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Can You Cash In on Sin?

An Analysis of Sin Stock Performance in Developed Markets

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Abstract

This thesis addresses the debate in the literature regarding the existence of a sin premium in equity markets. Focusing on three categories of sin stocks - alcohol, tobacco and gambling - we analayse data from global developed markets spanning the period 2000 to 2023. Using monthly returns, we construct value-weighted portfolios of sin stocks and comparable non-sin stocks. Through regression analyses, we evaluate the risk-adjusted performance of these portfolios using the Fama-French three-factor model, the Carhart four-factor model, and the Fama-French five-factor model, both with and without momentum. To assess whether a sin premium exist and if it can be attributed to the unique characteristics of the sin stocks, we estimate and analyse alphas through a dual approach: (i) the excess return of the sin portfolio ($R_{Sin} - R_f$), and (ii) a long-short strategy by going long in the sin portfolio and short in the comparable portfolio ($R_{Sin} - R_{Comp}$). Our findings reveal no significant alphas, indicating that the excess returns of sin stocks can largely be explained by conventional risk factors rather than a sin effect. These results challenges the notion of a distinct sin premium and emphasize the efficiency of modern equity markets - reminding investors that even the most controversial assets rarely escape the fundamental tenets of rational pricing.

Keywords – Sin stocks, Sin premium, Tobacco, Alcohol, Gambling, Developed markets, Alpha, Asset pricing models

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1 Introduction

The choice between good and bad sits at the very core of our moral identity, influencing our everyday decisions and who we are as individuals. However, this moral struggle is not limited to our personal lives; it also guides choices in the economic world. Every day, investors choose not only which investments to pursue but also how these choices reflect their values.

Traditionally, investors have focused on one goal above all others: Maximizing their profits. Achieving the right balance of risk and return has been considered the gold standard of financial success. More recently, however, the ethical and moral implications of investment choices have gained momentum, drawing attention to the types of companies that make up a portfolio. Here, at the intersection of profits and morality, lies the world of "sin stocks" – companies earning their revenue from morally questionable activities. While moral investors may steer clear of these industries, these stocks have historically performed remarkably well, generating high and stable returns. As a result, the question facing today's investors is increasingly one of values as much as value: Where do we draw the line between profits and morality?

This thesis sets out to examine that very crossroads. Specifically, we investigate the appeal of sin stocks despite their ethically controversial activities. We hypothesize that their appeal lies in the so-called "sin premium", which refers to the potential excess returns these stocks generate. Understanding this premium could not only explain the strong performance of sin stocks, but also reveal why some investors are willing to embrace them despite the ethical dilemmas they present. By unraveling this premium, we gain insight into the broader interplay of ethics, economics, and the pursuit of financial gain.

Our study builds on existing literature, which presents diverging evidence regarding the sin premium. A cornerstone in this field is the paper of Hong and Kacperczyk (2009), which examines how social norms impact sin stock returns. They argue that institutional investors avoid these stocks for ethical reasons, thus making them underpriced. This creates a lucrative opening for investors willing to shoulder the reputational risk, allowing them to secure a sin premium. Fabozzi et al. (2008) further argue that sin stocks outperform not just because they are shunned but also due to their "sinful" traits, such

as monopolistic power, resilience in downturns, and endurance of litigation risk. Their findings suggest that institutional investors might be paying a financial cost to uphold societal norms, raising the question of whether upholding standards is worth the loss to portfolio performance. More recently, however, Blitz and Fabozzi (2017) challenge the notion of a sin stock premium. By applying updated asset pricing models, they find that contemporary risk factors can fully explain the steep returns of the sin stocks. In other words, what might have been regarded as a premium in earlier years, in fact, has been standard risk at work.

Based on the disparities in the literature, we aim to investigate the phenomenon of the sin stock premium firsthand. Our contribution to the literature lies in unifying the various definitions of sin stocks used across prior studies, ensuring reliable and broadly applicable results. By adopting a modern time frame, we capture the impact of structural changes, such as the evolving regulatory frameworks and growing focus towards ESG (Environmental, Social, and Governance) investing. This lets us better represent a contemporary investment landscape. Moreover, earlier studies use varying factor models, reaching different conclusions. We employ multiple factor modes to ensure robust results that allow for meaningful analysis and comparison across literature. By considering the varied definitions and methodologies from earlier research, we bridge their approaches and seek to determine whether a sin premium truly exists in modern financial markets.

We draw our data from the past two decades, spanning a period from 2000 to 2023, focusing on global developed markets. We analyze sin stocks in the tobacco, alcohol, and gambling industries, along with the sin stocks' comparables – stocks from industries with similar characteristics but without the sinful attributes. Using this data, we construct value-weighted portfolios at the global and industry levels. We apply a long-short strategy and use established factor models to estimate and compare the portfolios' excess returns.

We delve into the concept of the sin premium by first investigating whether sin stocks generate any excess returns. Specifically, we examine whether a sin stock portfolio would generate a significant alpha (α), which are returns beyond what the asset pricing models can explain. A significant alpha would suggest the presence of a sin premium. We also employ various asset pricing models to identify the factors contributing to the performance of sin stocks. Next, we investigate whether any observed excess returns can be attributed to

a "sin effect". We do this by comparing the returns of the sin stocks and their comparables in a difference portfolio. This comparison allows us to isolate whether the returns are uniquely tied to the sinful nature of the sin stocks. By combining these two approaches, we aim to shed light on whether a sin premium genuinely exists.

Our thesis cast doubt upon the existence of a sin premium. Like Hong and Kacperczyk (2009), we find a positive significant alpha using simpler factor models, initially suggesting that sin stocks may offer excess returns. However, when we account for additional risk factors, the sin premium vanishes, supporting the conclusions of Blitz and Fabozzi (2017). When extending the analysis to the individual sin industries, we arrive at the same conclusions. While none of the industries show a significant alpha, we are able to highlight distinct characteristics for the different sectors. Alcohol companies tend to be the most profitable, gambling stocks show higher cyclicality, and tobacco firms appear more established. These insights can help investors tailor their choices based on their risk tolerance and investment goals, even in the absence of a true sin premium.

Furthermore, our analysis of sin stocks relative to their comparables reveals no distinct sin effect in their returns. We find no significant alphas here either, suggesting that sin stocks do not outperform their peers simply because of their sinful nature. However, they possess qualities highlighted by Fabozzi et al. (2008) that help drive returns. Sin stocks display stronger value-stock characteristics and demonstrate better operational profitability than their comparables – aligning with the argument that they are well-established firms. Although we find no evidence of a sin premium, these features do, however, indicate that sin stocks can be highly profitable investments – though investors must weigh the potential gain against their individual risk aversion.

The remainder of this thesis describes our study in detail and is structured as follows: Section two dives deeper into sin stocks and the sin premium, and addresses the disparities in the literature, before establishing our main research question. Section three outlines our data selection process, detailing which data was retrieved and why. Section four describes our methodology, including portfolio construction, and introduces the asset pricing models used to derive our results. Section five presents and interprets the regression results, followed by a deeper discussion of the findings in section six. Finally, section seven concludes the thesis, offering a final reflection on the study.

2 Background

The following section lays the foundation of our thesis by defining sin stocks and establishing the rationale for our study. The first part will explore sin stocks' unique characteristics and discuss why they present an intriguing case within financial markets. Thereafter, we will examine the literature on sin stocks and highlight key studies. Finally, we will develop our own research questions, which seek to make a meaningful contribution to the research on sin stocks.

2.1 Introduction to Sin Stocks

Although different approaches have been taken to define sin stocks, a universally accepted definition has yet to be established. Generally, sin stocks are considered "sinful" due to their involvement in business activities which are considered morally or socially controversial. Although the activities might be legal, they are associated with adverse social, health, or ethical implications. The most common sectors that fall under this scope have been defined by Hong and Kacperczyk (2009) as the "Triumvirate of Sin", and include the alcohol, tobacco, and gambling industries. However, what can be considered as sin stocks is not only limited to these industries. Industries such as adult entertainment, biotechnology, and defence have also been included in various definitions (Blitz & Fabozzi, 2017; Fabozzi et al., 2008). Given that all these industries conduct activities that are associated with ethical, social, or moral implications, they can be argued to be sinful too. However, this proves to place sin stocks under a broad definition.

Both investors and academics have sought to define the ambiguous term over time. Part of the difficulty lies in the ongoing debate over what is considered "sinful". What is considered sinful is inherently subjective, varying not only from investor to investor but also across regions, cultures, and time. Investors may have a unique perspective of what they deem sinful, leading to differing classifications of sin stocks between individuals.

As social norms and public attitudes shift, the perceptions of industries and companies change accordingly (Blitz & Fabozzi, 2017). For instance, while the cannabis industry is viewed as controversial today, its growing acceptance – particularly due to advancements in medical applications – may eventually alter its status. Conversely, the usage of tobacco

was not widely considered unhealthy before the 1960s (U.S. Department of Health and Human Services, 2024). However, tobacco companies have increasingly been classified as "sinful" as research has shed light on the severe health and environmental impacts of smoking. This exemplifies how companies may move in and out of the sin stock definition as societal norms evolve.

In light of the complexities surrounding sin stocks, reaching a universally accepted definition remains challenging. However, consistent with the approach of Hong and Kacperczyk (2009), the most cited researchers within this field, we limit our definition to the Triumvirate of Sin – constituting tobacco, alcohol, and gambling stocks. While other industries may also be perceived as sinful, these three sectors are most closely associated with shared characteristics and most readily accessible for regular consumption. Therefore, for the purposes of this study, we focus exclusively on these industries as the core representative of sin stocks.

2.2 The Sin Stock Premium

If sin stocks are associated with human vice and socially controversial activities, what makes them worth investing in? The answer may lie in the potential "sin premium" investors could gain from holding these assets. As academic opinions vary on whether such a premium exists, compelling arguments are made both for and against it. This section will explore the concept of the sin stock premium, examining the rationale behind its potential existence and the critiques that challenge it.

First and foremost, the literature argues that sin stocks are systematically shunned by investors who follow social norms, leading to the potential underpricing of these assets. Public opinions are often shaped by contemporary societal norms, which generally disapprove of companies that offer products or services – as well as investors who profit from activities – that go against such standards (Fabozzi et al., 2008). Consequently, societal norms may drive investors to avoid sin stocks that engage in controversial activities. Hong and Kacperczyk (2009) argue that this neglect leads to the underpricing of sin stocks, creating reputational risks for those who invest in them. The underpricing can also be displayed in sin stocks generally being relatively cheaper when benchmarked against their comparables, offering lower price-to-book and price-to-earnings ratios.

The shunning of sin stocks is not merely theoretical but also observable in real-world practices, especially with the rise of socially responsible investing (SRI)[1]. As ethical considerations and ESG criteria continue to gain traction among investors (Pástor et al., 2021; Pedersen et al., 2021), both private and institutional portfolios increasingly exclude unethical assets such as sin stocks. A notable example of this trend is Norway's Government Pension Fund Global (GPFG), the world's largest sovereign wealth fund, which since 2010 has excluded tobacco producers from its portfolio (Norges Bank Investment Management, n.d.). While examples such as the exclusion practices of Norway's GPFG may support the findings of Hong and Kacperczyk (2009), can we confidently conclude that this neglect directly leads to the underpricing of sin stocks and, thus, a sin premium? The argument also raises a broader question about market inefficiencies:

On one side, norm-constrained institutional investors such as pension and sovereign wealth funds exclude sin stocks for ethical reasons. On the other side, less norm-constrained investors such as mutual and hedge funds – who act as natural arbitrageurs – capitalize on pricing anomalies like the underpricing of sin stocks. If the efficient market hypothesis holds, these arbitrageurs should correct any underpricing, ensuring that stock prices reflect all available information (Fama, 1970). In essence, while the avoidance of sin stocks by some investors appears to create conditions for underpricing, the efficient market hypothesis challenges the existence of such a sin premium in fully informed and rational markets. Thus, while the rationale for a sin premium is compelling, its persistence in the real world remains debatable.

Another argument for the existence of a sin premium is the market power and monopolistic tendencies often associated with certain firms within sin industries. These industries are typically subject to stringent regulations and policies that elevate the barriers to entry for new firms. Moreover, many of these firms boast long operational histories, allowing them to consolidate market power over time. The combination of high barriers to entry and market power gives sin firms a competitive edge, allowing them to generate higher returns that others cannot easily replicate (Fabozzi et al., 2008). Monopolistic tendencies are most pronounced among tobacco companies, whereas the alcohol and gambling industries

[1]Socially Responsible Investing (SRI) refers to the practice of considering ethical, social and environmental factors in investment decisions. The main idea of the movement is to invest in companies that have a positive impact on environmental and social issues, and to exclude companies that negatively impact these issues (Riedl & Smeets, 2017).

tend to resemble oligopolies dominated by a few concentrated firms. Nevertheless, by leveraging their market power, sin companies often achieve high returns – a factor that fuels the argument for a sin premium.

While market power theoretically allows firms to extract higher revenues by influencing market conditions, it does not necessarily translate into an inherent sin premium. The additional profits generated through mechanisms like price-setting can be considered an economic rent arising from the firms' advantageous positions (Pindyck & Rubinfeld, 2017, pp. 556–557). However, as asset prices incorporate all available information, the rent derived from market power should be embedded in the stock's valuation. Hence, these advantages are typically reflected in the share price, meaning the market already accounts for the firms' market power. This casts doubt upon the existence of a sin premium, suggesting that the observed high returns of sin stocks may reflect their underlying market power rather than an unexplained anomaly such as a sin premium.

Beyond their market power, the sin companies also stand out for their remarkable stability. These well-established firms generate steady cash flows driven by the inelastic demand for their products (Fabozzi et al., 2008), as consumers will likely continue to drink alcohol, smoke cigarettes, and gamble regardless of economic conditions. Moreover, paired with consistent dividend payments, the stability of sin stocks positions them as defensive assets, capable of delivering reliable returns even in turbulent markets. Their reputation for resilience raises an important question: Are sin stocks more recession-proof than their peers, making them particularly appealing in times of economic uncertainty?

If sin stocks are widely recognized as defensive assets, this may undermine the argument for a sin premium. Their stable and predictable cash flows make them attractive hedges during economic downturns, prompting investors seeking stability to drive up demand. While the increased demand may yield short-term gains, they narrow the underpricing gap as prices are pushed closer to their fair value. Consequently, the opportunity for excess returns diminishes over time. Paradoxically, the resilience that makes sin stocks appealing during market distress could also leave less room for a sin premium to materialize.

In addition to their unique characteristics, sin stocks face specific risks that can affect their valuation. Two prominent risks are headline and litigation risk (Fabozzi et al., 2008; Hong & Kacperczyk, 2009). Headline risk arises when major news, whether true

or not, unfavorably affect a company's stock value and reputation. For example, in the Master Settlement Agreement (MSA) of 1998, major tobacco companies faced significant financial and reputational repercussions (National Association of Attorneys General, 1998). The settlement required these companies to cover over $200 billion in healthcare costs associated with smoking-related illnesses and imposed strict advertising restrictions. Meanwhile, litigation risk reflects the possibility of legal challenges, such as lawsuits over health impacts, regulatory non-compliance, or product safety concerns. The MSA itself was a result of extensive litigation, where states sought to recover billions of dollars in healthcare costs linked to smoking-related diseases. Both headline and litigation risks contribute to the uncertainty surrounding sin stocks, leading investors to demand higher compensation for bearing these risks. This higher required return is often highlighted as a key factor underlying the sin premium.

In summary, while several arguments support the existence of a sin premium, equally strong counterarguments cast doubt on its validity. The conflicting perspectives reflect the issue's complexity and could explain the lack of consensus regarding whether such a premium truly exists.

2.3 Literature Review

The concept of "sin stocks" has long sparked interest among investors and academics alike. As these stocks have become subject to research, the literature has examined their performance using various approaches. These papers investigate whether sin stocks offer excess returns and if this can hint at a sin premium. Not surprisingly, the evidence from the literature points in both directions.

One of the most cited papers in the sin investing sphere is Hong and Kacperczyk (2009), who investigates the effect of social norms on stock returns. Analysing a sample of US sin stocks from 1965 – 2006, the paper finds that sin stocks offer excess returns due to neglection from institutional investors. As norm-constrained investors abstain from investing in sin stocks, these stocks get undervalued and present a risk premium for the investors willing to oppose social norms. Their analysis was also expanded to Canadian and a selection of European markets, which exhibited the same patterns. Their research is founded on the capital asset pricing model (CAPM), and the three-factor and four-factor

models developed by Fama and French, and Carhart.

Furthermore, Hong and Kacperczyk found that sin stocks are subject to greater litigation risk and have lower valuation ratios than comparable stocks. Additionally, the paper found evidence that sin stocks receive less analyst coverage, contributing to reduced market visibility and mispricing of these stocks. Based on their analysis, Hong and Kacperczyk argue that investors pay a financial cost when excluding sin stocks, thus rewarding the investors willing to take the risk. In addition, by utilizing difference portfolios, they find that sin stocks demonstrate higher expected returns than comparable stocks.

Fabozzi et al. (2008) analyze a broader dataset with additional countries and six sin industries, including defense, biotech, and adult services. More specifically, they cover 21 developed markets across Europe, the US, Asia and Japan. Their study explores how social values affect sin stock returns, hypothesizing that moral and ethical principles impact the value of these assets. While traditional asset pricing models assert that returns are solely driven by risk-return trade-offs, Fabozzi et al. (2008) argue that an investor's values also influence sin stock performance. The authors also argue that firms may benefit economically by not conforming to social norms, as they would incur additional costs to uphold socially responsible standards.

The study also suggests that sin stocks tend to be initially undervalued due to the negative sentiment held by the average investor. Another explanation for excess returns is the inherent entry barriers for sin industries. These industries face higher scrutiny and regulatory oversight and are severely disciplined by social opinion. Consequently, firms in these sectors that have withstood such pressures often establish monopolistic positions, in turn allowing them to achieve positive monopolistic returns. Fabozzi et al. (2008) base their analysis only on the CAPM and the Fama-French three-factor model, measuring the excess returns only over a market benchmark, and no comparable stocks.

Conversely, more recent research suggests that despite all these findings there might not exist any sin premium after all. Blitz and Fabozzi (2017) adopt the Fama-French five-factor model (FF5), incorporating risk factors for profitability and investment. Their study covers global developed markets from the in Europe, the U.S. and Japan. The authors highlight that varying definitions of sin stocks influence conclusions and narrow their focus to the Triumvirate of Sin and defence stocks. They underline the earlier

findings in the literature, which propose that returns from sin stocks might be attributable to systematic underpricing due to investor aversion, coupled with monopolistic benefits and higher litigation risks. However, their analysis demonstrates that the sin premium shrinks as models with more risk factors were utilized, and that the sin stock returns were fully accounted for by adding the profitability and investment quality factors in the FF5 model. Blitz and Fabozzi (2017) include a "betting against beta" (BAB) factor to account for the tendency of sin stocks to be low-beta stocks. This factor is added as omitting it can lead to systematic undervaluation (Frazzini & Pedersen, 2014). While the BAB factor contributes to explaining the excess return of the sin stocks, its effect is outweighed by the added Fama-French factors.

After controlling for the additional factors, they find no distinct sin premium that would specifically reward investors for holding sin stocks. Blitz and Fabozzi (2017) ultimately conclude that sin stocks' performance aligns with expectations based on exposure to contemporary risk factors, negating the notion of a sin stock anomaly. They further emphasize that perceptions of "sin" evolves over time as social norms, industry landscapes, and company operations shift – emphasizing that in future research, the conclusions could change based on the definitions and approaches used.

2.4 Research Question

The following section will identify inconsistencies and gaps in the current literature and formulate research questions aimed at addressing these. While early studies identify a sin premium (Fabozzi et al., 2008; Hong & Kacperczyk, 2009), more recent research challenges these findings. Using updated asset pricing models, newer studies demonstrate that sin stock returns can be fully explained by conventional risk factors, suggesting that no distinct sin premium exists (Blitz & Fabozzi, 2017).

We seek to address the lack of consensus within the literature and account for the variations in asset pricing models to determine whether a sin premium exists. Furthermore, inconsistencies in defining "sin" across studies limit comparability, prompting us to focus specifically on the "Triumvirate of Sin" according to our definition of sin stocks.

In addition, we identify regional and temporal variations across the existing research. Like earlier studies, our thesis will focus on developed markets but restrict the analysis to the

period 2000 to 2023. The temporal limitation is grounded in the argument that societal views on what is considered sinful or unethical evolve over time, allowing us to better capture contemporary social norms. This basis leads to our central research question:

Does there exist a sin stock premium in developed markets today, driven by a distinct "sin effect" not explained by conventional risk factors?

To answer the research question, we set out to test the following hypotheses:

Hypothesis 1 (H_1):

The sin stock portfolio generates a positive and statistically significant alpha.

The alpha (α) is defined as the portion of a portfolio's excess returns that cannot be explained by conventional risk factors (e.g. market premium, size, value). Excess returns are defined as the performance of the sin portfolio over a chosen benchmark, here being the risk-free rate (R_f). Specifically, we test whether the sin portfolio generates a significant alpha using various asset pricing models, where the dependent variable $R_{\text{Sin}} - R_f$ measures the excess returns. When testing this hypothesis, a positive and statistically significant alpha would indicate that some of these excess returns remain unexplained by the risk factors, thereby indicating a potential sin premium.

Hypothesis 2 (H_2):

The sin stock portfolio generates a positive and statistically significant alpha when compared to a comparable portfolio of non-sin stocks.

This hypothesis builds on the same assumptions as H_1, but measures excess returns relative to the comparable portfolio of non-sin stocks ($R_{\text{Comparable}}$). Specifically, we test whether the sin portfolio generates a significant alpha using various asset pricing models, where the dependent variable $R_{\text{Sin}} - R_{\text{Comparable}}$ measures the excess returns of the sin portfolio over its comparable portfolio. When testing this hypothesis, a positive and statistically significant alpha would indicate that some excess returns remain unexplained by the risk factors, indicating a potential "sin effect". The "sin effect" implies that the excess returns are driven by the sinful nature of the sin stocks, as this is the primary distinction between them and their comparables.

3 Data

This section outlines the process of extracting and preparing the data required to evaluate the performance of the sin stock portfolios and test the associated hypotheses. First, we describe the steps taken to clean the raw data and classify both sin and comparable stocks. Next, we discuss alternative definitions of sin stocks. We then detail the selection criteria for the time period and countries included in the analysis. Finally, we address the limitations of the dataset which might impact the robustness of the results.

3.1 Data Sources

The stock data for our analysis was retrieved from Refinitiv Datastream (hereafter referred to as Datastream), previously known as Thomson Reuters Datastream, and currently integrated into the LSEG Workspace platform (London Stock Exchange Group, n.d.). This approach is similar to Blitz and Fabozzi (2017) and Fabozzi et al. (2008), who sourced all their stock data from Datastream, as well as Hong and Kacperczyk (2009), who specifically used Datastream for their international stock data.

Risk factor data and market proxies was retrieved from Kenneth R. French's Data Library. This provided us with historical benchmarks for the market premium, the risk-free rate and other risk factors for our markets. See Table 3.1 below for an overview of the extracted variables.

Table 3.1: Data Sources & Retrieved Variables

Refinitiv Datastream	**Kenneth R. French's Data Library**
Stock Price	Market Premium (Mkt-Rf)
Total Return Index	Risk-free Rate
Market Value	SMB
Turnover by Volume	HML
Turnover by Value	CMA
Datastream Industrial Sector Classification	RMW
TRBC Activity Name	WML
Country of Listing	
Ticker Symbol	
Quote Name	

Note: This table shows an overview of the retrieved stock data from Refinitiv Datastream and risk factor data from Kenneth R. French's Data Library.

3.2 Data Cleaning Process

To ensure adequate stock data to construct our portfolios, we performed several steps to select and clean our data. Firstly, static stock data was retrieved from Datastream. Relevant sin stocks were identified through their ticker, the company name, and the respective country of listing. The Datastream Industrial Sector Classification variable (hereafter referred to as INDM) was utilized to identify all companies that conducted business within the alcohol, tobacco or gambling industries.

Furthermore, both active and delisted companies are included in the data to not neglect valuable historical stock data for companies that ceased to exist during our selected timeframe, thus avoiding survivorship bias (López de Prado, 2018, p. 152). Finally, only primary stock quotes and major securities are included in our data[2].

After identifying relevant stocks for our analysis, time series data was retrieved and merged with the static data. A column for monthly returns was manually created, based on the month-by-month change of the "Total Return Index" (TRI), which accounts for dividend payouts. The time series data was retrieved for the last trading day of each month. Monetary variables were retrieved in a common currency (USD) to make the data comparable. To avoid look-ahead, we avoided uniform restrictions across the dataset, using dynamic, monthly liquidity checks during portfolio rebalancing instead.

In the following sections, we will detail the selection process for alcohol, tobacco and gambling stocks, as well as the criteria for selecting comparable stocks.

3.3 Data Selection

3.3.1 Selection of Tobacco Stocks

The selection of tobacco companies was based on the industry category in Datastream. With “Tobacco” listed as its own industry in Datastream, the relevant companies were easily accessible. The data includes tobacco companies that directly engage in the production of tobacco products, such as cigarettes and cigars (e.g., British American Tobacco).

[2]Only the primary security for each firm is included, meaning if a firm has issued multiple share classes (e.g., A and B shares), only the main equity is considered. Additionally, only the primary listing on the firm’s home market is included, excluding any cross-listed shares on foreign exchanges.

Furthermore, companies directly contributing to the production of tobacco, such as the cultivation of tobacco plants or manufacturers of tobacco were also included. Examples of such firms included in our data is the Universal Corporation, a producer of leaf tobacco, and SWM International, which produce tobacco filters and paper packaging. Companies producing and distributing electronic cigarettes and vaporizers were also included, as these products have similar properties to tobacco companies, being providers of an addictive product where consumption leads to proven detrimental effects on the health of the consumer (Centers for Disease Control and Prevention, 2016).

Cannabis companies also exist in a gray area where the classification as sin stocks can be discussed. Companies involved in cannabis cultivation and distribution is classified under the "Tobacco" industry in Datastream. Socially responsible investors may avoid investing in cannabis due to ethical concerns, as it in most jurisdictions is considered an illegal product, which also has addictive properties and long-term detrimental health effects (National Institute on Drug Abuse, n.d.). Whether or not there should be a distinction between producers of cannabis for recreational and for medicinal purposes might be a topic for discussion in future research, as the last decades has seen an increasing degree of social acceptance and legalization of the latter. Nevertheless, all eligible cannabis-related stocks from Datastream have been included in our analysis.

Our sin universe contains stock data for 62 unique tobacco firms.

3.3.2 Selection of Alcohol Stocks

In contrast to tobacco companies, alcohol companies do not have a separate industry category in Datastream. The alcohol companies appear under the broader industry classification “Beverages”. Stocks classified under the “Beverages” category were thus further broken down into “Brewers” and “Distillers & Vintners” using the INDM variable.

This category includes companies directly involved in the production of alcoholic drinks, such as brewers and distillers, as well as those that directly contribute to the alcohol industry. Some examples of the latter include bar- and nightclub chains, producers of malt and hops, suppliers of wine barrels, bottling companies and distributors. Even though these companies are not directly engaged in the production of alcohol, they are gaining profits from supporting the sinful activities of alcohol companies.

Several alcohol companies produce alcohol intended for purposes other than human consumption, typically for manufacturing, cleaning, as a chemical solvent, or for fuel. Although one may argue that industrial alcohol production can have environmental concerns, making it subject to a negative ESG classification, for the purposes of this analysis, these stocks have not been classified as sin stocks.

Our sin universe contains stock data for 284 unique alcohol stocks.

3.3.3 Selection of Gambling Stocks

As with alcohol-related stocks, gambling stocks lack a distinct industry category in Datastream, appearing instead within the broader "Travel & Leisure" industry. To identify gambling-related firms, we again broke the data set down by utilizing the INDM variable, using the subcategory "Casinos & Gambling."

Examples of stocks included in this category are physical casinos, online gambling and betting websites, and dog racing tracks. They also include supporting businesses, such as producers of gaming machines, providers of betting software and, especially in the case of Japan, prepaid IC cards specially intended for use in pachinko halls[3]. Many stocks included in our dataset operate in the activity sector "Hotels and Resorts", typically resort destinations with a heavy focus on offered casino facilities.

This category includes some of the largest gambling firms by market cap. While it may be argued that these companies are in the hotel business, we chose to include hotels and resorts with a significant focus on their gambling activities—particularly in cases like casino hotels in Las Vegas, where gambling is a core part of their business model. This approach allows us to capture the full spectrum of firms with meaningful involvement in gambling services.

Our sin universe contains stock data for 349 unique gambling stocks.

[3]Pachinko parlors are widespread in Japan and feature «arcade»-like games intended for gambling, similar to slot machines.

3.3.4 Selection of Comparable Stocks

The selection of comparable companies follows a similar procedure to that employed by Hong and Kacperczyk (2009), with the distinction that we utilize Datastream industry classifications, instead of Fama-French Industry groups and SIC codes, to identify suitable comparable firms. We base our comparable firms on the non-sin stocks that fall within the same broader parent industry classification as the sin stocks.

The tobacco comparables include all eligible stocks under the **Food Producers** category in Datastream, less the previously identified tobacco stocks. This is a broad category of firms, including dairy farms, confectionery producers, canned food producers and other food-related firms. Some well-known firms found in this category include Mondelēz International and the Dole Food Company.

The alcohol comparables include all eligible stocks under the **Beverages** category in Datastream, less the previously identified alcohol stocks. This include producers of soft drinks, coffee and tea, juice and other non-alcoholic beverages, and include several household names such as Coca-Cola.

The gambling comparables include all eligible stocks under the **Travel & Leisure** category in Datastream, less the previously identified gambling stocks. This encompasses a broad range of companies, including airlines, (non-casino) hotels and resorts, restaurants and sport venues. Well-known firms within this category include the Starbucks Corporation and Marriot International.

These categories represent a reasonable proxy for the broader industries in which sin stocks operate, and thus provide a balanced benchmark for comparison. By utilizing Datastream's own classifications, we aim to emulate the Fama-French industry groupings utilized by Hong and Kacperczyk (2009)[4], ensuring that the non-sin comparable stocks provide a reasonable representation of the relevant market segments used in previous research.

Our comparable universe contains stock data for 3598 unique comparable stocks.

[4] 2 (food), 3 (soda), 7 (fun), and 43 (meals)

3.4 Alternative Sin Stocks

The perception of what constitutes a sin industry can vary widely between individuals and evolve significantly over time. While our thesis focuses on the "Triumvirate of Sin" other industries also face ethical scrutiny and could be relevant for future research on the topic.

Sex Industry

The global sex industry is sizable, including sectors like prostitution, pornography, and adult products. The global sex toy market alone is projected to exceed $75 billion by 2030 (Spherical Insights LLP, 2023), while the global adult entertainment market is expected to exceed $74 billion within the same period (Research and Markets, 2024). Prostitution and pornography, which forms a substantial part of the global sex industry, is also often associated with issues of exploitation and human trafficking (United Nations Office on Drugs and Crime, 2022).

Given these ethical concerns, it is likely that most of society view many aspects of the sex industry as morally questionable or "sinful." Despite the industry's size, very few companies with involvement in adult services or products are publicly traded. The lack of investment opportunities likely reflects regulatory restrictions and societal reluctance to legitimize or invest in these activities on public exchanges. This limited presence on the stock market thus makes including this sin category in our analysis unfeasible.

Defence

It may be argued that defence is also a sin industry, given that it profits directly from conflict by supplying weapons and military equipment. However, others may view the industry as essential for ensuring protection and national security. Perspectives on the defence sector can vary significantly by culture, for example in the United States, where guns and the defence sector is deeply embedded in the national identity. As highlighted by Hong and Kacperczyk (2009), "We have decided against including defence as a sin industry in our main analysis because it is not clear that defence is considered a sin by many Americans". Given the substantial representation of U.S. stocks in our data set, we have similarly excluded the defence industry from our main analysis.

Oil & Gas

The definition of what constitutes a "sin industry" is continually evolving, with societal values and environmental concerns reshaping perceptions of corporate ethics. The oil and gas sector offers a prime example of this shift. As outlined in United Nations Environment Programme (2019), the last decade has seen little progress in bridging the global emissions gap. The largest reduction potential is within the energy sector, requiring a transition to greener forms of energy production, such as solar and wind energy (United Nations Environment Programme, 2019). Therefore, many might consider the traditional emission-intensive oil and gas industry a sin industry. However, this sector operates under fundamentally different conditions and objectives than the traditional Triumvirate of Sin industries, and we have thus decided not to include it in our analysis.

3.5 Time Period & Countries

Our data covers the period from January 2000 to December 2023, to gain a contemporary perspective on sin stock returns. This is in contrast to the studies of Hong and Kacperczyk (2009) and Fabozzi et al. (2008) which looked at a broader time period but contained little data from the past two decades. By focusing on this time period we can analyse stock performance from the perspective of modern markets with an increased focus on SRI and new regulatory frameworks. Our time period also includes two major events of market turmoil, namely the 2008 financial crisis and the 2020 COVID-19 pandemic.

When selecting countries for our analysis, we have two main concerns in mind. Firstly, we consider similarities in culture and values. We chose to include countries that have relatively similar cultural norms and values. This can ensure that any findings related to the performance of sin stocks are comparable across the included countries. All included countries are generally either a part of the Western world or are Western-aligned.

Secondly, we must ensure the availability of factor data. To ensure accurate factor data for our regression models, our selection was also based on the availability of this data. We used data from Kenneth R. French's Data Library, which provided us with risk factors and market proxies for the 23 countries they define as "developed markets". Using these countries as our base ensures that the factor data closely aligns with our stock data. Kenneth R. French's Library provided us with benchmark return data for global developed

markets and regional subsets, as well as benchmark return data for the "North America", "Europe", "Japan", and "Asia-Pacific (ex. Japan)" regions. For a detailed breakdown of which countries and markets are included in each region, please see Appendix A.1.

While our main focus is beyond just the Americas and Europe, approximately 75% of the investable sin stocks[5] in our analysis are from the U.S., Canada and Europe. Table 3.2 below provides a detailed breakdown of the number of investable sin stocks by country and category.

Table 3.2: Investable Sin Stocks by Country and Industry

Country of Listing	**Alcohol**	**Gambling**	**Tobacco**	**Total**
United States	36	96	21	153
United Kingdom	18	35	3	56
Australia	14	20	2	36
Germany	24	10	0	34
Canada	10	13	5	28
France	19	6	2	27
Japan	9	13	1	23
Hong Kong	6	13	2	21
Sweden	2	16	1	19
Spain	8	1	2	11
Greece	2	5	3	10
Italy	4	4	0	8
Austria	3	3	1	7
Belgium	4	0	0	4
Denmark	3	0	1	4
Netherlands	4	0	0	4
New Zealand	3	1	0	4
Finland	3	0	0	3
Portugal	2	1	0	3
Norway	1	1	0	2
Singapore	1	1	0	2
Switzerland	0	2	0	2
Total	**176**	**241**	**44**	**461**

Note: This table shows the distribution of investable sin stocks by country and sin industry. Note that many countries only contain 2-4 sin stocks. The highest concentration of sin stocks is found in the U.S., U.K., Germany and Australia. Ireland is the only country from Kenneth R. French's definition of developed markets that had no investable stocks included in the final sin portfolio.

[5]Investable sin stocks are sin stocks which have entered the total sin stock portfolio at least once during our analysis, and thus differ from the number of stocks in the sin stock universe. More on restrictions for portfolio entry and portfolio construction is detailed in section 4.1.

3.6 Data Limitations

Industry Classification

As previously discussed, the main filtering of stocks within relevant industries was done through Datstream's industry category when searching for stocks and adding the Datastream Industrial Classification (INDM) variable. There is always a risk of misclassification when handling this type of data, which also became apparent using the INDM variable. To alleviate this, we took two main actions.

Firstly, we included The Refinitiv Business Classification variable at the (lowest) activity level (TR5N). Several discrepancies were uncovered by cross-checking the activity classification against Datastream's own industry classification. One example is the Norwegian offshore drilling company, Deep Value Driller, which was classified as "Casinos and Gambling" through its industry classification but "Diversified Mining" through its activity classification. Not all firms included a TRBC Activity Classification, but we could eliminate several of the misclassifications in our dataset through this method.

Lastly, we manually checked all remaining firms to confirm if they were operating in the sin industry. This was mainly done by analysing the firms' company descriptions in Datastream and checking the stock information and description through third-party sites. An example of this was the Australian firm "Sydney Attractions Group," which primarily operated tourist attractions such as aquariums, but was classified as a "brewer" by Datastream. These manual cross-checks allow us to exclude companies that initially appeared to be sin stocks but were not, thereby enhancing the robustness of our sample.

Regional Risk Factor Data

While the risk factor data and benchmark returns used in our analysis are comprehensive and provided by reliable sources, there are certain limitations regarding regional mapping. As previously mentioned, the Fama-French factors are based on predefined regional groupings of countries. While our stock data includes precisely the countries defined as "developed markets" by French's pre-defined classification, the distribution of sin stocks across these countries is not uniform. This entails that the factor data does not perfectly match the geographical composition of our stock data.

For the total sin portfolio, we thus use the "total" developed market factor data, representing the average returns of all included developed markets across all regions. Our global analysis is standardized across all stocks, irrespective of their home country. In regional analyses, such as sin stocks from the U.S. and Canada, we apply the corresponding regional factor data set, e.g., "North America", to align more accurately with the stock data. While this approach may not fully capture the distribution of stocks at the country level, we assume it will capture important nuances while remaining practical to implement.

4 Methodology

This section outlines the methodology used to analyse our research question and test the hypotheses H_1 and H_2 outlined in Section 2.4. To determine whether sin stocks generate a sin premium and assess if this can be attributed to a sin effect, we construct and analyze the performance of sin stock portfolios. We begin by describing the construction of our sin stock portfolios, including both total and industry-specific portfolios. To provide a basis for comparison, we construct the corresponding portfolios for the comparable stocks, and establish relevant market proxies. Additionally, we construct regional sin stock portfolios, which are later used as a robustness check for our main analysis. Finally, we outline the asset pricing models applied to evaluate the portfolios' risk-adjusted returns.

4.1 Portfolio Construction

The sin portfolio is based on the month-by-month returns for each company included in the portfolio, from month $t-1$ to t. To determine returns for the first period in January 2000, stock data was also gathered from December 1999. This additional month was used exclusively to compute the returns for January 2000 and was subsequently excluded from the dataset. The calculations employ the "Total Return Index" (TRI) variable from Datastream, which measures the total value growth of a security over a specified period by incorporating reinvested dividends and accounting for stock splits. This ensures that the data reflects the true growth in investor value. For a further explanation of the TRI variable, see Appendix A.2. The monthly return can be expressed using the formula:

$$R_{i,t} = \frac{P_{i,t} + D_{t,1}}{P_{i,t-1}} - 1 \tag{4.1}$$

Where:

$R_{i,t}$ = Return of asset i in period t

$P_{i,t}$ = Price of asset i in period t

$D_{i,t}$ = Dividend of asset i in period t

$P_{i,t-1}$ = Price of asset i in period $t-1$

Similar to Fabozzi et al. (2008), we ensure the investability of our sample by applying liquidity restrictions to the stocks selected for our portfolio. These restrictions are dynamically updated at each monthly rebalancing, allowing stocks to enter or exit the portfolio as their characteristics change over time. Stocks included in the portfolio for at least one period are classified as investable. To achieve this, we impose two key criteria: First, firms must have a minimum market value of $50 million to be included. Second, stocks priced below $1, commonly referred to as penny stocks, are excluded.

The sin and comparable portfolios were constructed by using value-weighted monthly returns, where each firm's market value from the previous period determines its weight in the current period. This approach is crucial in backtesting financial data, as it mitigates look-ahead bias - a common pitfall where information unavailable at a given point in time, is improperly incorporated into the analysis (López de Prado, 2018, p. 152). For instance, if we used a firm's current market value to calculate the current period's weights, we would incorporate return and market value data not yet known during that period, resulting in artificially inflated cumulative returns.

By utilizing value-weighted portfolios we ensure that larger firms, which are typically more stable and liquid, have a greater influence on the portfolio's performance, while smaller firms with potentially more volatile returns contribute less. The portfolio is rebalanced monthly and ignores taxes and transaction costs. The following formula was applied to calculate value-weighted returns in each period:

$$R_{p,t} = \sum_i R_{i,t} \cdot \left(\frac{MV_{i,t-1}}{\sum_j MV_{j,t-1}} \right) \tag{4.2}$$

Where:

$R_{p,t}$ = Return of the value-weighted portfolio p in period t

$R_{i,t}$ = Return of firm i in period t

$MV_{i,t-1}$ = Market value of firm i in period $t-1$

$\sum_j MV_{j,t-1}$ = Sum of market values of all firms in period $t-1$

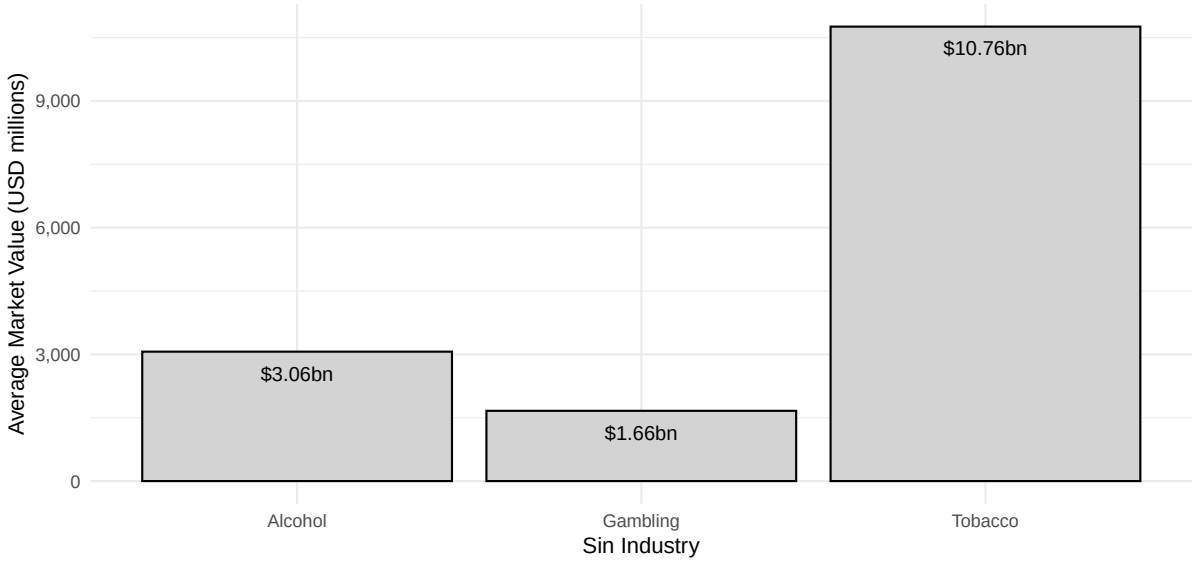
This method was used to construct all the portfolios necessary for our analysis. The subsections below will explain each portfolio in detail.

4.1.1 Total Sin Portfolio

The total sin portfolio is constructed from the global sin universe, compromising 695 sin stocks across various regions and industries. Of these, 461 stocks met our liquidity restrictions and were included in the portfolio at some point in time, making them investable and thus included in the portfolio. By company count, the portfolio shows a strong weighting toward the regions North America and Europe, as well as the alcohol and gambling industries. Below, we provide further insights into the total sin portfolio's composition, discussing its distribution of market values by industry and region.

Figure 4.1 shows the average market value of firms across the different sin industries. Tobacco firms stand out with the highest average market value at $10.76 billion per firm, far surpassing the alcohol and gambling industries, which average at $3.06 billion and $1.66 billion, respectively. This finding aligns with Fabozzi et al. (2008), who argue that tobacco firms tend to be larger in size and exhibit monopolistic characteristics.

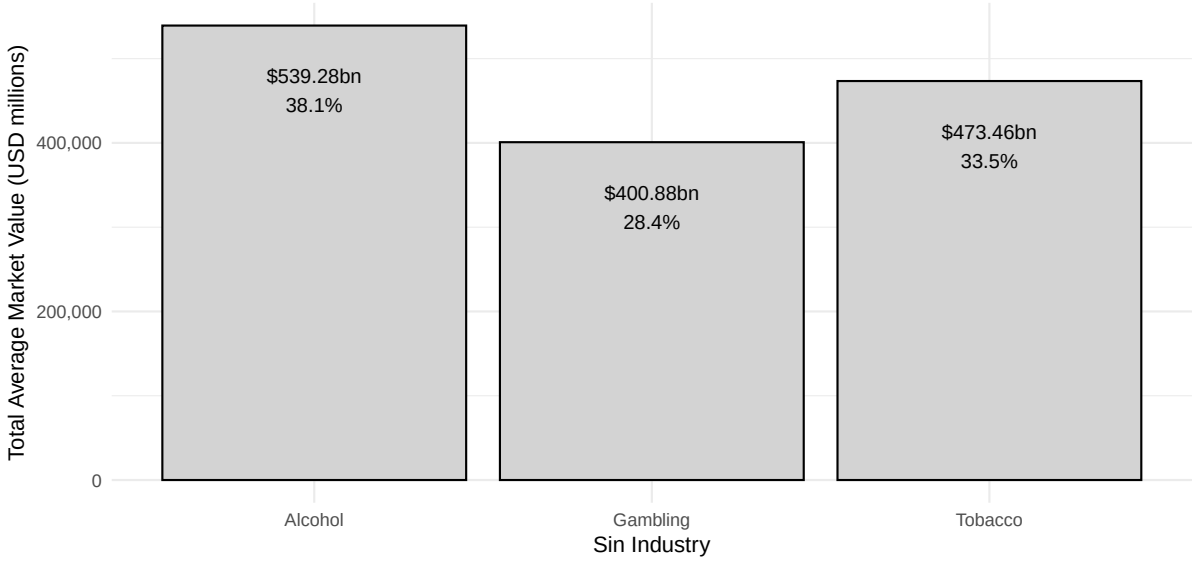
Figure 4.1: Average Market Value by Industry



Note: This figure shows the average market value (across the entire time series) per company within each sin industry. This is calculated by finding the average market value for each company within their respective industries, followed by computing the company-level average per industry.

Figure 4.2 illustrates each sin industry's share of the total market value within the sin portfolio. While there are relatively few tobacco companies represented in our stock data, their significantly higher average market value enables them to represent 33.5% of the total portfolio value. The alcohol industry holds the largest share at 38.1%, while the gambling industry accounts for 28.4%. This distribution highlights the dominant role of alcohol firms in the total market value of the sin portfolio, while also emphasizing the substantial contribution of the few, but large, tobacco companies.

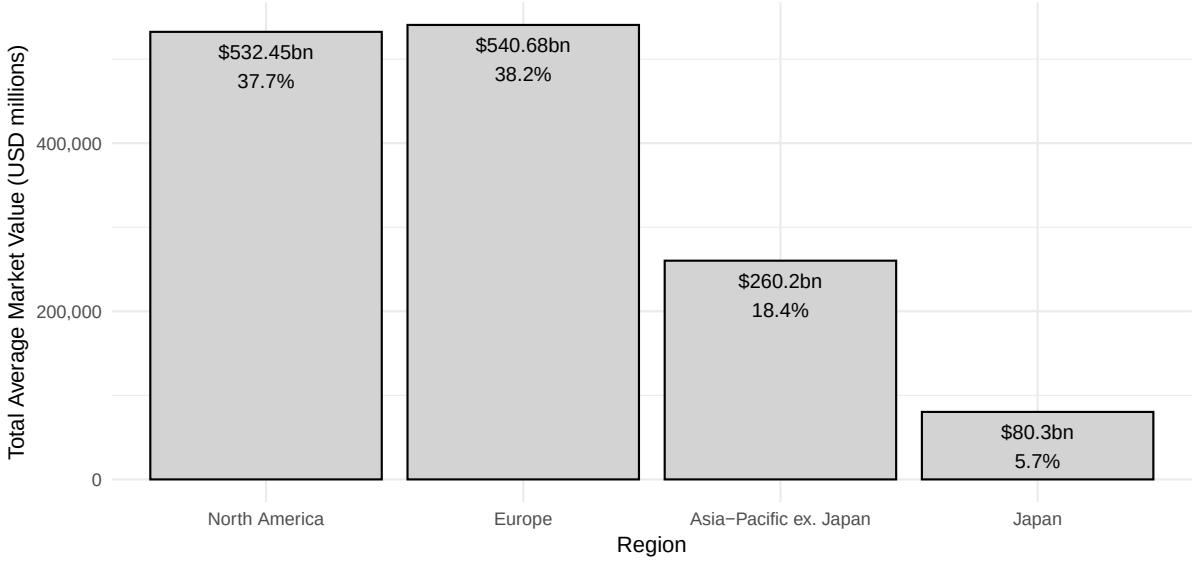
Figure 4.2: Share of Total Market Value by Industry



Note: This figure shows the sum of average market value (across the time series) per company within each sin industry. The percentage represents the sin industry's share of the total average market value. This is calculated by computing the sum of average market value of all companies within each industry.

Figure 4.3 illustrates the regional distribution of the total sin portfolio by market value. As previously mentioned, the portfolio is mainly represented by North America and Europe, which together account for 75.9% of the total market value. This dominant share reflects the significant influence of these markets within a global context. In contrast, the Asia-Pacific (excluding Japan) and Japan regions contribute 18.4% and 5.7%, respectively, underscoring the concentration of sin stocks in Western markets.

Figure 4.3: Share of Total Market Value by Region



Note: This chart shows the sum of average market value (across the time series) per company within each sin region. The percentage represents the sin industry's share of the total average market value. This is calculated by computing the sum of average market value of all companies within each region.

4.1.2 Industry Portfolios

While the total sin portfolio provides a global perspective, examining the individual sin industries offers a deeper understanding of their unique characteristics. To this end, we construct separate portfolios for the tobacco, alcohol, and gambling industries, each including all global stocks within the respective category. Analyzing these industries individually allows us to uncover differences in performance and risk profiles, shedding light on how each industry behaves within the broader sin stock universe. More importantly, this approach helps identify which industry — tobacco, alcohol, or gambling — delivers the highest returns, providing valuable insights into the factors driving their success.

Table 4.1 provides an overview of the sin stock universe and the number of stocks in the different sin industries. It also highlights how many of these stocks meet the investability criteria and are included in their respective industry portfolios at some point. Notably, the alcohol and gambling industries have significantly more investable stocks than the tobacco industry.

Table 4.1: Number of Sin Stocks by Industry

Industry Portfolio	Sin Universe	Investable Stocks
Alcohol	284	176
Tobacco	62	44
Gambling	349	241
Total	**695**	**461**

Note: This table shows the number of stocks in the sin universe by industry, as well as the number of investable sin stocks by industry. Investable sin stocks are stocks from the sin universe that have passed the liquidity restrictions and been included in the sin portfolio for at least one period.

4.1.3 Regional Portfolios

While the total and industry portfolios form the core of our analysis, we also construct regional portfolios to ensure the robustness of these findings. Dividing the sin stocks into regional sub-portfolios allows us to evaluate whether the results remain consistent across different geographical regions, thereby enhancing the reliability and generalizability of our conclusions. The regional portfolios include all sin stocks grouped by the respective regions they belong to.

Table 4.2 provides an overview of the sin stock universe, showing the number of stocks in each region. It also highlights how many of these stocks meet the investability criteria and are included in the regional sub-portfolio at some point. Notably, the Japan and Asia-Pacific ex. Japan portfolios contain relatively few stocks, which may limit the ability to draw meaningful conclusions from these regions.

Table 4.2: Number of Sin Stocks by Region

Regional Portfolio	Sin Universe	Investable Stocks
North America	306	181
Europe	267	194
Asia-Pacific ex. Japan	99	63
Japan	23	23
Total	**695**	**461**

Note: This table shows the number of stocks in the sin universe by region, as well as the number of investable sin stocks by region. Investable sin stocks are stocks from the sin universe which have passed the liquidity restrictions and been included in the sin portfolio for at least one period.

4.1.4 Comparable Portfolio & Difference Portfolio

The comparable portfolio is constructed to serve as a benchmark for the sin stock portfolio. It is drawn from the universe of 3598 comparable non-sin stocks across regions and comparable industries, as described in Section 3.3.4. Of these, 2148 stocks met the liquidity restrictions, qualifying them as investable and thus included in the portfolio at some point in time. Alongside the total comparable portfolio, we also construct industry-specific comparable portfolios. This approach allows us to identify differences at both the total and industry levels, ensuring a thorough comparison to the sin stock portfolios.

Table 4.3 provides an overview of the comparable stock universe, detailing the number of stocks across the different comparable industries. It also highlights how many of these stocks, both at the total and industry levels, meet the investability criteria and are included in their respective portfolios at some point.

Table 4.3: Number of Comparable Stocks by Industry

Industry	**Comparable Universe**	**Investable Stocks**
Beverages (Alcohol)	200	119
Food Producers (Tobacco)	1498	933
Travel & Leisure (Gambling)	1900	1132
Total	**3598**	**2148**

Note: This table shows the number of stocks in the comparable universe by industry, as well as the number of investable comparable stocks by industry. Investable comparable stocks are stocks from the comparable universe that have passed the liquidity restrictions and been included in the comparable portfolio for at least one period.

With our comparable portfolios established, we can compare the performance of the sin stocks to their comparables by constructing a difference portfolio. The difference portfolio helps us isolate any potential "sin effect" by directly comparing the returns of the sin portfolio with those of the comparable portfolio. This is achieved by constructing a long-short portfolio, where we take a long position in the sin portfolio and a short position in the comparable portfolio. We employ the difference portfolio analysis method, following the same approach of Hong and Kacperczyk (2009).

The underlying assumption is that the sin and comparable stocks are each other's closest peers, differing primarily in the "sinful" nature of the sin stocks. By comparing their excess returns, we can determine whether any excess returns generated by the sin stocks can be attributed to a "sin effect". The excess return of the difference portfolio is calculated using the following formula:

$$R_{Diff,t} = (R_{Sin,t} - R_{Comp,t}) - R_{f,t}$$

Where:

$R_{Diff,t}$ = Return of the difference portfolio in period t
$R_{Sin,t}$ = Return of the sin portfolio in period t
$R_{Comp,t}$ = Return of the comparable portfolio in period t
$R_{f,t}$ = Risk-free rate in period $t-1$

4.2 Market Proxies & Risk Factors

This section provides an overview of the characteristics of the market proxies and risk factor data used in our analysis. Additionally, it outlines the alignment of specific portfolios with their corresponding proxies and factor datasets.

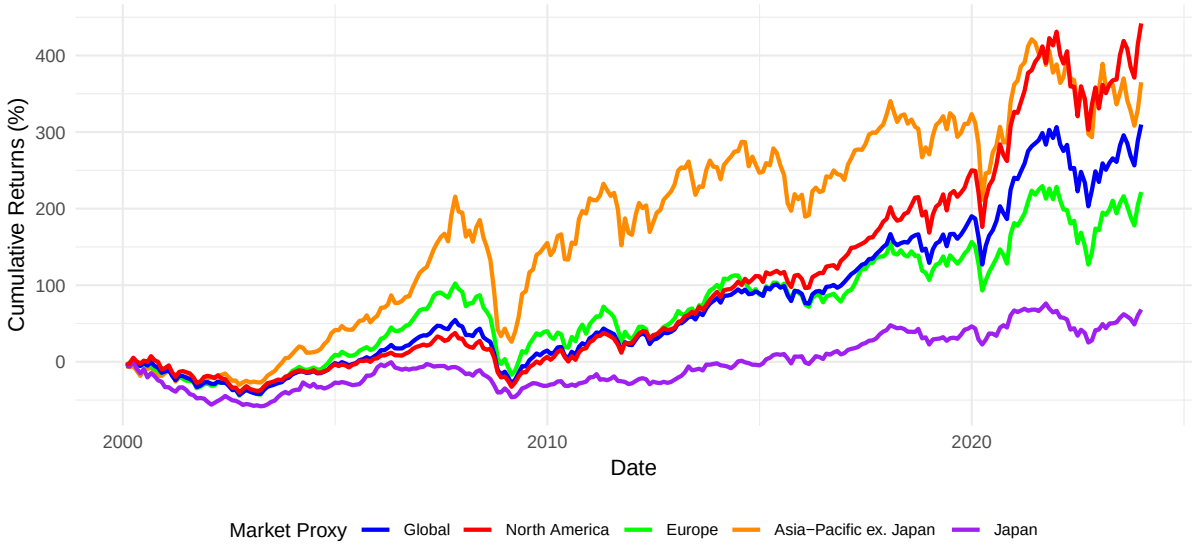
The market proxy for the total sin and industry-specific portfolios is represented by the market return data retrieved from Kenneth French's data library, specifically the "Developed Markets" dataset. This dataset encompasses all 22 developed markets included in our study, providing a comprehensive benchmark for comparison. Market premium is the return on a region's value-weight market portfolio minus the U.S. one-month T-bill rate (French, n.d.). In this case, this means the global aggregate market premium. Additionally, the total sin portfolio's performance was matched against the risk factor data, such as market premium, size, and value, from the same "Developed Markets" dataset to comprehensively analyse its risk-adjusted returns.

Each regional sin portfolio was benchmarked against region-specific market proxies and matched with corresponding risk factor data. The market proxies and risk factor data were retrieved from Kenneth French's data library for their respective regions: "North

America," "Europe," "Japan," and "Asia-Pacific (ex. Japan)". These regional datasets include country-specific market proxies and risk factors for their corresponding regions. For example, the market proxy for the 'North America' portfolio represents the combined return of the value-weighted market portfolios of the U.S. and Canada.

Figure 4.4 illustrates the cumulative returns for the total and regional market proxies, as retrieved from Kenneth French's Data Library.

Figure 4.4: Cumulative Return of Market Proxies by Region



Note: This figure shows the total return of each regions market proxy. The global market proxy has delivered a cumulative return of 310% from January 2000 to December 2023, while the regional proxies range between 68% (Japan) and 442% (North America).

4.3 Asset Pricing Models

This section introduces the regression models used to analyze the performance of the stocks in our portfolios. Rooted in asset pricing theory, these models aim to predict the prices of financial assets and are widely used in literature. While their detailed mechanics are not in the scope of this thesis, we will briefly discuss their origin and highlight the key factors included in each model. Finally, we will express the asset pricing models in regression form to facilitate our analyses.

The factor models stem from the Capital Asset Pricing Model (CAPM), considered the cornerstone of asset pricing theory. The CAPM shows how an asset's expected returns are determined by its systematic risk relative to the market (Lintner, 1975; Mossin, 1966; Sharpe, 1964). Over time, research uncovered additional factors influencing asset prices, leading to their inclusion in newer models. The Fama-French three-factor model (FF3) introduced the size and value factors (Fama & French, 1993). Later, the momentum effect was incorporated into the Carhart four-factor model (C4F) (Carhart, 1997). Further, the impact of the investment and profitability factors on stock returns formed the basis of the Fama-French five-factor model (FF5) (Fama & French, 2015). Adding momentum to this model creates the augmented Fama-French five-factor model (FF5 + WML), offering the most comprehensive framework for analyzing asset prices.

Identifying the factors that explain asset price movements is only part of the analysis. To determine whether sin stocks generate excess returns, we measure the mispricing of stocks by Jensen's Alpha (hereafter alpha), which captures the difference between an asset's actual return and the return predicted by the asset pricing models (Jensen, 1968). The alpha (α) reveals any returns unexplained by the risk factors included in the model.

To conduct regression analyses on the asset pricing models, they must be written in regression form. This implies that the asset pricing models must be expressed as linear equations where the dependent variable - excess returns - is explained by one or more independent variables - the risk factors - alongside an error term. In this framework, alpha (α) is expected to equal zero if the multifactor model fully captures the drivers of stock returns. A significant alpha, however, indicates that the model fails to fully explain the cross-sectional differences in returns.

The general regression equation for asset pricing models that regress excess returns, can be expressed in the following way:

$$R_{i,t} - R_{f,t} = \alpha_i + \sum_{k=1}^{K} \beta_{i,k} F_{k,t} + \varepsilon_{i,t}$$

Where:

$R_{i,t} - R_{f,t}$ = The excess return of asset i over the risk-free rate R_f at time t

α_i = Jensen's Alpha for asset i

$\beta_{i,k}$ = The exposure to the risk factors

$F_{k,t}$ = The risk factors (e.g., $R_m - R_f$, SMB, HML, etc.)

$\varepsilon_{i,t}$ = The error term for asset i at time t

See Appendix A.3 for an overview of the included risk factors and the different asset pricing models written in regression form.

Although the asset pricing models are widely applied in finance, they are not without flaws. Over time academics have critically examined their shortcomings, shedding light on the constraints and potential biases affeting their accuracy and applicability. A major critique is that despite incorporating multiple factors, these models still often leave much of the cross-sectional variations unexplained (Lewellen et al., 2010). Moreover, the models operate under market efficiency assumptions (Fama, 1970) and do not account for market anomalies and irrational investor behavior, which can cause them to fall short in capturing real-world dynamics. Despite these limitations, they remain foundational in financial research, and are widely applied in the literature. Accordingly, we employ these models in our analysis, while recognizing the need for caution when interpreting results.

5 Analysis

In this section, we present the results of our analysis, focusing on the performance of sin stock portfolios and difference portfolios across global and industry-specific markets. We provide a detailed analysis of each portfolio, including descriptive statistics and regression outputs. Through this analysis, we aim to address our hypotheses by providing insights into the characteristics and behavior of sin stock returns.

5.1 Descriptive Statistics

This section presents the descriptive statistics for the total and industry-specific sin portfolios and their respective comparable portfolios. The focus is on understanding the main fundamental characteristics of the portfolios, such as average returns, standard deviations, minimum- and maximum observations, and Sharpe ratios. These characteristics give fundamental insights to the risk-return dynamics of the portfolios.

5.1.1 Total Portfolios

Descriptive Statistics

Table 5.1 shows descriptive statistics of the value-weighted total sin portfolio, the comparable portfolio, and the market proxy. The statistics are based on monthly returns from January 2000 to December 2023.

Table 5.1: Descriptive Statistics for Total Portfolios

Portfolio	Sharpe Ratio (Ann.)	Mean Return (Mon.)	Mean Return (Ann.)	Standard Deviation (Mon.)	Min Return (Mon.)	Max Return (Mon.)	Cumulative Return
Sin	0.62	0.92%	11.63%	4.57%	-16.23%	17.15%	941.20%
Comparable	0.52	0.68%	8.42%	3.68%	-14.67%	11.10%	472.35%
Market Proxy	0.36	0.60%	7.41%	4.59%	-19.43%	13.35%	309.76%

Note: This table shows descriptive statistics for the total sin portfolio, the total comparable portfolio, and the global market proxy. The Sharpe ratio (Ann.) is annualized based on excess monthly returns over the risk-free rate, by multiplying the monthly Sharpe Ratio with the square root of 12. Mean return (Mon.) and standard deviation (Mon.) are calculated monthly, while the mean return (Ann.) is the annualized average return. Cumulative returns are the total return achieved across the time series. Min return (Mon.) and max return (Mon.) are the lowest and highest returns observed in the portfolio within a single month.

The descriptive statistics highlight the sin portfolio's consistent performance across all metrics, showcasing its potential appeal to investors. With the highest Sharpe ratio, the sin portfolio delivers the highest risk-adjusted returns compared to the comparable and market portfolios.

This translates to both returns and standard deviations. Sin stocks achieve annualized returns of 11.63%, well above the comparables at 8.42% and the market at 7.41%. The sin portfolio balances high returns with moderate levels of risk, while the comparables offer greater stability due to their more diversified holdings. In contrast, the market proxy reflects its broad exposure to diverse industries, including more volatile sectors, leading to modest returns and relatively higher risk.

These risk-return dynamics are also reflected in the maximum and minimum returns. The sin portfolio stands out for its potential to deliver high rewards, although with notable risks. Interestingly, its worst losses are smaller than those of the broader market, hinting at better downside protection. Meanwhile, the comparables once again demonstrate their stability. With lower minimum returns than the sin portfolio, they appear more defensive than their sinful counterparts. However, this stability comes at the expense of less potential for substantial gains.

However, the true appeal of the sin portfolio emerges in its cumulative returns. With an impressive cumulative return of 941.20%, it far outpaces both the comparables and the market proxy. This stark difference highlights the long-term return of investing in sin stocks, despite their controversial nature. For an illustration of the cumulative returns over the whole time series see Figure B.1 in the Appendix.

The impressive performance of the sin portfolio raises intriguing questions about the factors driving its higher returns. While the comparable portfolio shares some traits with sin stocks, it lacks the distinctive return profile that sets the sin portfolio apart, hinting at the possibility of a unique premium. For investors prioritizing maximum returns, the sin portfolio's long-term outperformance is hard to ignore. However, ethical or social considerations may steer others toward less controversial alternatives, such as the comparables portfolio. Although the sin portfolio appears compelling, descriptive statistics alone are insufficient to fully capture the complexities of the risk-return dynamics.

5.1.2 Industry Portfolios

The impressive returns of the sin portfolio prompted a closer examination of the individual sin industries, to explore potentially different underlying effects among them. Analyzing the industries separately allows us to better identify specific characteristics that set them apart.

Descriptive Statistics

Table 5.2 shows the descriptive statistics of the value-weighted sin and comparable portfolios for the individual sin industries of alcohol, gambling, and tobacco, as well as the market proxy. The statistics are based on monthly returns from January 2000 to December 2023.

Table 5.2: Descriptive Statistics for Industry Portfolios

Portfolio	Sharpe Ratio (Ann.)	Mean Return (Mon.)	Mean Return (Ann.)	Standard Deviation (Mon.)	Min Return (Mon.)	Max Return (Mon.)	Cumulative Return
Alcohol	0.54	0.83%	10.44%	4.61%	-18.33%	19.75%	701.67%
Alcohol Comparable	0.48	0.68%	8.47%	4.01%	-18.03%	10.55%	457.15%
Gambling	0.35	0.88%	11.02%	7.70%	-31.81%	33.37%	421.57%
Gambling Comparable	0.38	0.68%	8.53%	5.12%	-24.28%	17.78%	386.30%
Tobacco	0.72	1.18%	15.13%	5.36%	-16.25%	21.32%	1860.06%
Tobacco Comparable	0.61	0.71%	8.97%	3.41%	-12.22%	10.49%	558.41%
Market Proxy	0.36	0.60%	7.41%	4.59%	-19.43%	13.35%	309.76%

Note: This table provides descriptive statistics for industry-specific portfolios, including Alcohol, Gambling, Tobacco, their comparable portfolios, and the global market proxy. The Sharpe ratio (Ann.) is annualized based on excess monthly returns over the risk-free rate, calculated by multiplying the monthly Sharpe Ratio by the square root of 12. Mean return (Mon.) and standard deviation (Mon.) are calculated monthly, while the mean return (Ann.) is the annualized average return. Cumulative returns are the total return achieved across the time series. Min return (Mon.) and max return (Mon.) reflect the lowest and highest returns observed in a single month.

When examining the individual industry portfolios, sin stocks consistently outperform their comparables and the market. All industries, except gambling, show higher Sharpe ratios than their comparable portfolios, likely linked to their elevated risk. Similar to the total portfolios, the sin industries demonstrate higher returns, though with higher standard deviations.

The tobacco industry stands out, offering particularly high returns while maintaining moderate risk levels compared to other industries. This suggests that tobacco companies may exhibit especially strong sin effect characteristics. Once again, the market underperforms the sin and comparable portfolios, emphasizing the strong performance of these stocks.

When inspecting the maximum and minimum values, the gambling portfolio stands out with its highest and lowest returns of 33.37% and -31.81%. The wider gap between the maximum and minimum may reflect the industry's cyclical nature with its performance closely tied to economic conditions and consumers' disposable income. With higher volatility, the gambling industry showcases its potential for significant gains but also substantial losses compared to the more stable alcohol and tobacco industries. Meanwhile, the comparables consistently demonstrate their stability, with narrower ranges between their highest and lowest monthly returns.

Despite the gambling industry's highest monthly maximum return, the clear standout in the cumulative returns is the tobacco industry - boasting an impressive cumulative return of 1860% over our time frame. The sizable gap between the tobacco and comparable portfolios invites reflection on the unique factors driving these returns and suggests a significant premium inherent to tobacco stocks. Although not equally high, the alcohol portfolio also performs impressively, showcasing solid long-term growth with cumulative returns of 702% over the same period. The gambling portfolio also delivers respectable returns of 422%, slightly above its comparables.

The comparable portfolios consistently underperform their sin counterparts, highlighted by lower cumulative returns. Meanwhile, the market shows cumulative returns of 310% in the same period. These observations highlight the sin stocks' ability to deliver exceptional long-term returns, and prompts further exploration into whether there exists an underlying premium. For an illustration of the cumulative returns over the whole time series see Figure B.2 in the Appendix.

5.2 Regression Results

This section presents the results of our regression analyses, which analyze the sin premium through established asset pricing models. We begin by exploring our first hypothesis, investigating whether sin stocks generate a positive and significant alpha. Thereafter, we explore our second hypothesis, analysing whether sin stocks generate a positive and significant alpha when compared to a comparable portfolio of non-sin stocks, isolating a potential "sin effect".

H_1: The sin stock portfolio generates a positive and statistically significant alpha.

5.2.1 Total Sin Portfolio

We begin by analyzing the regression results for the total sin portfolio. The analysis provides insight into how sin stocks perform over the risk-free rate and helps identify the factors contributing to any observed excess returns. The results are summarized in Table 5.3 below.

Table 5.3: Regression Results for the Total Sin Portfolio

	Dependent variable:			
	$(R_{\text{Sin},t} - R_{f,t})$			
	FF3	Carhart	FF5	FF5 + WML
Intercept (Alpha)	0.293*	0.235	−0.135	−0.139
	(0.162)	(0.168)	(0.148)	(0.151)
Mkt-Rf	0.794***	0.827***	0.935***	0.937***
	(0.035)	(0.038)	(0.037)	(0.037)
SMB	−0.013	−0.056	0.250***	0.243***
	(0.093)	(0.094)	(0.082)	(0.085)
HML	0.380***	0.411***	0.122	0.132
	(0.072)	(0.073)	(0.084)	(0.100)
RMW			0.730***	0.727***
			(0.127)	(0.124)
CMA			0.501***	0.490***
			(0.132)	(0.147)
WML		0.096*		0.012
		(0.055)		(0.051)
Observations	288	288	288	288
R^2	0.646	0.652	0.717	0.717
Adjusted R^2	0.642	0.647	0.712	0.711

*Note: This table presents the regression results for the Total Sin Portfolio (excess returns over the risk-free rate) using four different factor models: Fama-French 3-Factor (FF3), Carhart 4-Factor (Carhart), Fama-French 5-Factor (FF5), and FF5 + Momentum. The dependent variable is the total risk portfolios ($R_{Sin,t}$) minus the risk-free rate ($R_{f,t}$). Coefficients for the risk factors are reported with robust standard errors in parentheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.*

At first glance, only the FF3 model exhibit a significant alpha. The three-factor model has an alpha of 0.293, statistically significant at the 10% level. This suggests that sin stocks deliver monthly excess returns of 0.293% after accounting for the market premium, size, and value factors. As more factors are added to the model, the alpha disappears, in line with the findings of Blitz and Fabozzi (2017). When the profitability (RMW) and investment (CMA) factors are included in the FF5 model, the alpha remains insignificant and becomes negative. This implies that the sin stock excess returns can largely be explained by known risk factors, not market inefficiencies or unobserved risks.

The market premium (Mkt - Rf) coefficient is positive and statistically significant across

all models. It increases from 0.794 in the FF3 model to 0.937 in the augmented FF5 model and is consistently significant at the 1% level. The positive coefficient suggests the sin portfolio tends to move in the same direction as the market; when the market premium rises, the sin portfolio's returns also tend to rise. Such behavior is expected, as most stock portfolios – whether sinful or not – exhibit positive market exposure (Sharpe, 1964).

Although no apparent effect can be traced to the size factor (SMB) in the simpler factor models, it is positive and statistically significant in the FF5 models. The positive coefficient suggests that for every 1% increase in the return spread between small and large-cap stocks, the excess return of the sin portfolio will increase by approximately 0.25% per month on average. The shift to positive coefficients suggests that sin stocks likely include a bias toward small-cap firms when the profitability (RMW) and investment (CMA) factors are accounted for.

In other words, when small-cap stocks perform well, sin stocks tend to benefit as well, hinting at the presence of small-cap characteristics in the sin portfolio. In light of our data, it is reasonable to expect that part of the sin portfolio's excess returns is driven by small-cap stocks, which are particularly prevalent in the alcohol and gambling industries. Although the literature does not explicitly discuss small-cap tendencies among sin stocks, our findings align with the well-documented size effect (Banz, 1981), where smaller firms tend to generate higher returns. This finding provides a plausible explanation for some of the excess returns observed in sin portfolios, particularly in the alcohol and gambling sectors.

The regression results reveal that the value factor (HML) significantly impacts the sin stock excess returns in the simple models but becomes negligible as additional factors are introduced. In the FF3 and Carhart models, the coefficients are positive at 0.380 and 0.411, respectively, and statistically significant at the 1% level. This suggests that the sin stock portfolio generates higher excess returns when high book-to-market (value) stocks outperform low book-to-market (growth) stocks. Thus, the positive HML coefficient implies that sin stocks may share characteristics with value stocks. This aligns with the findings of Hong and Kacperczyk (2009), who argue that the high book-to-market values of sin stocks stem from their systematic undervaluation by institutional investors.

However, in the FF5 models, the value factor (HML) weakens and loses significance,

suggesting that its effects are absorbed by the profitability (RMW) and investment (CMA) factors. Value stocks are often characterized by high operational profitability and conservative reinvestment strategies due to their established market positions. These shared characteristics create correlations between the risk factors, likely redistributing explanatory power from HML to RMW and CMA.

This interpretation aligns with Fama and French (2015), who identify multicollinearity among these factors and find that including RMW and CMA in the FF5 models reduces the explanatory power of HML. To validate this, we constructed a correlation matrix illustrated in Appendix A.4, which confirms the presence of multicollinearity between HML and CMA, supporting this conclusion. Importantly, the shift in significance from HML to CMA does not undermine our results; instead, it underscores the enhanced precision of the FF5 model in capturing the drivers of sin stock returns. Additionally, this shift allows the size effect (SMB) to become more pronounced within the model.

In summary, the HML coefficient is significant in simpler models, highlighting the value stock characteristics of sin stocks. This aligns with expectations, as value stocks typically exhibit high operational profitability and established market positions. However, as additional factors are introduced, the HML coefficient loses significance, as the variations in sin stock excess returns being better explained by the correlated RMW and CMA factors.

Turning to the factors unique to the FF5 model, the profitability (RMW) and investment (CMA) factors display strong, positive, and statistically significant coefficients. First, the RMW factor suggests that the sin portfolio's excess returns increase by 0.730% monthly, driven by their high operational profitability. In line with existing literature, we believe the high operational profitability can be attributed to the combination of inelastic demand, strong cash flows, and resilience to economic downturns (Fabozzi et al., 2008; Hong & Kacperczyk, 2009).

Similarly, the CMA coefficient shows that sin stocks with conservative investment strategies are predicted to achieve an additional 0.5% excess monthly returns. The positive coefficient suggests that sin stocks are linked to conservative investment practices, likely due to their strong positions in mature industries, that reduce the need for aggressive expansion (Blitz & Fabozzi, 2017). This notion is also supported by Fabozzi et al. (2008), who argue that

regulatory scrutiny and social opposition pressure sin stock firms to adopt risk-averse strategies, prioritizing efficiency and profitability over aggressive expansion. This cautious approach, combined with high operational profitability, underpins the stable financial performance of sin stocks, as reflected in the regression results.

Momentum, a key driver in many asset classes, plays only a marginal role in the performance of sin stocks. Significant only in the Carhart model, the WML coefficient suggests that past winners earn 0.096% monthly excess returns in the short term. However, this effect is only significant at the 10% level, indicating a mild or no momentum effect. This implies that recent winners or losers do not influence sin stock returns heavily. Instead, the limited momentum impact indicates that sin stock performance is more stable and less influenced by short-term trends.

Although the momentum effect has been recognized as a global phenomenon (Asness et al., 2013), the evidence for its impact on sin stocks suggests otherwise. According to Moskowitz and Grinblatt (1999), stable and regulated industries like tobacco and alcohol tend to exhibit weaker momentum effects. However, the gambling industry may be an exception. Its increasing reliance on online platforms, dependence on technological innovation, and sensitivity to disposable income create conditions that could support stronger momentum effects in this industry.

The model's goodness-of-fit is measured by the R^2 and adjusted R^2 values, which describe how well the independent variables explain the variation in the model's dependent variable (Wooldridge, 2020). While the R^2 increases as more factors are added, the adjusted R^2 accounts for the number of predictors, ensuring the model does not become overfitted by penalizing unnecessary variables.

In the regression models, adding the profitability (RMW) and investment (CMA) factors improves the explanatory power, whereas the momentum factor (WML) has only a marginal effect. As the augmented FF5 with momentum is the most comprehensive model, it is the one we choose to utilize for further analysis of the industry-specific portfolios. With an adjusted R^2 of 0.711, the augmented FF5 model provides a good balance between explanatory power and parsimony.

5.2.2 Industry Sin Portfolios

To deepen our understanding of the drivers behind the excess returns in the total sin portfolio, we found it valuable to analyse each sin industry individually. This approach allows for a closer examination of the unique characteristics and return drivers of each industry. Sin industries are not uniform; some demonstrate distinct trends or stronger sensitivities to specific risk factors, making it valuable to explore these variations further.

In this regression, the dependent variable represents the excess returns for each industry portfolio, calculated as the portfolio's monthly returns minus the monthly risk-free rate. The regression results for each separate sin industry portfolio is summarized in Table 5.4.

Table 5.4: Regression Results for the Industry Sin Portfolios

	Dependent variable:		
	$(R_{\text{SinIndustry},t} - R_{f,t})$		
	Alcohol	Gambling	Tobacco
Intercept (Alpha)	−0.224	−0.152	0.145
	(0.177)	(0.273)	(0.263)
Mkt-Rf	0.888***	1.286***	0.819***
	(0.053)	(0.070)	(0.056)
SMB	0.263**	0.985***	−0.150
	(0.107)	(0.157)	(0.153)
HML	0.056	0.293*	0.139
	(0.111)	(0.162)	(0.183)
RMW	0.896***	0.574***	0.590***
	(0.133)	(0.198)	(0.207)
CMA	0.405**	−0.079	0.817***
	(0.158)	(0.229)	(0.267)
WML	0.031	−0.251***	0.061
	(0.063)	(0.085)	(0.091)
Observations	288	288	288
R^2	0.622	0.689	0.400
Adjusted R^2	0.614	0.683	0.387

*Note: This table presents the regression results for the Industry-Specific Sin Portfolios (excess returns over the risk-free rate) using the augmented FF5 model with momentum. The dependent variable is the return of the industry-specific sin portfolio ($R_{SinIndustry,t}$) minus the risk-free rate ($R_{f,t}$). Coefficients for the risk factors are reported with robust standard errors in parentheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.*

Alphas are insignificant across all industries after accounting for all risk factors. The lack of a significant alpha is consistent also for the industries individually, supporting the idea that the sin stock performance is explained by the exposure to systematic risk factors rather than a sin effect.

All the industries show significant market risk premium factors at the 1% level, showing that exposure to market conditions can explain much of the excess returns for the separate sin industries. Meanwhile, there are differences between them. The gambling industry has a strong positive coefficient of 1.286, suggesting that this industry, in particular, has a positive market exposure. The positive coefficient suggests gambling stocks are more cyclical than the rest of the Triumvirate and perform better in good economic conditions. The coefficients for the alcohol and tobacco industries is positive, but slightly lower, indicating that these stocks are less sensitive to the market fluctuations. The reason for this is that they are more stable than gambling stocks. In line with our expectations, we believe this can be due to a higher relative volatility, as gambling companies are smaller and not as stable and mature as the tobacco and alcohol industries.

In line with our expectations based on the previous discussion, we can see that the alcohol and gambling stocks load positively on the size factor (SMB), while the tobacco stocks do not. The alcohol and gambling companies have a positive coefficient of 0.263 and 0.985 at a 5% and 1% significance level. This indicates that when small stocks perform well relative to large-cap stocks, the alcohol and gambling stocks perform 0.263% and 0.985% better monthly than the risk-free rent. Tobacco stocks, on the other hand, are not significantly affected by the size factor, most likely because larger, well-established firms dominate the industry. This suggests that, alcohol and gambling companies are dominated by more regional and niche firms, which contribute to higher returns but are also more risky, consistent with the size premium.

Although the gambling stocks are slightly significant, the other stocks have an insignificant exposure to the value effect (HML). A significance of 10% suggests a marginal positive tilt toward value characteristics for gambling stocks, meaning they have high book-to-market values, indicating they might be value stocks. The alcohol and tobacco industries show no strong value or growth tendencies. Thus, gambling may include some undervalued companies, while alcohol and tobacco do not show significant exposure.

All the sin stock industries showcase a strong positive exposure to the profitability factor (RMW). With all factors statistically significant at the 1% level, these stocks seem to have profitability as a key driver for their excess returns. The alcohol stocks have a particularly high coefficient, suggesting this industry is a slightly more profitable than the other Triumvirate industries.

For the investment factor, we can again spot discrepancies between the sin stock industries. Alcohol and tobacco stocks are associated with conservative investment behaviors, thus loading positively on the CMA factor. Especially tobacco stocks are strongly conservative, investing less aggressively in new projects, as indicated by the coefficient of 0.817 at a 1% level of significance. The gambling stocks, on the contrary, do not exhibit any significant investment behavior – either conservative or aggressive – as they have an insignificant coefficient. In line with our expectations, we believe the tobacco and alcohol companies have more conservative investment strategies as they are more stable and well-established, compared to gambling stocks that don't present any effects in particular.

Also for the momentum factor, the gambling stocks stand out. With a coefficient of -0.251 on a 1% significance level, gambling stocks exhibit a momentum effect. The alcohol and tobacco industries show no significant coefficients, thus not experiencing any momentum effect. Momentum in gambling stocks may reflect speculative behavior or investor sentiment, while alcohol and tobacco, being more defensive, do not rely on momentum trends. In line with our earlier argument, as gambling stocks are more exposed to trends, this can also contribute to the positive loading on the momentum factor.

Inspecting the R^2 values, the models for the alcohol and gambling industries showcase higher explanatory power (> 0.6) than the tobacco industry - indicating the models better explain the excess returns in these industries. These values suggest that while the risk factors explain much of the variation, there are additional industry-specific risks or characteristics that the model does not capture.

H_2: The sin stock portfolio generates a positive and statistically significant alpha when compared to a comparable portfolio of non-sin stocks.

5.2.3 Total Difference Portfolio

The results from the total sin portfolio show no significant alpha, except in the FF3 model, providing little evidence of a sin premium. In the following section, we compare sin stocks to their most similar non-sin counterparts using the difference portfolio. This long-short portfolio isolates potential sin-specific characteristics by taking a long position in sin stocks and a short position in comparables, as outlined in section 4.1.5. Given the general lack of significant alpha in the total sin portfolio, we expect similar results here, but this comparison allows us to more confidently determine whether any excess returns are uniquely tied to the sinful nature of these stocks – a so-called "sin effect". Table 5.5 below shows the regression output of the total difference portfolio.

Table 5.5: Regression Results for the Total Difference Portfolio

	Dependent variable:			
	$(R_{\text{Sin},t} - R_{\text{Comparable},t})$			
	FF3	Carhart	FF5	FF5 + WML
Intercept (Alpha)	0.148	0.098	0.049	0.027
	(0.140)	(0.140)	(0.144)	(0.141)
Mkt-Rf	0.089***	0.117***	0.114***	0.129***
	(0.034)	(0.035)	(0.038)	(0.038)
SMB	0.063	0.027	0.122	0.077
	(0.081)	(0.081)	(0.084)	(0.084)
HML	0.171***	0.197***	0.143	0.204**
	(0.053)	(0.053)	(0.090)	(0.095)
RMW			0.200*	0.180
			(0.116)	(0.110)
CMA			0.036	−0.026
			(0.133)	(0.136)
WML		0.081*		0.074
		(0.049)		(0.050)
Observations	288	288	288	288
R^2	0.063	0.078	0.079	0.090
Adjusted R^2	0.053	0.065	0.062	0.070

*Note: This table presents the regression results for the Total Difference Portfolio (Sin portfolio excess returns over the total comparable portfolio) using four different factor models: Fama-French 3-Factor (FF3), Carhart 4-Factor (Carhart), Fama-French 5-Factor (FF5), and FF5 + Momentum. The dependent variable is the sin portfolios return ($R_{Sin,t}$) minus the comparable portfolios return ($R_{Comparable,t}$). Coefficients for the risk factors are reported with robust standard errors in parentheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.*

The regression results for the total difference portfolio reveal no statistically significant alpha across any factor models, suggesting that the sin portfolio's excess returns are fully explained by the included risk factors when compared to their non-sin counterparts. These results imply that the so-called "sin effect" may not exist at all or has diminished over time since previous research on the topic.

These results go against the findings of Hong and Kacperczyk (2009), who did find significant alphas for the FF3 and Carhart models when utilizing the same long-short strategy with the sin and comparable portfolios. However, they align with the more recent

findings of Blitz and Fabozzi (2017) who, while not utilizing a comparable portfolio, still failed to isolate significant alpha in sin stocks when introducing new risk factors.

We do however see that the market premium (Mkt-Rf) remains significant and positive across all models, indicating that the difference portfolio retains exposure to broader market movements. This would suggest that the excess returns generated by the sin stocks is partly due to their stronger exposure to the market movements. The size factor (SMB) loses significance in the difference portfolio, implying no distinct size effects between the sin and comparable portfolios. The value factor (HML) is significant in three of the models, highlighting a greater tilt toward value stocks within the sin portfolio relative to its comparables. The profitability factor (RMW) is significant and positive, suggesting a stronger exposure to profitable firms for sin stocks compared to their counterparts, while the investment factor (CMA) and momentum factor (WML) show no consistent significance.

Although we see that some of the excess returns generated by the sin stocks over their comparables are explained by their higher exposure to the market and the value factor, we cannot say with confidence that there is a sin effect present. It is important to note that all the models adjusted R^2 are significantly lower than our models for the total sin portfolio, at just 0.070 for the most comprehensive model (FF5 + WML). This indicates that the models explain only a small portion of the variance in the difference portfolios returns, even when including all available risk factors.

5.2.4 Industry Difference Portfolios

To identify variations in the difference portfolio driven by industry-specific factors, we analyze the industry-specific difference portfolios for alcohol, gambling, and tobacco. Table 5.6 below presents the regression outputs, offering insights into how these industries differ in their factor exposures and performance relative to their comparable portfolios.

Table 5.6: Regression Results for the Industry Difference Portfolios

	Dependent variable:		
	$(R_{\text{SinIndustry},t} - R_{\text{CompIndustry},t})$		
	Alcohol	Gambling	Tobacco
Intercept (Alpha)	−0.084	−0.004	0.286
	(0.211)	(0.273)	(0.241)
Mkt-Rf	0.220***	0.283***	0.113*
	(0.065)	(0.074)	(0.059)
SMB	0.427***	0.570***	−0.255*
	(0.127)	(0.165)	(0.145)
HML	0.259*	0.311**	0.234
	(0.144)	(0.148)	(0.164)
RMW	0.228	0.198	−0.039
	(0.157)	(0.183)	(0.201)
CMA	−0.344*	−0.471**	0.249
	(0.206)	(0.234)	(0.238)
WML	0.084	−0.064	0.037
	(0.076)	(0.100)	(0.081)
Observations	288	288	288
R^2	0.156	0.191	0.080
Adjusted R^2	0.138	0.174	0.060

*Note: This table presents the regression results for the Industry-Specific Difference Portfolios (excess returns over Industry-Specific Comparable Portfolios) using the augmented FF5 model with momentum. The dependent variable is the return of the industry-specific sin portfolio ($R_{SinIndustry,t}$) minus the corresponding industry's comparable portfolio return ($R_{CompIndustry,t}$). Coefficients for the risk factors are reported with robust standard errors in parentheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.*

When analyzing the industry-specific difference portfolios, alphas remain insignificant across all three sin industries, suggesting no unique "sin effect" at the industry level. The market premium is significant for all industries, with gambling exhibiting the highest coefficient, reflecting its greater sensitivity to market movements. Conversely, tobacco is the least impacted, suggesting a more defensive profile.

The size factor (SMB) is significant across all industries, with alcohol and gambling showing strong positive coefficients due to their smaller average firm sizes. In contrast, tobacco exhibits a weaker and negative size effect, consistent with its larger and more established firms compared to its comparable industry. The value factor (HML) is significant for

alcohol and gambling, indicating a stronger tilt toward value stocks in these industries, but remains insignificant for tobacco.

The profitability factor (RMW) and investment factor (CMA) exhibit mixed results. While profitability is insignificant for all industries, investment is significant and negative for alcohol and gambling, indicating greater exposure to aggressive investment strategies, whereas tobacco shows no significance. Lastly, the momentum factor (WML) is insignificant across all industries, consistent with findings from the total difference portfolio.

The goodness-of-fit varies significantly by industry. While alcohol and gambling show moderate explanatory power (Adjusted R^2 around 0.14 to 0.17), the tobacco difference portfolio exhibits a very low adjusted R^2, indicating that much of the return differences remain unexplained by the included risk factors.

5.3 Other Considerations

5.3.1 Regional Sin Stock Portfolios

The inclusion of the regional sin stock portfolios serves as an additional robustness check to validate the findings of our main analysis. The regression output can be found in Appendix B.2 and align with the analysis of the total sin portfolio, with all regions being tested on the FF3, Carhart and FF5 models to show how they change similarly to our main analysis.

When running the FF3 model on regional sin portfolios, we find significant alphas in the returns in excess of the risk-free rate for both North America and Europe. This aligns with the main analysis which also found significant alpha in the total sin portfolio using the FF3 model. However, neither the regions of Asia-Pacific ex. Japan and Japan exhibit significant alpha, likely due to their lower number of stocks compared to Europe and North America, making it hard to draw meaningful standalone inferences from these regions.

When we extend the analysis to the Carhart model, the significant alpha in Europe disappears, leaving only the North American sin stocks with significant alpha. This North American alpha however, disappears completely when introducing the new risk factors

from the FF5 model. This would suggest, in line with our main analysis, that the observed alpha from the simpler models is caused by omitted risk factors rather than a true sin premium associated with the sin stocks. These results also show similarities with the findings of Hong and Kacperczyk (2009), considering the significant alphas found when testing the FF3 and Carhart models.

5.3.2 Returns in Excess of the Market Proxy

We considered analysing the sin portfolios excess return over the market proxy ($R_{\text{Sin}} - R_{\text{Mkt}}$), as done in Blitz and Fabozzi (2017), but ultimately deemed it to not add any value to our thesis. Our method utilizing the excess returns over the risk-free rate and the comparable portfolio, similarly to Hong and Kacperczyk (2009), allow us to evaluate both the absolute and relative excess returns in line with our two main hypothesises. Adding yet another analysis was thus deemed redundant.

6 Discussion

This section reflects upon the findings of our analysis, contextualising them within the previous literature on the topic of sin returns and explore potential implications for investors. As our analysis found no proof of a "sin effect" or significant alphas across most models, we also focus on summarizing the risk factors introduced by newer multifactor models that explain the excess return of the sin portfolios.

As discussed at the start of this thesis, previous academic ventures focus on different areas of the sin stock return. While the publications of Hong and Kacperczyk (2009) and Fabozzi et al. (2008) identify a sin premium and thus focus on identifying which factors might cause this premium, other publications such as Blitz and Fabozzi (2017) reject the existence of a sin effect, explaining the excess returns by simply including the newest risk factors introduced in the Fama-French five-factor model. Our analysis falls more in line with the latter.

Our total sin portfolio showed a significant and positive alpha in the FF3 model. While this might be seen as an early indication that the sin stocks may provide excess returns above what could be explained by common risk factors, this was quickly disproven by the implementation of the momentum-, profitability- and investment factors in the Carhart and FF5 models.

Most notably, beyond the market premium and size-factor, most of the excess returns could be attributed to the portfolios toward firms with high profitability and conservative investment strategies. This is in line with the observation that many of the traditional "sinful" firms included in our total sin portfolio are more established, mature companies with high margins, stable cash flows and an inelastic consumer base. Notably, even without explicitly including the Betting Against Beta (BAB) factor highlighted in the work of Blitz and Fabozzi (2017), we arrived at a similar conclusion. This reinforces their argument that profitability and conservative investment are key drivers of excess returns, suggesting the idea that the so-called "sin effect" may not be inherent to the moral ambiguity of the sin stocks, but rather tied to their financial characteristics.

In order to expand upon Blitz and Fabozzi (2017) we also analysed the difference portfolio, similarly to Hong and Kacperczyk (2009). None of our models could establish significant

alpha in the excess return of the sin portfolio above the returns of the comparable portfolio. The most relevant risk factors for explaining these returns were the market premium, suggesting that the sin portfolio is more impacted by changes in the market premium than the comparable portfolio, and the value factor. As for the latter, this would indicate that the sin portfolio is more exposed towards value stocks than their peers.

However, caution should be taken when interpreting these results. While the models for the difference portfolio offer some insights into the relative performance of sin stocks, their explanatory power is low. The adjusted R^2 values for these models ranged between 0.052 (FF3) and 0.07 (FF5 + WML), indicating a limited ability to fully explain the excess return over its comparables.

The discrepancy between our findings and those of Hong and Kacperczyk (2009) likely stems from temporal, contextual, and methodological differences. Their study spans 1965–2006, while ours focuses on 2000–2023, reflecting modern market dynamics and other societal attitudes. Hong and Kacperczyk attribute underpricing to institutional investor avoidance, particularly among banks and insurance companies, while mutual funds and hedge funds act as natural arbitrageurs. However, the rise of socially responsible investing and increased market transparency may have reduced pricing inefficiencies over time.

Additionally, their analysis focuses primarily on the U.S. market, which may explain part of the divergence. They also include a separate portfolio of select European countries and Canada, which also showed evidence of a sin premium. In our regional robustness check, significant alphas for North America under the FF3 and Carhart models disappeared with the FF5 model, suggesting newer risk factors account for the excess returns. A similar pattern emerged in Europe: while initial alphas were significant under FF3, they vanished with the Carhart and FF5 models. This indicates that the sin premium observed in their studies may have been specific to the U.S., and possibly to Europe, and thus diluted when including other developed markets with differing cultural and regulatory conditions.

Methodological differences further explain the variance. While Hong and Kacperczyk rely on the FF3 and Carhart models, our study incorporates the FF5 and augmented FF5 models, where additional factors such as profitability and investment explain much of the variation in returns. Our findings thus aligns more with Blitz and Fabozzi (2017), who also argue that excess returns are driven by the financial characteristics of sin stocks

rather than their sinful nature.

Although we find no evidence of a sin premium, it is indisputable that sin stocks still present a compelling investment alternative. As our results show, these companies significantly outperform both the market and their comparable stocks. Some of the characteristics that set these companies apart from others are their high profitability, defensive nature, established market positions, as well as cyclicality and growth opportunities. The sin stock universe offers a variability of investment cases with exposure to various factors that might suit different investors.

One of the most interesting factors is their market power. As seen from our results, sin stocks benefit from established market positions and high barriers to entry. This is especially prominent in the tobacco industry, which has shown remarkable resilience despite years of regulatory shifts and public scrutiny. Although the tobacco firms are not perfect monopolies, many of them do exhibit monopolistic attributes. On the other side, while Fabozzi et al. (2008) argue that alcohol and tobacco industries resemble oligopolies, our results show the opposite. While these industries likely hold large corporations with concentrated market power, our results also show that there is a considerable size-effect in these industries, highlighting the smaller companies in the sample. Nevertheless, the sin stocks' established positions pave the way for high profitability and stable cash flows, which have especially been characteristic in the alcohol industry. The stable cash flows combined with conservative investments lay the foundation for reliable dividend payments, letting investors reap the rewards beyond just the price appreciation of shares.

However, as we can see from our results, alcohol and gambling stocks also show small-cap firm tendencies, which typically offer higher potential returns. Smaller firms like niche regional breweries and growing online gambling platforms contribute to portfolios with high growth opportunities and higher portfolio returns, over what could be expected from the otherwise stable sin industries. Altogether, the sin stocks demonstrate unique return characteristics that catch the eye of any profit-seeking investor.

Although the sin stocks might prove profitable investment cases, they do, however, come at the cost of engaging in sinful activities. First and foremost, this exposes them to a variety of risks like litigation risk, headline risk, and public scrutiny risk (Fabozzi et al., 2008). But more importantly, the controversial activities introduce ethical considerations.

Despite being compelling investments, the literature has shown that ethically constrained investors systematically shun sin stocks (Hong & Kacperczyk, 2009). As mentioned in this paper's introduction, a specific example is Norway's Government Pension Fund Global (GPFG), which screens out companies engaging in controversial business activities. Such exclusions may prevent investors from benefiting from the strong financial performance often associated with sin stocks. Additionally, these ethical exclusions can impact portfolio performance and contribute to market inefficiencies such as systematical underpricing.

However, despite the arguments of Hong and Kacperczyk (2009) and Fabozzi et al. (2008), we can see that this underpricing does not translate to a sin premium. As our results show, the sin stocks are fairly priced and their returns can be explained by conventional risk factors. This highlights that this underpricing is likely corrected by the market, where less norm-constrained investors such as hedge funds balance out this market inefficiency.

7 Conclusion

This thesis investigates whether a "sin premium" exists in developed markets, focusing on sin stocks in the alcohol, tobacco, and gambling industries. Motivated by conflicting findings in previous literature, we analyse whether these stocks generate abnormal returns (alpha) that conventional risk factors cannot reasonably explain. Using a modern time frame (2000 - 2023) and contemporary factor models, we evaluate both global and industry-specific portfolios and compare the sin stocks to their non-sin counterparts by utilizing a difference portfolio. By doing so, we aim to determine whether the sin stock performance is tied to their inherent controversial nature, or explained by broader market forces.

Our thesis finds no evidence of a sin premium in modern developed markets. While simpler models do show significant alpha, this disappears when controlling for additional risk factors introduced by more comprehensive asset pricing models. The industry-specific analysis highlights unique characteristics that drive returns within each sin industry. Alcohol stocks exhibit strong profitability, gambling stocks display momentum effects and cyclicality, and tobacco stocks demonstrate value-stock traits and defensiveness. However, none of these industries generate significant abnormal returns. Additionally, when compared to non-sin comparables, sin stocks show no distinct "sin effect," suggesting their performance is driven by value and profitability characteristics rather than their controversial nature. These findings challenge the notion of a sin premium and emphasize the role of systematic risk factors in explaining sin stock returns.

Our thesis contributes to the existing literature by offering a comprehensive analysis of the sin premium in modern developed markets, bridging the methodological gaps and conflicting findings of earlier studies. By employing the contemporary FF5 model, in line with Blitz and Fabozzi (2017), and extending the analysis to a potential "sin effect" through difference portfolios, as done by Hong and Kacperczyk (2009), we provide a nuanced perspective on sin stock performance. Our findings challenge the conclusions of Hong and Kacperczyk (2009), suggesting that modern markets are efficient and that no sin premium exists.

The findings of this thesis carry practical implications for investors and theoretical insights for future research. For investors, the absence of a sin premium would suggest that

sin stocks should not be viewed as a distict asset class offering unique excess returns. Instead, their performance is largely explained by conventional risk factors. Nevertheless, industry-specififc characteristics, such as the defensiveness of tobacco stocks (Fabozzi et al., 2008) and the cycliality of gambling stocks (Hong & Kacperczyk, 2009), remain valuable insights for tailoring portfolios to specific risk preferences. Theoretically, our results challenge the notion that behavioral biases, such as aversion to sin industries, significantly influence modern asset prices. Instead, the findings reinforce the efficiency of contemporary financial markets (Fama, 1970), where returns are largely driven by systematic factors.

The thesis is limited to the Triumvirate of Sin (alcohol, tobacco and gambling) in developed markets in a modern timeframe, excluding other controversial industries, as well as regional and temporal dynamics which may offer additional insights. While we the established asset pricing models of Fama and French, alternative frameworks or factors such as ESG trends or consumer sentiment could provide further explanatory power. Future research on the topic could explore broader definitions of sin stocks, regional differences in emerging markets, broader time frames, or the impact of other societal factors.

In conclusion, this thesis challenges our research question and dispels the notion of a sin premium or a sin effect, showing that sin stocks succeed not because of their controversial nature but because of the same systematic factors driving all investments. You can in fact not "cash in" on sin. The decision to include them depends not on achieving alpha, but on aligning investment strategies with specific risk preferences and goals.

Declaration on the use of AI tools in the work on this master's thesis

Name (and version) of the AI tool: ChatGPT 4o

Purpose of using the tool: Code Assistance and Troubleshooting, Idea Generation, Suggestions for Section Structuring

Name (and version) of the AI tool: Grammarly (v1.2.114.1528)

Purpose of using the tool: Spelling, Grammar, Sentence Structuring

We are aware that we are responsible for all content of this master's thesis, including the parts where AI tools are used. We are responsible for ensuring that the thesis complies with ethical rules for privacy and publication.

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Appendix

A Data & Methodology

A.1 Regional Division of Global Developed Markets

Table A.1 presents the classification of countries into regions as defined by Kenneth French's data library (French, n.d.). The "Developed Markets" dataset encompasses the market premium and risk factors from all listed countries, while the regional datasets are derived from the countries specified for each region.

Table A.1: Markets by Region per Kenneth French's Data Library

Country	North America	Europe	Japan	Asia-Pacific
United States	X			
Canada	X			
United Kingdom		X		
Germany		X		
France		X		
Sweden		X		
Spain		X		
Italy		X		
Austria		X		
Denmark		X		
Greece		X		
Belgium		X		
Netherlands		X		
Finland		X		
Norway		X		
Portugal		X		
Ireland		X		
Switzerland		X		
Japan			X	
Australia				X
Hong Kong				X
New Zealand				X
Singapore				X

A.2 Monthly Return Calculations

This section explains the details behind our monthly return calculations, which utilize the Total Return Index (TRI) variable from Datastream. The TRI incorporates reinvested dividends and accounts for stock splits. Thus, the monthly return calculations utilized in our analysis are based on the following equation:

$$R_{i,t} = \frac{P_{i,t} + D_{i,t}}{P_{i,t-1}} - 1 \tag{A.1}$$

Where:

$R_{i,t}$ = Return of asset i in period t
$P_{i,t}$ = Price of asset i in period t
$D_{i,t}$ = Dividend of asset i in period t
$P_{i,t-1}$ = Price of asset i in period $t-1$

By using the Total Return Index, which already incorporates the reinvestment of dividends, we simplify the return calculation. The index itself serves as the price-inclusive-of-dividends term ($P_{i,t} + D_{t,1}$), meaning that the return can be directly calculated as:

$$R_{i,t} = \frac{TRI_{i,t}}{TRI_{i,t-1}} - 1 \tag{A.2}$$

Where:

$R_{i,t}$ = Return of asset i in period t
$TRI_{i,t}$ = Total Return Index of asset i in period t
$TRI_{i,t-1}$ = Total Return Index of asset i in period $t-1$

This approach aligns with the regular return formula, as the TRI inherently accounts for price changes ($P_{i,t}$) and dividends ($D_{i,t}$). The TRI variable was used as it includes both these values, which are critical for the calculation of the true returns of the stocks in our chosen time frame. By using the TRI, we maintain precision and ensure that our methods are transparent and replicable, as the calculations rely on a single variable readily available in Datastream.

A.3 Risk Factors & Regression Equations

Table A.2: Explanation of Risk Factors

Risk Factor	Name	Explanation
Mkt - Rf	Market Risk Premium	The asset's systematic risk relative to the overall market.
SMB	Small minus big	Returns of small-cap stocks minus returns of large-cap stocks. The size effect.
HML	High minus low	Returns of low book-to-market stocks minus returns of high book-to-market stocks. The value effect.
WML	Winners minus losers	Return of past high-performing stocks minus return of past low-performing stocks. The momentum effect.
CMA	Conservative minus aggressive	Return of stocks with conservative investments minus return of stocks with aggressive investments.
RMW	Robust minus weak	Returns of stocks with robust profitability minus returns of stocks with weak profitability.

The market risk premium compensates investors for bearing systematic risk, also known as non-diversifiable risk. Systematic risk includes factors like economic downturns, geopolitical events, and inflation—risks that cannot be eliminated through portfolio diversification (Lintner, 1975; Mossin, 1966; Sharpe, 1964).

The size effect captures the difference in returns between firms with small market capitalization and those with large market capitalization Banz (1981). Shows the effect where smaller firms tend to achieve higher average returns than larger firms.

The value factor shows the difference in returns between high book-to-market stocks and low book-to-market stocks. Fama and French (1992) found that stocks with high book-to-market ratios, so-called "value stocks", tend to outperform their counterparts with low book-to-market ratios, namely "growth stocks".

In their study, Jegadeesh and Titman (1993) found that stocks that performed well in the past 3 to 12 months used to continue performing well in subsequent periods and named this phenomenon the "momentum effect". The momentum factor is denoted as WML and addresses the effect where stocks that have performed well in the past tend to continue performing well in the short term, and vice versa.

Titman et al. (2004) and Novy-Marx (2013) examine the effects of respectively investments and profitability on stock returns. Research on the investment factor finds a negative relationship between firms' capital investments and future stock returns, indicating that firms investing heavily tend to have lower subsequent returns. Meanwhile, the profitability factor is a strong predictor for stock returns, suggesting that firms with higher operating profitability tend to have higher expected returns.

With the relevant risk factors in place, the asset pricing models can now be expressed in regression form. These regression equations measure excess returns as the dependent variable. The alpha α measures the systematic excess return over the model's prediction. All risk factors are accompanied by their β-coefficient, representing the excess returns' sensitivity to that risk factor. Finally, the regression equation has an error term ε_i, which measures purely random noise. Find below the asset pricing models employed in this analysis, written in regression form:

Fama-French Three-Factor Model

$$R_i - R_f = \alpha_i + \beta_{Mkt}(Mkt - R_f) + \beta_{SMB} \cdot SMB + \beta_{HML} \cdot HML + \varepsilon_i$$

Carhart Model

$$R_i - R_f = \alpha_i + \beta_{Mkt}(Mkt - R_f) + \beta_{SMB} \cdot SMB + \beta_{HML} \cdot HML + \beta_{WML} \cdot WML + \varepsilon_i$$

Fama-French Five-Factor Model

$$\begin{aligned} R_i - R_f = \alpha_i &+ \beta_{Mkt}(Mkt - R_f) + \beta_{SMB} \cdot SMB + \beta_{HML} \cdot HML \\ &+ \beta_{CMA} \cdot CMA + \beta_{RMW} \cdot RMW + \varepsilon_i \end{aligned}$$

Fama-French Five-Factor Model with Momentum

$$\begin{aligned} R_i - R_f = \alpha_i &+ \beta_{Mkt}(Mkt - R_f) + \beta_{SMB} \cdot SMB + \beta_{HML} \cdot HML \\ &+ \beta_{CMA} \cdot CMA + \beta_{RMW} \cdot RMW + \beta_{WML} \cdot WML + \varepsilon_i \end{aligned}$$

A.4 Sample Characteristics & Robustness

Several vital assumptions must be satisfied for valid OLS estimation, as per the Gauss-Markov theorem (Wooldridge, 2020). Although asset pricing models and real-world financial data may not always satisfy these assumptions, these models remain widely used in empirical research. To ensure reliable inference in the presence of potential heteroskedastic residuals, we employ robust standard errors in all our models. This approach, introduced by White (1980), adjusts standard error estimates to remain consistent even when the assumption of homoscedasticity is violated. Additionally, we include a Variance Inflation Factor (VIF) test and a correlation matrix of the independent variables, as these are relevant to the discussion in the analysis section.

Table A.3: Variance Inflation Factor (VIF) Results

	Mkt-Rf	**SMB**	**HML**	**RMW**	**CMA**	**WML**
FF3	1.025	1.047	1.049	–	–	–
Carhart	1.223	1.109	1.113	–	–	1.294
FF5	1.410	1.110	2.635	1.212	3.099	–
FF5 + WML	1.483	1.222	3.097	1.227	3.344	1.421

Note: The table shows the Variance Inflation Factors (VIFs) for the independent variables of our analysis across all models. No multicollinearity issues were detected, as all VIFs are below the critical threshold of 5.

Table A.4: Correlation Matrix of Independent Variables

	Mkt-Rf	**SMB**	**HML**	**RMW**	**CMA**	**WML**
Mkt-Rf	1.00	0.06	-0.12	-0.31	-0.40	-0.34
SMB	0.06	1.00	0.04	-0.29	-0.07	0.19
HML	-0.12	0.04	1.00	0.02	0.76	-0.22
RMW	-0.31	-0.29	0.02	1.00	0.15	-0.14
CMA	-0.40	-0.07	0.76	0.15	1.00	0.07
WML	-0.34	0.19	-0.22	-0.14	0.07	1.00

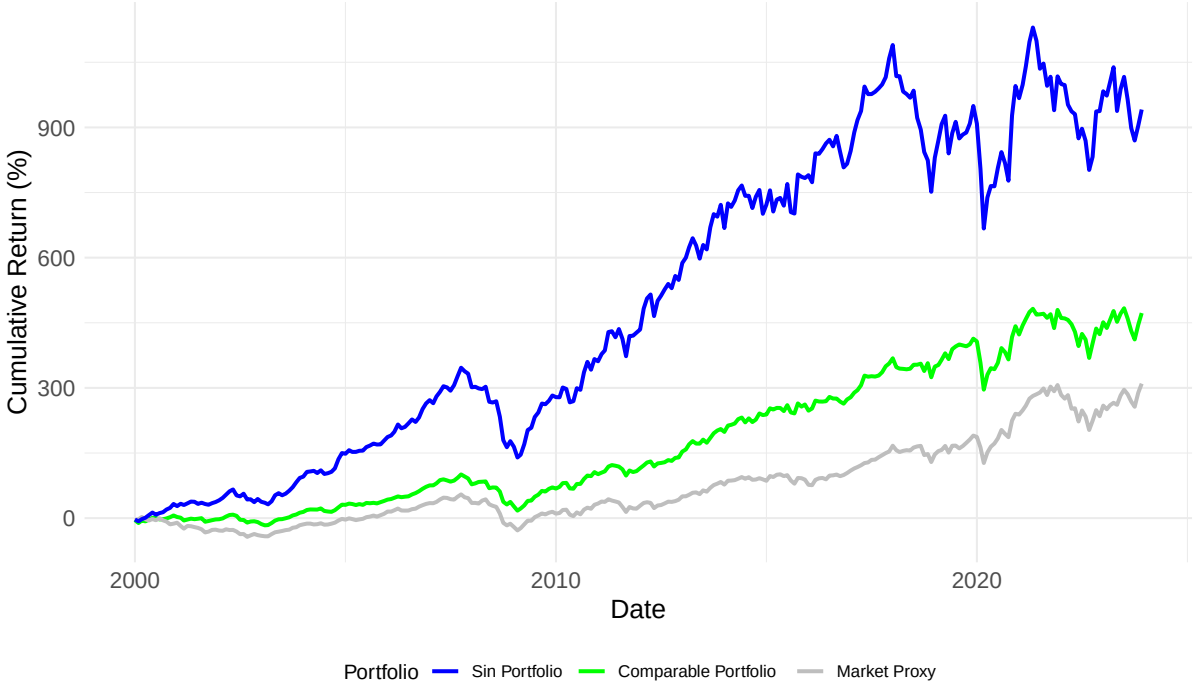
Note: The table shows the correlation matrix of our independent variables. Note the high correlation between HML and CMA.

B Analysis & Results

B.1 Figures of Cumulative Returns

Figure B.1 shows the cumulative returns of the value-weighted total sin portfolio, the comparable portfolio, and the market proxy, based on monthly returns from January 2000 to December 2023.

Figure B.1: Cumulative Return of Total Portfolios

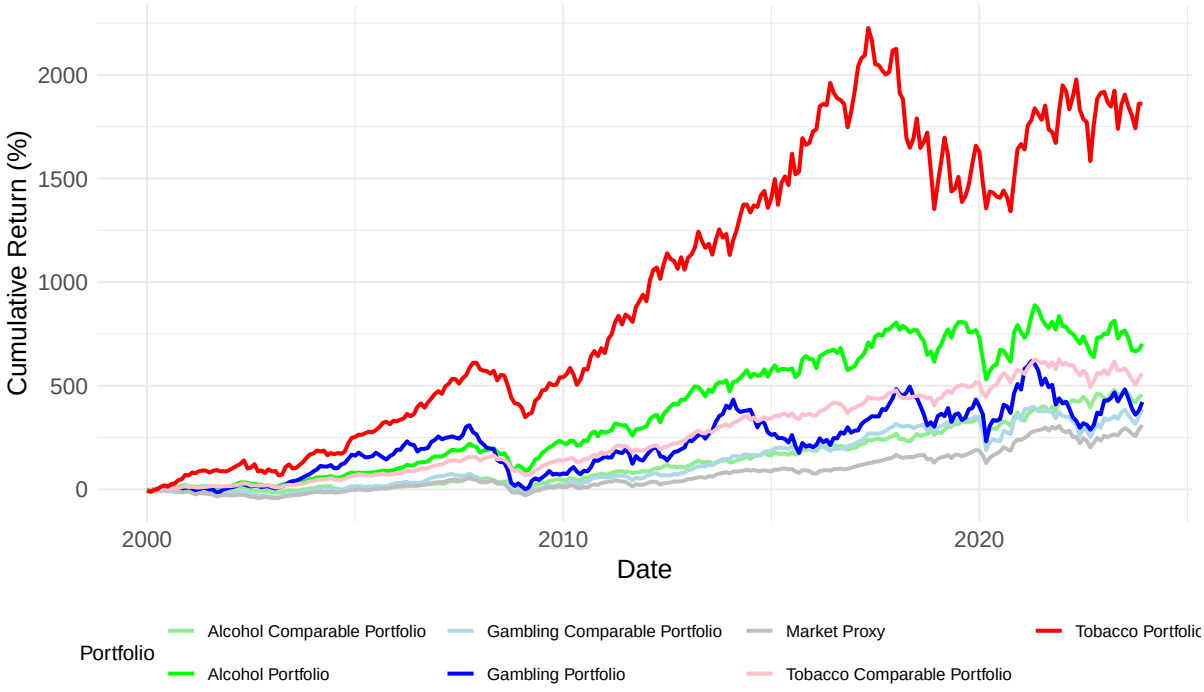


Note: This figure illustrates the cumulative returns of the Sin Portfolio, Comparable Portfolio, and Market Proxy over the sample period from January 2000 to December 2023. The Sin Portfolio demonstrates higher cumulative returns compared to both the Comparable Portfolio and the Market Proxy.

The sin portfolio shows a steady upward trend, weathering volatile periods like the 2008 financial crisis and the COVID-19 pandemic. By the end of the period, cumulative returns surpassed 900%, highlighting the long-term profitability of sin stocks. Meanwhile, the comparable portfolio delivers respectable returns, outperforming the market but falling short of the sin stocks. As the market proxy reflects the overall market returns it is characterized by broader diversification, lower risk, and consequently lower returns.

Figure B.2 shows the cumulative returns of the value-weighted sin and comparable industry portfolios, alcohol, gambling, and tobacco, as well as the market proxy. The statistics are based on monthly returns from January 2000 to December 2023.

Figure B.2: Cumulative Return of Industry-Specific Portfolios



Note: This figure illustrates the cumulative returns of the Sin Portfolio, Comparable Portfolio, and Market Proxy over the sample period from January 2000 to December 2023. The Sin Portfolio demonstrates higher cumulative returns compared to both the Comparable Portfolio and the Market Proxy.

The tobacco industry stands out with exceptional cumulative returns of 1860%, far surpassing its comparable portfolio. The alcohol portfolio follows with strong cumulative returns of 702%, while the gambling portfolio reflects higher volatility and delivers cumulative returns of 422%. Compared to the tobacco industry, both the alcohol and gambling industries show narrower gaps relative to their comparable portfolios, suggesting weaker evidence of a potential sin premium. Meanwhile, the market proxy lags behind all sin industries and their comparables, with cumulative returns of 310%. These observations highlight the sin stocks' ability to deliver exceptional long-term returns, particularly evident in the tobacco industry.

B.2 Regression Results for the Regional Sin Portfolios

As a robustness check for our main main analysis, we examine regional sin stock portfolios using the FF3, Carhart, and FF5 models. The results, detailed in Tables B.1, B.2 and B.3, provide insights into how regional portfolios align with the overall sin portfolio findings.

Table B.1: Regression Results for the Regional Sin Portfolios - FF3

	Dependent variable:			
	$(R_{\text{SinRegion},t} - R_{f,t})$			
	North America	Europe	Asia-Pacific	Japan
Intercept (Alpha)	0.485**	0.459**	0.178	0.276
	(0.218)	(0.203)	(0.340)	(0.239)
Mkt-Rf	0.824***	0.696***	0.922***	0.775***
	(0.053)	(0.043)	(0.056)	(0.063)
SMB	−0.104	0.003	−0.397***	0.102
	(0.098)	(0.109)	(0.116)	(0.103)
HML	0.437***	0.073	−0.209*	0.093
	(0.061)	(0.085)	(0.118)	(0.083)
Observations	288	288	288	288
R^2	0.541	0.595	0.533	0.437
Adjusted R^2	0.536	0.591	0.528	0.431

*Note: This table presents the regression results for the regional sin portfolio (excess returns over the risk-free rate) using Fama-French three-factor model (FF3). Note the significant alphas in both North America and Europe. The dependent variable is the total regional sin portfolios return ($R_{SinRegion,t}$) minus the risk-free rate of the corresponding region ($R_{fRegion,t}$). Coefficients for the risk factors are reported with robust standard errors in parentheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.*

Table B.2: Regression Results for the Regional Sin Portfolios - Carhart

	Dependent variable:			
	$(R_{\text{SinRegion},t} - R_{f,t})$			
	North America	Europe	Asia-Pacific	Japan
Intercept (Alpha)	0.480**	0.298	0.272	0.278
	(0.218)	(0.203)	(0.340)	(0.239)
Mkt-Rf	0.827***	0.752***	0.913***	0.787***
	(0.053)	(0.043)	(0.056)	(0.063)
SMB	−0.107	−0.045	−0.379***	0.065
	(0.098)	(0.109)	(0.116)	(0.103)
HML	0.440***	0.131	−0.227*	0.114
	(0.061)	(0.085)	(0.118)	(0.083)
WML	0.008	0.171***	−0.092	0.109
	(0.054)	(0.064)	(0.098)	(0.075)
Observations	288	288	288	288
R^2	0.541	0.611	0.535	0.442
Adjusted R^2	0.534	0.605	0.529	0.435

*Note: This table presents the regression results for the regional sin portfolio (excess returns over the risk-free rate) using the Carhart model. Note that the significant alpha in North America remains, while the significant alpha for Europe disappears. The dependent variable is the total regional sin portfolios return ($R_{SinRegion,t}$) minus the risk-free rate of the corresponding region ($R_{f,t}$). Coefficients for the risk factors are reported with robust standard errors in parentheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01.*

Table B.3: Regression Results for the Regional Sin Portfolios - FF5

	Dependent variable:			
	$(R_{\text{SinRegion},t} - R_{f,t})$			
	North America	Europe	Asia-Pacific	Japan
Intercept (Alpha)	0.179	−0.009	−0.094	0.212
	(0.211)	(0.191)	(0.314)	(0.237)
Mkt-Rf	0.891***	0.837***	1.010***	0.799***
	(0.051)	(0.041)	(0.061)	(0.063)
SMB	0.080	0.093	−0.265**	0.082
	(0.095)	(0.100)	(0.113)	(0.092)
HML	0.160	0.093	−0.135	0.043
	(0.111)	(0.112)	(0.162)	(0.099)
RMW	0.382***	0.879***	0.380***	0.334*
	(0.118)	(0.152)	(0.135)	(0.193)
CMA	0.351**	0.584***	0.366*	0.378**
	(0.151)	(0.158)	(0.206)	(0.168)
Observations	288	288	288	288
R^2	0.574	0.678	0.552	0.451
Adjusted R^2	0.567	0.673	0.544	0.441

Note: This table presents the regression results for the regional sin portfolio (excess returns over the risk-free rate) using Fama-French five-factor model (FF5). Note the disappearance of significant alphas for both North America and Europe. The dependent variable is the total regional sin portfolios return ($R_{SinRegion,t}$) minus the risk-free rate of the corresponding region (Rf,t). Coefficients for the risk factors are reported with robust standard errors in parentheses. Significance levels: p<0.1; p<0.05; p<0.01.