncratic risk, which distorts the long-short portfolio returns as well. In a similar fashion, the abnormal returns for the defense sector may skew the results due to our exclusion of defense software companies, which are important players in the contemporary defense industry.

Lastly, we do not control for potentially important factors such as firm size and leverage. Using the FF5 factor model, some of these effects will be indirectly controlled for, but the exclusion will nevertheless cause some degree of omitted variable bias. The limitations of this study warrant a cautious approach when generalizing our results to the broader market.

6 Conclusion

This bachelor thesis investigates whether moral attitudes towards industries of unethical nature yield persistent abnormal returns of the stocks belonging to the neglected industries. Using the CAPM, FF3, and FF5 models, we find evidence of the existence of sin alpha. The traditional "triumvirate of sin", and our extended definition, in both long-only and long-short portfolios for the US and Europe, all show positive and statistically significant abnormal returns for the period 1995 to 2025. Contrary to recent literature, these results indicate that norm-constrained investing continues to impact asset pricing in modern financial markets. However, we observe a high variation of sin alpha, in magnitude and in statistical significance, across different time periods, and the different industries. External forces, such as political and regulatory factors, can

play a role in performance. These unexplored dynamics behind the sin alpha, complicate interpretations of sin stocks as consistently mispriced assets, calls for further contextualization of the result on social trends.

7 Appendix

Table 11: Comparable Industries Business Description

Sin Industry	**NAICS**	**Comparable Business Description**
Alcohol	311930	Flavoring Syrup and Concentrate Manufacturing
	312111	Soft Drink Manufacturing
Tobacco	311340	Non-chocolate Confectionery Manufacturing
	311351	Chocolate and Confectionery Manufacturing from Cacao Beans
	311352	Confectionery Manufacturing from Purchased Chocolate
Gambling	713110	Amusement and Theme Parks
	721110	Hotels (except Casino Hotels) and Motels
Fossil Fuels	221111	Hydroelectric Power Generation
	221115	Wind Electric Power Generation
	221116	Geothermal Power Generation
	221117	Biomass Electric Power Generation
Weapons	333111	Farm Machinery and Equipment Manufacturing
	333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing
	333120	Construction Machinery Manufacturing
	333241	Food Product Machinery Manufacturing
	333243	Sawmill, Woodworking, and Paper Machinery Manufacturing
	333248	All Other Industrial Machinery Manufacturing

Table 12: US long-only triumvirate-all portfolios 1995 to 2025 in 10 year intervals

The table presents time-series regression results for long-only sin portfolios in 10-year intervals for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Panel a: 95-05 Triumvirate, All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00063***	0.00056***	0.00055***	0.00081***	0.00070***	0.00072***
	(0.00016)	(0.00016)	(0.00017)	(0.00010)	(0.00010)	(0.00010)
beta_MktRF	0.46759***	0.62044***	0.67812***	0.48563***	0.68342***	0.72198***
	(0.01501)	(0.01802)	(0.01510)	(0.01459)	(0.01782)	(0.01600)
beta_SMB		0.28596***	0.33082***		0.40799***	0.42044***
		(0.01972)	(0.01845)		(0.01606)	(0.01502)
beta_HML		0.30210***	0.08902***		0.40505***	0.17510***
		(0.01967)	(0.02067)		(0.01991)	(0.02087)
beta_RMW			-0.00427			-0.05156**
			(0.02632)			(0.02281)
beta_CMA			0.30888***			0.28531***
			(0.02862)			(0.02526)

Panel b: 05-15 Triumvirate, All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	-0.00206***	-0.00207***	-0.00205***	-0.00101***	-0.00104***	-0.00102***
	(0.00027)	(0.00027)	(0.00027)	(0.00017)	(0.00017)	(0.00017)
beta_MktRF	0.77351***	0.74300***	0.75826***	0.87842***	0.81974***	0.81015***
	(0.00773)	(0.00691)	(0.00767)	(0.00757)	(0.00666)	(0.00760)
beta_SMB		0.17965***	0.18402***		0.29317***	0.30348***
		(0.01016)	(0.01019)		(0.00710)	(0.00931)
beta_HML		0.01737	-0.10204***		0.13661***	0.05230**
		(0.01354)	(0.01560)		(0.02567)	(0.02478)
beta_RMW			-0.00018			0.06251*
			(0.03553)			(0.03223)
beta_CMA			0.31152***			0.00710
			(0.03078)			(0.02715)

Panel c: 15-25 Triumvirate, All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00643***	0.00652***	0.00654***	0.00439***	0.00450***	0.00453***
	(0.00064)	(0.00065)	(0.00064)	(0.00038)	(0.00038)	(0.00038)
beta_MktRF	0.81715***	0.77693***	0.79601***	0.85446***	0.81149***	0.82015***
	(0.00888)	(0.00699)	(0.00739)	(0.00787)	(0.00806)	(0.00821)
beta_SMB		0.38731***	0.37180***		0.48359***	0.42434***
		(0.01939)	(0.01891)		(0.01560)	(0.01395)
beta_HML		0.12017***	-0.00613		0.29043***	0.15294***
		(0.02511)	(0.02803)		(0.01700)	(0.02333)
beta_RMW			0.00628			-0.13288***
			(0.02184)			(0.02196)
beta_CMA			0.13057***			0.19010***
			(0.04335)			(0.03352)

Table 13: US long-only sin portfolios 1995 to 2025 in 10 year intervals

The table presents time-series regression results for long-only sin portfolios in 10-year intervals for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Panel a: 95-05 Triumvirate

Factor	Alcohol			Gambling			Tobacco		
	capm	ff3	ff5	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00013	0.00013	0.00010	0.00117***	0.00109***	0.00115***	0.00059***	0.00046***	0.00042***
	(0.00048)	(0.00048)	(0.00048)	(0.00009)	(0.00008)	(0.00007)	(0.00013)	(0.00012)	(0.00014)
beta_MktRF	0.30536***	0.37669***	0.42961***	0.61812***	0.86120***	0.87092***	0.47930***	0.62344***	0.73381***
	(0.01567)	(0.02187)	(0.02155)	(0.01738)	(0.02204)	(0.01952)	(0.02498)	(0.02787)	(0.02657)
beta_SMB		0.13295***	0.18930***		0.68397***	0.70636***		0.04095	0.09679***
		(0.02264)	(0.02773)		(0.03427)	(0.03056)		(0.02826)	(0.03155)
beta_HML		0.12884***	0.03115		0.45426***	0.21461***		0.32318***	0.02131
		(0.02377)	(0.02526)		(0.03019)	(0.03535)		(0.03903)	(0.03684)
beta_RMW			0.09673***			-0.05134*			-0.05821
			(0.01986)			(0.02971)			(0.07019)
beta_CMA			0.12652***			0.13056***			0.66954***
			(0.03155)			(0.03173)			(0.05719)

Panel b: 05-15 Triumvirate

Factor	Alcohol			Gambling			Tobacco		
	capm	ff3	ff5	capm	ff3	ff5	capm	ff3	ff5
alpha	-0.00744***	-0.00745***	-0.00741***	0.00047***	0.00050***	0.00059***	0.00079***	0.00075***	0.00067***
	(0.00080)	(0.00080)	(0.00081)	(0.00010)	(0.00009)	(0.00009)	(0.00010)	(0.00010)	(0.00008)
beta_MktRF	0.60965***	0.61822***	0.63477***	1.07554***	0.91606***	0.89409***	0.63534***	0.69471***	0.74593***
	(0.01924)	(0.01718)	(0.01727)	(0.01115)	(0.00987)	(0.00987)	(0.01300)	(0.01175)	(0.01221)
beta_SMB		0.06448***	0.06214**		0.62189***	0.59896***		-0.14742***	-0.10903***
		(0.02262)	(0.02436)		(0.02080)	(0.02210)		(0.00883)	(0.01224)
beta_HML		-0.05039*	-0.13858***		0.15832***	0.01806		-0.05583**	-0.18561***
		(0.02819)	(0.02670)		(0.03025)	(0.02767)		(0.02441)	(0.02900)
beta_RMW			0.08638*			-0.27655***			0.18964***
			(0.04409)			(0.04253)			(0.04639)
beta_CMA			0.41284***			-0.09992**			0.62164***
			(0.05346)			(0.04335)			(0.05738)

Panel c: 15-25 Triumvirate

Factor	Alcohol			Gambling			Tobacco		
	capm	ff3	ff5	capm	ff3	ff5	capm	ff3	ff5
alpha	0.01909***	0.01914***	0.01915***	0.00039***	0.00055***	0.00058***	-0.00018*	-0.00012	-0.00010
	(0.00192)	(0.00192)	(0.00192)	(0.00011)	(0.00010)	(0.00009)	(0.00010)	(0.00008)	(0.00008)
beta_MktRF	0.61477***	0.62691***	0.65026***	1.11288***	1.00010***	0.97102***	0.72378***	0.70379***	0.76674***
	(0.01643)	(0.01826)	(0.01922)	(0.02224)	(0.01960)	(0.01821)	(0.01132)	(0.00991)	(0.01013)
beta_SMB		0.16504***	0.15359***		0.73261***	0.69104***		0.26427***	0.27078***
		(0.01722)	(0.01961)		(0.02977)	(0.02312)		(0.02744)	(0.02933)
beta_HML		0.09649***	-0.00553		0.14535***	0.05687**		0.11868***	-0.06973**
		(0.03641)	(0.03992)		(0.02364)	(0.02745)		(0.02696)	(0.02747)
beta_RMW			-0.02179			0.04043			0.00021
			(0.02598)			(0.06111)			(0.03727)
beta_CMA			0.21672***			-0.31832***			0.49331***
			(0.04323)			(0.10015)			(0.02826)

Table 14: US long-only extended sin industries 1995 to 2025 in 10 year intervals

The table presents time-series regression results for long-only sin portfolios in 10-year intervals for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Panel a: 95-05 Extended

Factor	Fossil			Weapons		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00044***	0.00026*	0.00032**	0.00172***	0.00157***	0.00161***
	(0.00015)	(0.00015)	(0.00016)	(0.00023)	(0.00022)	(0.00022)
beta_MktRF	0.50778***	0.83392***	0.85850***	0.51759***	0.72183***	0.71707***
	(0.01959)	(0.02766)	(0.02383)	(0.01891)	(0.02282)	(0.02439)
beta_SMB		0.62074***	0.55863***		0.56132***	0.55113***
		(0.02637)	(0.02027)		(0.01951)	(0.02284)
beta_HML		0.69810***	0.34739***		0.42085***	0.26102***
		(0.04567)	(0.05184)		(0.03383)	(0.03754)
beta_RMW			-0.20281***			-0.04219*
			(0.04187)			(0.02283)
beta_CMA			0.47180***			0.02811
			(0.03813)			(0.04050)

Panel b: 05-15 Extended

Factor	Fossil			Weapons		
	capm	ff3	ff5	capm	ff3	ff5
alpha	-0.00044**	-0.00060***	-0.00057**	0.00153***	0.00159***	0.00162***
	(0.00021)	(0.00022)	(0.00022)	(0.00010)	(0.00011)	(0.00011)
beta_MktRF	1.10717***	1.06228***	0.96835***	0.96439***	0.80743***	0.80761***
	(0.02212)	(0.02088)	(0.01890)	(0.01010)	(0.01638)	(0.01556)
beta_SMB		0.32530***	0.36550***		0.60159***	0.59982***
		(0.03043)	(0.03674)		(0.02367)	(0.02613)
beta_HML		0.53362***	0.55874***		0.09732***	0.00889
		(0.11367)	(0.09525)		(0.02805)	(0.03484)
beta_RMW			0.40637***			-0.09327**
			(0.09056)			(0.03790)
beta_CMA			-0.95156***			0.05251
			(0.07344)			(0.04416)

Panel c: 15-25 Extended

Factor	Fossil			Weapons		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00205***	0.00224***	0.00234***	0.00059***	0.00069***	0.00068***
	(0.00060)	(0.00058)	(0.00058)	(0.00013)	(0.00012)	(0.00011)
beta_MktRF	1.07334***	1.07228***	1.03941***	0.74752***	0.65435***	0.67334***
	(0.02367)	(0.02023)	(0.01999)	(0.01741)	(0.01374)	(0.01395)
beta_SMB		0.70728***	0.47928***		0.54876***	0.52703***
		(0.03405)	(0.03328)		(0.01928)	(0.01754)
beta_HML		1.11499***	0.89464***		-0.02334	-0.11157***
		(0.03643)	(0.06582)		(0.01518)	(0.02114)
beta_RMW			-0.71659***			0.03336
			(0.06909)			(0.04347)
beta_CMA			0.42856***			0.13022***
			(0.10912)			(0.04776)

Table 15: US long-short triumvirate-all portfolios 1995 to 2025 in 10 year intervals

The table presents time-series regression results for long-short sin portfolios in 10-year intervals for the entire time period (1995-2025). The "triumvirate" portfolio contains the alcohol, tobacco, and gambling industries. The "all" portfolio contains the alcohol, tobacco, gambling, fossil, and defense industries. Alpha (intercept term) and factor betas are displayed for the three models used: CAPM, FF3, and FF5. Parentheses show Newey-West standard errors. The model results are in fractional terms (1% is 0.01 in the results). Significance levels are denoted as *: 10%, **: 5%, ***: 1%.

Panel a: 95-05 Triumvirate, All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	-0.00109***	-0.00108***	-0.00108***	-0.00001	-0.00002	0.00000
	(0.00017)	(0.00017)	(0.00017)	(0.00010)	(0.00010)	(0.00010)
beta_MktRF	-0.02039***	-0.02800***	-0.01046	0.00353	0.01743***	0.02071***
	(0.00514)	(0.00861)	(0.00809)	(0.00222)	(0.00561)	(0.00567)
beta_SMB		-0.00814	0.01188		0.05506***	0.04859***
		(0.00885)	(0.00914)		(0.00712)	(0.00702)
beta_HML		-0.01292	-0.04202***		0.02443**	-0.01435
		(0.01329)	(0.01368)		(0.01115)	(0.01215)
beta_RMW			0.00531			-0.04564***
			(0.00784)			(0.00749)
beta_CMA			0.06325***			0.04702***
			(0.01358)			(0.01182)

Panel b: 05-15 Triumvirate, All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00002	0.00001	0.00001	0.00203***	0.00202***	0.00203***
	(0.00011)	(0.00011)	(0.00011)	(0.00006)	(0.00007)	(0.00006)
beta_MktRF	0.00552	0.02332***	0.02343***	0.03714***	0.04504***	0.03752***
	(0.00415)	(0.00462)	(0.00454)	(0.00296)	(0.00340)	(0.00352)
beta_SMB		-0.06237***	-0.06531***		-0.03228***	-0.03436***
		(0.00437)	(0.00467)		(0.00423)	(0.00508)
beta_HML		-0.01116	-0.04828***		0.01950**	0.00177
		(0.00709)	(0.00817)		(0.00826)	(0.00829)
beta_RMW			0.01162			0.02171
			(0.01586)			(0.01559)
beta_CMA			0.11510***			-0.00981
			(0.00922)			(0.00989)

Panel c: 15-25 Triumvirate, All

Factor	Triumvirate			All		
	capm	ff3	ff5	capm	ff3	ff5
alpha	0.00475***	0.00476***	0.00478***	0.00381***	0.00383***	0.00385***
	(0.00033)	(0.00033)	(0.00033)	(0.00025)	(0.00025)	(0.00025)
beta_MktRF	0.06322***	0.06299***	0.05204***	0.08401***	0.08567***	0.07230***
	(0.00361)	(0.00341)	(0.00346)	(0.00285)	(0.00275)	(0.00291)
beta_SMB		0.03521***	0.00633		0.06550***	0.02290***
		(0.00650)	(0.00617)		(0.00473)	(0.00533)
beta_HML		0.01576**	0.02589***		0.07337***	0.07572***
		(0.00669)	(0.00996)		(0.00581)	(0.01017)
beta_RMW			-0.08551***			-0.11784***
			(0.00915)			(0.01030)
beta_CMA			-0.04222***			-0.01602
			(0.01629)			(0.01394)

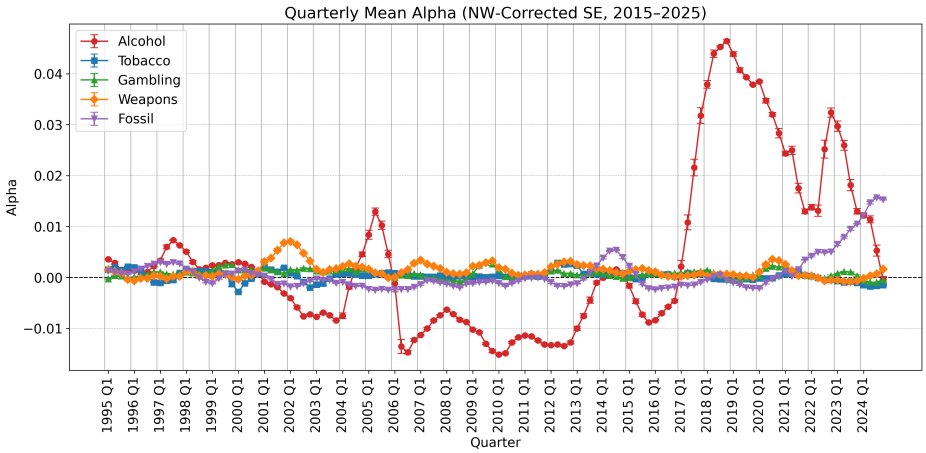

Figure 5: US Long-Only Sin Industries Alpha

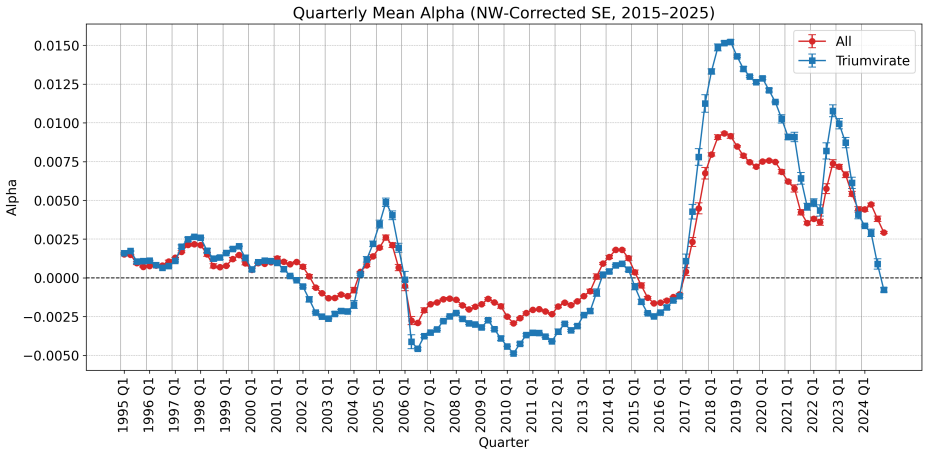

Figure 6: US Long-Only Triumvirate and All Portfolio Alpha

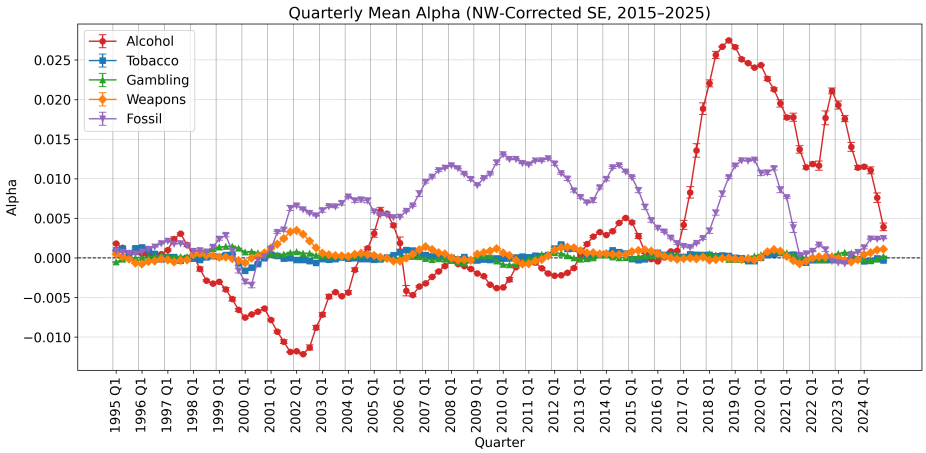

Figure 7: US Long-Short Sin Industries Alpha

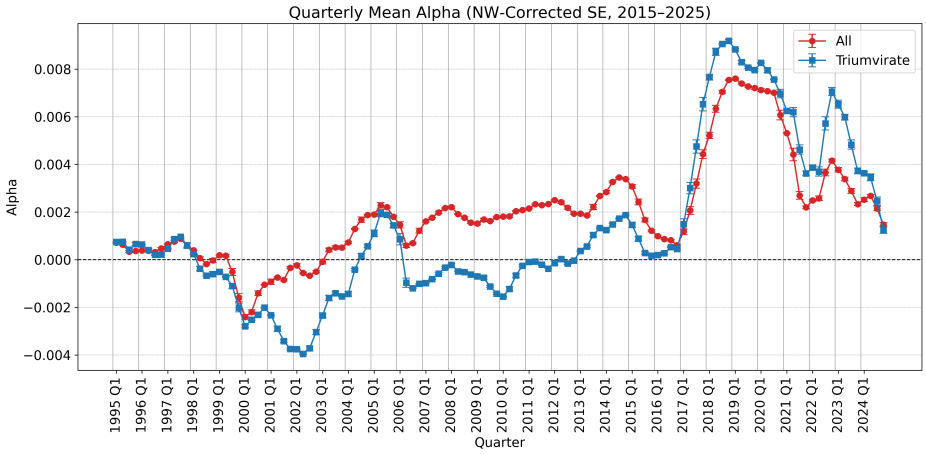

Figure 8: US Long-Short Sin Portfolios Alpha

Use of Artificial Intelligence

This thesis has used AI to polish writing and to spell check. AI has also been used to assist with smaller syntactic coding questions and to help structure and comment on the code for this project. Finally, AI has been used to automate the writing of regression tables in LaTeX code.

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