M.Sc. in Finance - Master's Thesis

Do Sin Stocks Outperform the Market?

A European Multi-Factor Analysis

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UNIVERSITY

Author: Leivur Højgaard (20231424)

Supervisor: Caglar Kaya

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Abstract

Motivated by the paradox of sin stocks outperforming despite ESG-related stigmas, this thesis examines whether European sin stocks—listed firms in the alcohol, tobacco, and gambling industries—deliver superior financial performance, and what drives this effect. It investigates the persistence of the sin premium, its sensitivity to economic regimes, and whether its magnitude has diminished over time.

Using monthly data from 2005 to 2024, sin stock portfolios are constructed using equal, value, and industry weighting methods. Performance is evaluated through CAPM, Fama-French 3- and 5-factor models, and an extended 5-factor model including a defensive (DEF) factor. Risk-adjusted metrics—Sharpe, Sortino, and Treynor ratios—complement the regression-based analysis. Recession and post-2016 subsamples allow for evaluation across time and macroeconomic conditions.

Results confirm the existence of a sin premium, particularly in EW and IW portfolios, which consistently generate positive alpha and superior risk-adjusted returns. VW portfolios underperform, reflecting their concentration in large-cap stocks. Tobacco stocks stand out for their resilience during downturns, offering the strongest support for defensive characteristics among sin industries. A clear decline in abnormal returns and performance ratios after 2016 suggests that ESG pressures and market segmentation may have eroded the premium.

Overall, the study provides a comprehensive assessment of sin stock performance in Europe, emphasizing that returns are shaped by portfolio design, market cycles, and evolving investor norms. The findings offer practical insights for both ethically constrained and unconstrained investors navigating a changing financial landscape.

List of Abbreviations

Abbreviation	Meaning
EW	Equal-Weighted
VW	Value-Weighted
IW	Industry-Weighted
CAPM	Capital Asset Pricing Model
FF	Fama-French
FF3	Fama-French Three-Factor
FF5	Fama-French Five-Factor
FF5+DEF	Fama-French Five-Factor with Defensive Factor
MKT	Market Factor
SMB	Size Factor (Small Minus Big)
HML	Value Factor (High Minus Low)
RMW	Profitability Factor (Robust Minus Weak)
CMA	Investment Factor (Conservative Minus Aggressive)
DEF	Defensive Factor (Long defensive stocks, short cyclical stocks)
RF	Risk-Free Rate
α (Alpha)	Risk-adjusted excess return (intercept in regressions)
HAC	Heteroskedasticity and Autocorrelation Consistent standard errors
HC	Heteroskedasticity-Consistent standard errors
VIF	Variance Inflation Factor
SRI	Socially Responsible Investing
ESG	Environmental, Social, and Governance
SIC	Standard Industrial Classification
NAICS	North American Industry Classification System
RBICS	Revere Business Industry Classifications System
ECB	European Central Bank

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1 Introduction

Sin investing continues to provoke debate within both academic finance and investment practice. At its core, it involves allocating capital to companies operating in industries considered ethically controversial or socially undesirable. These typically include alcohol, tobacco, and gambling—often referred to as the "triad of sin"—though definitions may also extend to sectors such as weapons manufacturing or adult entertainment, depending on cultural, regional, and temporal norms. Despite ongoing moral scrutiny, these industries have long demonstrated strong financial fundamentals, including high margins, stable cash flows, and resilient demand.

In recent years, the rise of socially responsible investing (SRI) and the widespread adoption of ESG (Environmental, Social, and Governance) frameworks have increased pressure on sin stocks through divestment and exclusionary screening. Paradoxically, empirical research has shown that sin stocks may outperform the broader market, particularly on a risk-adjusted basis, challenging the assumption that ethical investing necessarily entails a financial trade-off.

This thesis revisits this paradox within a European context—an underexplored setting with distinct regulatory regimes, cultural norms, and ESG maturity compared to the U.S. It evaluates whether sin stocks in Europe generate abnormal returns, whether these returns can be explained by known risk factors, and how performance varies across economic cycles and over time.

This chapter introduces the study by outlining the central research problem, specifying the scope and delimitations, summarizing the methodological approach, and clarifying the significance of the contribution. It concludes with an overview of the structure of the thesis.

1.1 Problem Statement

Although the financial performance of sin stocks has been extensively studied in the U.S., limited research addresses whether these dynamics persist in European markets. Europe offers a unique setting due to its diverse regulatory frameworks, strong ESG integration, and varied cultural and religious attitudes toward vice industries. These differences raise questions about whether sin stocks in Europe exhibit the same patterns of risk-adjusted outperformance observed elsewhere.

Additionally, much of the existing literature does not explore how sin stock performance is affected specifically during economic downturns or in the context of structural shifts potentially related to ESG integration. This thesis addresses these gaps by assessing whether European sin stocks continue to generate abnormal returns, how their performance responds during recessions, and whether their exposure to traditional and defensive risk factors has changed, particularly following 2016.

1.2 Research Question

Primary Research Question:

- Do European sin stocks outperform the broader European market in terms of financial performance, and what key factors drive this performance?

Supporting Research Question:

- How have sin stocks performed compared to the market during recessions?
- Have sin stock returns and factor exposures changed over time, particularly after 2016, a period commonly associated with rising ESG integration?

Based on these research questions, the study develops three hypotheses that guide the empirical analysis:

- ***H1****: European sin stocks outperform the broader European market in terms of risk-adjusted returns.*
- ***H2****: Sin stocks exhibit defensive characteristics that make them more resilient during economic downturns.*
- ***H3****:* The *abnormal performance of European sin stocks has declined over time, potentially reflecting increased ESG integration or changing investor preferences.*

These hypotheses are tested using time-series regressions on sin stock portfolios constructed with different weighting schemes. The models assess both performance and factor exposures across different economic conditions.

1.3 Scope and Delimitations

This thesis focuses on the European market and examines three traditional sin industries: alcohol, tobacco, and gambling. The analysis includes 58 publicly listed firms across 24 countries, identified using standardized industry classification systems (SIC, NAICS, and RBICS) and selected based on a minimum revenue threshold of 50% from sin-related activities.

The study excludes other controversial sectors, such as weapons, fossil fuels, or adult entertainment, to maintain consistency with conventional definitions in sin stock literature. Rather than pursuing a normative evaluation of sin investing, it adopts an empirical, finance-based perspective.

The analysis includes only firms for which return data is available as of the end of the sample period, which introduces potential survivorship bias. This may lead to an overestimation of performance, as firms that exited the market are not included.

1.4 Methodological Overview

This thesis empirically evaluates the financial performance of sin stocks using a multi-model regression framework applied to monthly return data. To estimate risk-adjusted returns and factor sensitivities, the analysis employs the Capital Asset Pricing Model (CAPM), the Fama-French three-factor (FF3) and five-factor (FF5) models, and an extended FF5 model that includes a defensive factor (FF5+DEF).

Portfolios are constructed using three weighting approaches—equal-weighted (EW), value-weighted (VW), and industry-weighted (IW)—to test the robustness of results under different aggregation schemes. The EW portfolio serves as the primary specification, as it avoids bias toward large-cap stocks and better reflects average stock-level performance.

Two temporal dimensions are used to examine how sin stock performance varies under different conditions. First, the sample is segmented into recession periods, based on classifications from the European Central Bank, to assess whether sin stocks exhibit defensive behavior during economic downturns. Second, the dataset is divided into pre- and post-2016

subsamples to explore potential structural shifts in performance and risk exposures, possibly driven by the growing influence of ESG integration in financial markets.

To ensure statistical reliability, the regressions are accompanied by diagnostic tests for heteroskedasticity, autocorrelation, multicollinearity, functional form misspecification, and normality. Model fit is assessed using adjusted R^2. Additional robustness checks include industry-level subsample regressions, alternative weighting methods, and supplementary performance metrics such as Sharpe and Sortino ratios.

1.5 Contribution and Significance

This thesis contributes to the sin stock literature by providing a focused, methodologically rigorous, and regionally specific analysis of the European market. Its main contributions are:

- Delivering updated empirical evidence on the financial performance of European sin stocks over nearly two decades (2005–2024), including a period of heightened ESG scrutiny.
- Evaluating whether traditional and extended asset pricing models—including the FF5 model and a DEF factor extension—adequately explain sin stock returns.
- Examining how sin stocks perform during recessions and whether they exhibit defensive characteristics in periods of economic downturn.
- Conducting a post-2016 analysis to identify structural shifts in sin stock performance and factor exposures.
- Testing the robustness of portfolio constructions using EW, VW, and IW specifications, along with individual sin industries (alcohol, tobacco, and gambling).

Together, these contributions provide both theoretical and practical insights. They deepen the academic understanding of market anomalies related to sin stocks and guide investors, fund managers, and policymakers as they navigate the balance between ethical investment criteria and financial performance.

1.6 Structure of the Thesis

The remainder of this thesis is structured as follows:

- **Chapter 2: Literature Review** examines prior research on the financial performance of sin stocks and the impact of ethical screening on investment returns.
- **Chapter 3: Understanding Sin Investing** discusses the history and definition of sin investing, including the classification of industries and the impact of ESG and SRI strategies on investment decisions.
- **Chapter 4: Theoretical Framework** presents the financial theories and models utilized in the analysis, including market efficiency, behavioral finance, and asset pricing models.
- **Chapter 5: Methodology** outlines the data sources, portfolio construction, and regression models used in the study. It also details how the analysis considers economic cycles and periods, including various checks to ensure reliable results.
- **Chapter 6: Results** presents the main findings on sin stock performance, factor exposures, and how the results vary by portfolio type, during recessions, and across the pre- and post-2016 periods.
- **Chapter 7: Discussion** interprets the results and compares them with existing research.
- **Chapter 8: Conclusion** summarizes the findings, reflects on their significance, discusses limitations, and offers suggestions for future research.

By synthesizing theory, empirical evidence, and practical implications, this thesis aims to deepen the understanding of sin stock dynamics in European markets and to inform both academic research and practical investment decision making.

2 Literature Review

This section reviews key academic work on the financial performance of sin stocks and the implications of ethical investing. Section 2.1 summarizes empirical studies that support the outperformance of sin stocks, often attributing excess returns to market segmentation and defensive sector characteristics. Section 2.2 presents studies that challenge these findings, arguing that performance advantages may be overstated or explained by conventional risk factors. Section 2.3 examines how ethical screening practices, such as excluding sin stocks, affect portfolio efficiency, diversification, and risk-adjusted returns. Together, these perspectives form the basis for evaluating the risk-return trade-offs of investing in controversial industries.

2.1 Evidence Supporting Sin Stock Outperformance

A substantial body of empirical literature has documented that sin stocks often generate superior financial performance relative to the broader market. This observed return premium is frequently attributed to market segmentation, reputational risks, and behavioral biases that discourage institutional ownership, creating pricing inefficiencies. However, the robustness of these findings depends on context-specific factors such as region, period, and methodology, which merit closer examination.

The most widely cited study in this field is Hong & Kacperczyk (2009), who analyze monthly U.S. data from 1962 to 2003 using FF3 factor regressions. They find that sin stocks earn higher expected returns due to being systematically under-owned by norm-constrained institutional investors, resulting in higher required returns as compensation for elevated reputational and litigation risk. Notably, they show that sin stocks have significantly fewer analysts following them and are disproportionately held by retail rather than institutional investors. Their findings highlight a form of market segmentation that persists across decades, driven not by fundamentals but by ethical exclusion.

Fabozzi et al. (2008) take a broader sectoral approach, constructing a sin stock portfolio covering alcohol, adult entertainment, gambling, tobacco, weapons, and biotech alterations, covering multiple years of U.S. market activity. Using risk-adjusted performance metrics, they report annual returns of 19% and attribute this to monopolistic advantages, reduced

competition, and a lack of regulatory pricing constraints in these sectors. Their analysis highlights how the structural and economic characteristics of sin stocks contribute to their persistent profitability, regardless of market sentiment.

Salaber (2007) adds a crucial European perspective by examining monthly returns from 21 European countries between 1975 and 2006. Using FF regressions with country-fixed effects, she finds that sin stock outperformance is significantly more pronounced in countries with higher religious adherence and lower investor protection, factors that proxy for the strength of social norms. Notably, her study also identifies the influence of local culture and legal frameworks on return dispersion, suggesting that the sin premium is not universal but context-dependent.

Liston & Soydemir (2010) compare the performance of a sin stock portfolio and a faith-based investment strategy from 2001 to 2008, using daily data and rolling regressions within the CAPM, FF3, and Carhart four-factor models. They report a statistically significant positive alpha for the sin portfolio, particularly during periods of elevated market volatility. Their findings reinforce the view that sin stocks exhibit defensive characteristics and may serve as a hedge during macroeconomic downturns, possibly due to the inelastic demand for products in these sectors.

Richey (2016) further corroborates these conclusions using the Carhart four-factor model and Sortino ratios to evaluate the Vice Fund and various industry-based vice portfolios. He uses monthly returns from the early 2000s through the mid-2010s and finds that vice portfolios consistently outperform the market, with statistically significant alphas in both bull and bear markets. This cross-cycle robustness supports the argument that sin stock returns are not purely cyclical or opportunistic, but instead reflect persistent structural factors.

While most of the studies above focus on U.S. markets, there is increasing evidence of sin stock outperformance outside the U.S., though often with more nuance. For example, Salaber (2007) and Liston & Soydemir (2010) both emphasize the role of local market conditions, investor sentiment, and cultural factors in shaping the magnitude and persistence of the sin premium.

Across this body of literature, asset pricing models such as the CAPM and FF factor models are consistently employed to isolate risk-adjusted returns. Some studies above find that even after controlling for size, value, and profitability factors, sin stocks retain statistically

significant positive alphas. However, the strength of these effects may vary based on weighting schemes (e.g., equal- vs. value-weighted), firm size, and sector concentration.

Taken together, the empirical evidence offers strong support for the notion that sin stocks, particularly in the U.S., have delivered superior risk-adjusted returns over a range of periods, market conditions, and macroeconomic environments. Although the magnitude of the premium may vary across regions and investment horizons, the underlying mechanism, pricing inefficiencies due to social norms and constrained capital, remains a central theme in explaining their financial performance.

2.2 Challenges to the Sin Stock Premium

While a substantial body of literature highlights the historical outperformance of sin stocks, several studies cast doubt on the consistency, robustness, and underlying mechanisms of this so-called sin premium. These studies apply more granular methodologies, broader datasets, or alternative theoretical models to demonstrate that the observed outperformance may be overstated, context-specific, or explained by conventional risk factors rather than a unique pricing anomaly.

Salaber (2009) provides one of the earliest critiques, analyzing U.S. sin stocks from 1926 to 2005 using monthly data and conditional multifactor models that incorporate time-varying macroeconomic risk premia. She finds that while sin stocks outperform the market during recessions, this advantage disappears when compared to industry-comparable stocks and when controlling for variables such as the term spread and default spread. Her findings suggest that sin stock returns can be explained by cyclical risk premia and that their apparent defensiveness is not unique, as similar hedging properties are observable in other sectors like consumer staples. This challenges the notion that sin stocks possess inherent recession-proof qualities or offer abnormal returns on a risk-adjusted basis.

Hoepner & Zeume (2014) bring practical relevance into focus by evaluating the performance of the Vice Fund, one of the few real-world investment vehicles targeting sin sectors. Using monthly data spanning the early 2000s, they apply standard asset pricing models, including the CAPM and FF3 model. Their results show that the fund's alpha is statistically indistinguishable from zero, and that poor crisis management and misaligned trading strategies further erode any

potential outperformance. This suggests that while sin sectors may be profitable in theory, successfully capturing their excess returns in practice remains difficult, especially for institutional funds subject to transaction costs, behavioral errors, or strategy constraints.

Luo & Balvers (2014) offer a new perspective on sin stock returns by introducing a boycott-augmented CAPM. In their model, a portion of investors avoid controversial stocks for ethical reasons, reducing demand and creating a "boycott risk" that must be compensated through higher expected returns. Using U.S. stock data, they show that once this factor is included, the abnormal returns associated with sin stocks disappear. Their results remain consistent even after accounting for standard risk factors like size, value, momentum, and liquidity. This suggests that sin stock outperformance may not reflect market inefficiency but rather a rational risk premium resulting from investor exclusion.

El Ghoul et al. (2011) provide supporting evidence for this idea using data on over 12,000 U.S. firms between 1992 and 2007. They find that firms with lower CSR scores face higher costs of equity, particularly in controversial industries such as tobacco and nuclear energy. While not focused solely on sin stocks, the study shows that ethical concerns can increase financing costs, leading investors to demand higher returns. These findings reinforce the argument that the sin premium may be a priced response to reputational risk, rather than unexplained outperformance.

Adamsson & Hoepner (2015) expand on earlier studies by applying the Hong and Kacperczyk (2009) approach to a global sample. They show that the sin premium largely disappears when using VW portfolios, indicating that a small-cap bias influenced earlier findings. They also find that performance varies by region and firm size, with weaker results once intra-sector differences are controlled for. Their study highlights that sin stock outperformance is not universal and may depend on portfolio construction methods and local market conditions, rather than being a consistent or unique effect.

Lobe & Walkshäusl (2011) adopt a global lens by constructing sin portfolios across developed and emerging markets between 1995 and 2009 using monthly data. They employ multiple models, including CAPM, FF3, and Carhart four-factor regressions, and compare performance to SRI indices. The authors find no statistically significant outperformance of sin stocks once exposures to size, value, and momentum are accounted for. They caution against generalizing

from U.S.-based findings and argue that the relative performance of sin versus SRI strategies is largely a function of factor tilts rather than any inherent pricing advantage.

Blitz & Fabozzi (2017), while often cited in support of a sin stock premium, conclude that any performance advantage is fully attributable to exposure to the profitability and investment factors from the FF5-factor model. Once these risk factors are accounted for, they find no residual alpha associated with sin stocks. Their findings, which hold across both U.S. and international markets, challenge the notion of a unique "sin premium" and suggest that previously observed outperformance is simply compensation for exposure to well-known risk factors.

Sagbakken & Zhang (2022) extend this analysis to a European context, examining traditional and newer sin stocks from 2006 to 2020. While raw returns occasionally suggest a sin premium, these excess returns disappear once profitability and investment factors are included, reinforcing the findings of Blitz & Fabozzi (2017). Their results imply that sin stock performance is not driven by controversy or risk, but by firm fundamentals such as profitability and capital discipline. The authors also highlight that ESG-related divestment and shifting investor norms, especially after the Paris Agreement, are increasingly influencing valuations. This suggests that social preferences, alongside risk factors, may play a growing role in the pricing of European sin stocks.

Taken together, these studies challenge the assumption that sin stocks inherently offer superior performance. Whether through improved econometric specifications, inclusion of more comprehensive factor models, or regionally disaggregated analyses, the weight of recent evidence suggests that sin stock outperformance may not be as robust or universal as earlier studies proposed. Instead, much of the observed excess return can be explained by conventional risk factors, portfolio construction biases, or shifts in investor behavior driven by ESG and regulatory trends.

2.3 Ethical Constraints and Their Impact on Portfolio Efficiency

A growing body of literature investigates the financial implications of SRI, particularly regarding the exclusion of controversial or "sin" stocks. While screening strategies are discussed in Section 3.3, this section synthesizes empirical research on how such ethical constraints affect portfolio diversification, factor exposures, and overall efficiency.

A central concern is that negative screening reduces diversification and limits access to potentially high-performing sectors. Renneboog et al. (2008) argue that SRI portfolios often operate under restricted diversification, which can introduce inefficiencies and compromise returns. Trinks & Scholtens (2017) provide supporting evidence by analyzing over 1,700 stocks across 14 controversial categories. They find that while some exclusions, such as those for fur or stem cells, have minimal impact, others, notably alcohol, tobacco, and nuclear power, significantly shrink the investable universe.

The performance effects of these constraints have been extensively analyzed. Statman & Glushkov (2009) find that positive ESG tilts are often neutralized by the exclusion of sin stocks, resulting in returns comparable to conventional portfolios. This supports their "no effect" hypothesis, which suggests that ethical screening neither improves nor worsens performance on average. However, other studies report more pronounced trade-offs. Trinks & Scholtens (2017) observe that controversial sectors frequently outperform the broader market, implying that their exclusion may carry a persistent opportunity cost.

Adding further perspective, Filbeck et al. (2014) examine portfolio strategies that incorporate both sin stocks and high-ESG-rated firms. Their findings show that portfolios allowing exposure to controversial industries, particularly through active-extension structures such as 130/30, achieve superior risk-adjusted returns relative to strictly screened alternatives. These results suggest that rigid exclusionary screens may constrain performance and that flexible, design-conscious screening approaches can better balance ethical objectives with financial outcomes.

Blitz & Swinkels (2023) adopt a more cautionary stance, arguing that broad exclusions across entire industries increase tracking error and reduce expected returns by 0.25% to 0.50% annually. However, they also note that these effects can be mitigated by reallocating capital to factor-similar stocks, highlighting the importance of thoughtful portfolio construction.

In contrast, Humphrey & Tan (2014) find no significant performance penalty associated with either positive or negative screening in mutual fund-sized portfolios. They argue that the limited presence of pure-play sin stocks in major indices such as the S&P 500 reduces the impact of exclusions and challenges claims that ethical screening inherently leads to underperformance.

Taken together, these studies indicate that ethical constraints, particularly in the form of broad negative screens, can influence portfolio efficiency, mainly through reduced diversification and altered exposure to return-driving factors. However, the severity of these effects is context-dependent and varies with the type of screens applied, the market environment, and the investor's approach to portfolio design. As a result, investors may benefit from strategies such as best-in-class screening or factor-aware allocation, which aim to balance normative goals with long-term financial performance.

2.4 Synthesis and Research Gap

The literature on sin stocks reveals a longstanding divide. Early studies—particularly in the U.S.—report persistent outperformance of sin sectors, attributing abnormal returns to market segmentation, reputational risk premia, and the defensive characteristics of industries like alcohol, tobacco, and gambling. These stocks often operate with inelastic demand and limited institutional ownership, which may insulate them during downturns.

However, more recent research challenges the existence of a genuine sin premium. Notably, Blitz and Fabozzi (2017) and Sagbakken and Zhang (2022) show that sin stock outperformance often disappears once exposures to common risk factors are adequately accounted for. These findings suggest that what appeared to be alpha may reflect compensation for traditional risk exposures rather than market inefficiency.

Crucially, these studies often focus on U.S. or pooled global markets and lack rigorous testing under varying economic regimes or in the context of ESG evolution. There is a shortage of detailed, Europe-specific research that addresses whether sin stock excess returns persist once expanded factor models and structural shifts, such as post-2016 ESG integration, are considered.

Moreover, while ethical screening is a central theme in SRI literature, its impact on portfolio efficiency remains a topic of debate. Exclusionary strategies can reduce diversification and shift factor exposures, but the extent and direction of these effects depend on the screens applied and the weightings used.

In summary, several gaps remain. Existing studies either overlook Europe entirely or apply static, aggregated models that mask temporal dynamics. This thesis addresses these gaps by applying multi-model regressions—including an extended FF5+DEF model—to sin stock portfolios across three weighting schemes. It further explores behavior across recession and expansion periods, as well as structural changes in the post-2016 ESG environment, offering a more nuanced understanding of sin stock performance in the modern European context.

3 Understanding Sin Investing

Sin investing sits at the intersection of ethics, finance, and market behavior. This section traces its development alongside ethical and ESG investing, outlines key screening strategies, and defines the characteristics of sin stocks. It also presents the main arguments for and against sin investing, providing a foundation for evaluating their financial performance in the European context.

3.1 The Origins of Ethical and Sin Investing

Ethical and sin investing reflect contrasting approaches to financial markets, shaped by evolving societal norms, regulation, and economic factors. Ethical investing emphasizes social responsibility and sustainability, while sin investing targets industries that remain profitable despite ethical concerns. Understanding their historical development offers insight into their resilience and future trajectory.

3.1.1 Ethical Investing: Historical Roots

Ethical investing has deep historical roots, originating from religious and social movements that sought to align financial decisions with moral values (Sparkes & Cowton, 2004; Townsend, 2020). One of the earliest recorded examples is the Quakers' refusal to invest in the slave trade (Renneboog et al., 2008). Religious groups such as the Methodists and Islamic finance institutions also avoided industries linked to alcohol, gambling, and armaments.

The early 20th century witnessed the emergence of faith-based funds, such as the Pioneer Fund, established in 1928, which explicitly excluded so-called "sin stocks." However, ethical investing gained significant traction during the 1960s and 1970s, particularly through the global opposition to apartheid in South Africa (Schueth, 2003). Investors divested from companies operating in the region, marking a turning point in demonstrating how financial decisions could drive social change. This period also saw the development of socially responsible mutual funds, which began screening companies based on ethical criteria. The Vietnam War era further reinforced ethical investment strategies, as investors started avoiding companies that profited from warfare and environmental degradation. Ethical investing was also influenced by the civil rights and environmental movements, which advocated for corporate accountability and responsible business practices (Townsend, 2020).

3.1.2 The Emergence of ESG Investing

Over time, ethical investing evolved beyond purely moral considerations to incorporate ESG factors, driven by the growing availability of ESG data and the recognition of sustainability as a key financial risk (Townsend, 2020). By the late 20th and early 21st centuries, investors increasingly viewed sustainability not just as an ethical concern but as a driver of long-term financial performance.

Early regulatory initiatives, such as the Community Reinvestment Act of 1977 issued by the U.S. Government Publishing Office (1977) and the UK Stewardship Code published by the Financial Reporting Council (2010), encouraged financial institutions to consider social and environmental factors. As ESG investing gained momentum, key milestones accelerated its adoption: the United Nations Principles for Responsible Investment (2006) formalized ESG frameworks for investors, while the Paris Agreement (2015) reinforced the importance of corporate sustainability in combating climate change.

More recently, the EU Sustainable Finance Disclosure Regulation (2021) (SFDR, 2021) has mandated rigorous reporting on sustainability risks and impacts (European Commission, 2021). These developments have reinforced ESG principles, promoted corporate accountability, and helped establish sustainable investing as a mainstream financial strategy.

The growth of ESG investing is reflected in the creation of sustainability-focused indices and the widespread integration of ESG criteria by prominent asset managers. Financial innovations such as green bonds have also expanded ESG adoption beyond equities. As Townsend (2020) notes, modern ESG investing increasingly emphasizes positive selection, seeking companies with strong sustainability practices rather than relying solely on exclusionary screening.

The European Sustainable Investment Forum (Eurosif) defines SRI as a long-term investment approach that integrates ESG factors into security selection, combining fundamental analysis with engagement to enhance returns and promote corporate responsibility.

3.1.3 The Development of Sin Investing

Sin investing has long been intertwined with economic development, with industries such as alcohol, tobacco, and gambling serving as key drivers of commerce and government revenues (Goetzmann, 2017). During the 17th and 18th centuries, European colonial economies relied heavily on commodities like rum and tobacco, which became central to international trade and taxation (Courtwright, 2001). Despite moral objections, their profitability ensured their enduring prominence.

The 19th and early 20th centuries witnessed the rise of organized markets and stock exchanges, providing investors with broader access to industries associated with sin. Prohibition-era America (1920–1933) demonstrated the resilience of vice industries, as underground alcohol distribution flourished and gambling operations maintained strong profit margins, ultimately leading to the legalization of gambling in regions like Nevada.

Following World War II, institutional investment in sin industries surged, with tobacco and alcohol companies becoming blue-chip stocks. Aggressive marketing, sponsorships, and extensive advertising helped to solidify their brands in consumer culture, ultimately solidifying long-term profitability. Despite mounting scientific evidence of health risks by the 1960s and 1970s, particularly for tobacco, these industries expanded internationally where regulations were more lenient.

In the late 20th century, growing regulatory pressures and public health campaigns challenged the sin sectors. However, they adapted through strategic lobbying, diversification into emerging markets, and product innovation. Tobacco companies invested in alternative nicotine products, alcohol firms targeted premium and craft segments, and gambling operators expanded into digital platforms. These adaptive strategies enabled the sin industries to maintain profitability and market presence despite shifting regulatory and societal landscapes.

3.2 What Are Sin Stocks?

Sin investing stands in contrast to SRI, which excludes companies based on ethical concerns and prioritizes ESG criteria. Sin investing, by comparison, focuses on the financial potential of companies operating in controversial sectors, regardless of moral or societal views. These firms are evaluated based on factors such as profitability, regulation, and market dynamics, not ethical alignment (Hong & Kacperczyk, 2009).

What qualifies as a "sin stock" varies across regions and time, reflecting changes in cultural norms, legal frameworks, and investor sentiment. Still, companies in this category typically share several defining features:

- **Stigmatization** – These firms operate in sectors widely viewed as socially or morally harmful, often attracting public criticism and exclusion by ESG investors.
- **Limited institutional ownership** – Many institutional investors avoid sin stocks due to ethical guidelines, leading to under-ownership and potentially higher expected returns (Hong & Kacperczyk, 2009).
- **Non-cyclical demand** – Products such as alcohol and tobacco often see stable consumption, even in recessions, giving these stocks defensive traits.
- **Regulatory burden** – These industries face tight regulation, including advertising bans, excise taxes, and legal risk, which can impact operations and investor sentiment.
- **Strong profitability and cash flow** – Sin firms often enjoy pricing power, brand loyalty, and limited competition, resulting in high margins and consistent dividends.

The most commonly cited sin sectors include alcohol, tobacco, gambling, defense and weapons, and adult entertainment; however, newer categories such as cannabis, fossil fuels, and sugary drinks are also subjects of debate.

Despite ethical concerns, sin stocks remain prominent in global markets. Their combination of controversy, regulation, and financial strength continues to attract investor interest. These features are central to ongoing debates about whether sin stocks deliver superior risk-adjusted returns, particularly in settings like the European market, which this thesis investigates.

3.3 Screening Strategies in Ethical Investing

Screening is one of the oldest and most widely used strategies in SRI. It allows investors to align portfolios with ethical or sustainability goals by including or excluding companies based on non-financial criteria. While various screening techniques exist, this section focuses on two commonly used: exclusionary and inclusionary screening.

3.3.1 Negative (Exclusionary) Screening

Exclusionary screening, also known as negative screening, involves excluding companies, sectors, or practices deemed unethical or harmful, such as those associated with environmental damage, human rights violations, or corruption. A key form of this is sin screening, which targets industries like tobacco, alcohol, gambling, weapons, and, more recently, fossil fuels. These exclusions are typically based on ethical or religious values and often use revenue thresholds (e.g., excluding firms deriving over 5% of revenues from tobacco).

The sin industries examined in this thesis, alcohol, tobacco, and gambling, are frequently excluded due to their perceived negative societal impacts and generally low ratings on the Social (S) pillar of ESG frameworks. According to the European SRI Study (2018), exclusionary screening is the most widely adopted responsible investment strategy in Europe, covering over €11.8 trillion in assets. While initially driven by ethical concerns, it is now also recognized as a means to mitigate reputational and regulatory risks.

3.3.2 Positive (Inclusionary) Screening

Inclusionary screening (also known as positive or best-in-class screening) takes the opposite approach of exclusion by selecting companies with strong ESG performance relative to their sector peers. Rather than avoiding entire industries, it highlights firms that lead in sustainability, governance, or social responsibility. A common method is best-in-class screening, where only companies meeting specific ESG thresholds are included. This maintains diversification while promoting higher standards across sectors. Though smaller in scale than exclusion, inclusionary screening is growing, particularly in countries like France, Sweden, and the Netherlands. It is forward-looking, aiming to support companies that drive positive change and long-term value.

3.3.3 Screening in Practice

In practice, investors often combine screening methods to reflect ethical goals, regulatory requirements, and risk management. For example, a fund may exclude tobacco and weapons while applying best-in-class screening in other sectors. Exclusionary screening is commonly used as a baseline, with inclusionary strategies applied more selectively.

Screening is increasingly shaped by global standards, such as the UN PRI, SFDR, and Global Reporting Initiative (GRI), which guide the application and reporting of ESG criteria. As responsible investing evolves, screening remains a key tool for aligning portfolios with both values and long-term risk considerations.

3.4 The Case For and Against Sin Investing

Sin investing is a contentious topic in financial markets, with strong arguments on both sides. Proponents emphasize financial performance, resilience, and regulatory advantages, while critics point to ethical concerns, reputational risks, and long-term sustainability challenges. This section outlines the core arguments for and against the strategy.

3.4.1 Arguments in Favor

- **Strong Financial Performance and the Sin Premium:** Sin firms benefit from inelastic demand, brand loyalty, and pricing power—traits that contribute to strong financial performance and the persistence of the so-called sin premium. This premium arises because ESG and socially responsible investors systematically exclude these stocks, creating pricing inefficiencies. Institutional under-ownership further suppresses demand, thereby enhancing the potential for excess returns (Hong & Kacperczyk, 2009).
- **Market Resilience and Defensive Qualities:** The steady demand for sin products, even in economic downturns, gives sin stocks defensive characteristics. They often deliver stable revenue and lower volatility compared to more cyclical sectors, providing resilience during recessions (Salaber, 2009).
- **Regulatory Barriers and Competitive Edge:** Strict regulation often acts as a barrier to entry, protecting established sin firms and reinforcing their market dominance (Fabozzi et al., 2008). Governments' reliance on tax revenues further secures their

position. For investors willing to tolerate regulatory risks, the associated risk premium can enhance expected returns.

3.4.2 Arguments Against

- **Ethical and Social Responsibility Concerns:** Opponents argue that sin investing conflicts with ethical principles and CSR (Schueth, 2003). Many investors and institutions prefer to align their portfolios with values that promote sustainability, public health, and social well-being, making sin stocks undesirable from an ethical standpoint.
- **Reputational and Regulatory Risks:** Stigmatization exposes sin stocks to reputational risk, potentially resulting in divestment, ESG exclusion, or long-term brand damage. Stricter regulations and legal challenges can erode profitability, while fines and compliance costs further weigh on shareholder value.
- **Long-Term Sustainability Challenges:** As ESG investing grows, companies with poor environmental and social records may struggle to attract capital. Shifting consumption patterns, regulatory initiatives, and technological alternatives could erode their long-term profitability (Clark et al., 2014).

3.5 Conclusion: The Sin Investing Debate

The debate over sin investing highlights a core trade-off between financial returns and ethical values. Sin stocks have historically outperformed, driven by stable demand, regulatory protections, and the sin premium; however, they face growing scrutiny and shifting societal norms that threaten their long-term sustainability.

Positioned as a counterpoint to ESG and SRI, sin investing exploits inefficiencies created by exclusionary practices. Yet the rise of ESG mandates and ethical investor preferences casts uncertainty over its future viability.

Ultimately, the ongoing debate centers on whether financial gains outweigh ethical and reputational risks. Investors must navigate this landscape by aligning their portfolios with either pure financial motives or ethical considerations, or by seeking a balance between the two.

4 Theoretical Framework

This section outlines key theories used to evaluate stock performance, including the Efficient Market Hypothesis, Modern Portfolio Theory, and multi-factor asset pricing models. It also incorporates behavioral finance to explain potential market inefficiencies. Together, these frameworks guide the interpretation of whether the returns on sin stocks reflect risk-based compensation or persistent pricing anomalies.

4.1 Market Efficiency and the Pricing of Sin Stocks

The Efficient Market Hypothesis (EMH) posits that all available information is fully reflected in asset prices, making it difficult to consistently earn excess returns (Fama, 1970). Under this framework, any mispricing should be arbitraged away as rational investors exploit profit opportunities. However, sin stocks challenge this assumption.

Research by Hong & Kacperczyk (2009) shows that institutional investors often avoid sin stocks due to ethical or reputational constraints. This reduced participation lowers demand, potentially allowing mispricing to persist. Yet, this does not necessarily violate EMH. The higher returns of sin stocks may reflect compensation for bearing additional risks, such as litigation, regulatory pressure, and social stigma, which aligns with the risk-return trade-off at the core of EMH.

Thus, the sin stock puzzle presents a theoretical tension: do sin stocks generate abnormal returns due to market inefficiencies, or are those returns simply rational compensation for higher risk?

4.2 Behavioral Finance and Market Segmentation

While EMH assumes rational, utility-maximizing investors, behavioral finance offers a more nuanced view, highlighting how psychological biases and institutional constraints lead to persistent mispricing.

Prospect Theory, proposed by Kahneman & Tversky (1979), suggests investors are more sensitive to losses than gains, leading to excessive risk aversion. Sin stocks, often associated

with controversy, may be viewed as reputationally risky, prompting avoidance regardless of financial performance. De Bondt & Thaler (1985) demonstrate how investors overreact to news, an effect that is amplified in sin sectors, which are frequently subject to negative media and regulatory attention.

Barberis & Thaler (2003) argue that heuristics and availability bias lead investors to overweight prominent negative information, contributing to systematic underpricing of sin stocks. Market segmentation, as theorized by Merton (1987), further explains how institutional constraints, such as ESG mandates, limit the investor base, thereby reinforcing inefficiencies that cannot be easily arbitraged away.

These behavioral and institutional barriers help explain why sin stock anomalies may persist, even when their financial fundamentals suggest otherwise.

4.3 Utility Theory and Investor Identity

Beyond market-wide inefficiencies, individual investor preferences also play a significant role in shaping the performance of sin stocks. Traditional finance assumes investors aim to maximize risk-adjusted returns. However, utility theory, as proposed by Becker (1976), emphasizes that people seek to maximize total utility, which includes social, emotional, and moral satisfaction.

Akerlof & Kranton (2000) incorporate identity into economic behavior, arguing that individuals derive utility from actions aligned with their values. In investing, this means avoiding sectors like tobacco or gambling may enhance personal or institutional identity, even if it results in lower returns. Statman (2004) further suggests that investors pursue not only utilitarian benefits (returns), but also expressive and emotional outcomes, such as feeling responsible, virtuous, or aligned with community norms.

These non-financial preferences help explain persistent under-ownership of sin stocks. From this perspective, sin stocks may not be mispriced due to ignorance or irrationality, but rather systematically excluded by investors who prioritize ethical alignment over return maximization.

4.4 Modern Portfolio Theory and Diversification Effects

Modern Portfolio Theory (MPT), introduced by Markowitz (1952), emphasizes diversification as a way to improve a portfolio's risk-adjusted returns. In this framework, excluding certain asset classes, such as sin stocks, can reduce diversification and potentially lead to less efficient investment outcomes.

Because sin stocks are not perfectly correlated with the broader market, they can help spread risk. Studies have shown that sin stocks, particularly in sectors like tobacco and alcohol, often perform well during downturns, adding stability to a portfolio (Liston & Soydemir, 2010; Richey, 2016; Salaber, 2009). This makes them valuable from a diversification standpoint.

MPT quantifies portfolio risk using the following formula:

$$\sigma_p^2 = \sum w_i^2 \sigma_i^2 + \sum \sum w_i w_j \, \sigma_i \sigma_j \rho_{ij}$$

Here σ_p^2 is the total portfolio variance, w_i and w_j are asset weights, σ_i is the standard deviation of asset i, and ρ_{ij} is the correlation between assets i and j. The formula shows that adding assets with low correlations can reduce overall risk, underscoring the value of diversification.

Ethical investment strategies affect this dynamic. Negative screening, which removes entire sectors, narrows the investment universe and may increase concentration risk (Trinks & Scholtens, 2017). Positive screening, by selecting ESG leaders within sectors, helps preserve diversification while aligning with ethical goals (Kempf & Osthoff, 2007).

From an MPT perspective, excluding sin stocks can reduce portfolio efficiency by limiting diversification. Including them, regardless of ethical views, may enhance the portfolio's risk-return profile, highlighting the trade-off between ethical preferences and financial optimization.

4.5 Factor Models

Factor models explain asset returns by incorporating multiple risk factors beyond market exposure (Sharpe, 1964; Fama & French, 1993). This section explores their role in evaluating sin stocks, specifically whether their excess returns result from risk compensation or market inefficiencies. The evolution from single-factor models to multi-factor models provides a structured framework to analyze sin stock performance.

Factor models estimate stock returns based on exposure to different systematic risks. The general regression model here is:

$$R_i - R_f = \alpha_i + \sum_{j=1}^{k} \beta_{ij} F_j + \epsilon_i$$

where:

$R_i - R_f$ = excess return on asset i

α_i = abnormal return, representing unexplained performance

β_{ij} = factor loading, indicating asset i's exposure to risk factor j

F_j = systematic risk factor j

ϵ_i = error term

If sin stocks exhibit persistent positive alpha after controlling for risk factors, this suggests a potential sin premium driven by market frictions, investor constraints, or inefficiencies.

4.5.1 Risk Factors Relevant to Sin Stocks

Sin stocks exhibit distinct characteristics, including regulatory pressure, exclusion from ESG portfolios, and strong cash flow generation, which may influence their exposure to specific risk factors. The following section examines how each factor in the Fama-French framework, along with market risk, may capture or fail to capture the return drivers of sin stocks.

- **Market Risk (MKT):** Market risk reflects how closely a stock moves with overall market returns (Sharpe, 1964). Like most equities, sin stocks are exposed to market fluctuations. However, their sensitivity may differ due to industry-specific risks, such as regulation or shifting consumer sentiment.

- **Size Factor (SMB - small minus big):** The SMB factor captures the tendency of small-cap stocks to outperform large-cap ones (Fama & French, 1993). Sin stock portfolios, especially when equal-weighted, there is often a tilt toward smaller firms, which may drive their apparent outperformance. Adamsson & Hoepner (2015) suggest that much of the sin premium disappears in value-weighted portfolios, indicating the effect may stem more from size bias than a unique risk factor. Positive SMB loadings could reflect both actual size exposure and the impact of institutional avoidance.
- **Value Factor (HML - high minus low):** The HML factor captures the value premium associated with stocks that have high book-to-market ratios. Sin stocks are often undervalued due to limited institutional ownership, increasing their cost of capital (Hong & Kacperczyk, 2009). This exclusion can make them appear similar to traditional value stocks, contributing to positive HML loadings. Their returns, therefore, may be partly explained by value-like characteristics shaped by reputational concerns rather than intrinsic fundamentals.
- **Profitability Factor (RMW - robust minus weak):** RMW reflects the outperformance of highly profitable firms. Many sin stocks, particularly those in the alcohol and tobacco industries, maintain strong margins and steady cash flows due to inelastic demand. Blitz & Fabozzi (2017) argue that this consistent profitability explains much of their excess return. A positive loading on RMW suggests that their performance is driven by risk factors, not necessarily market mispricing.
- **Investment Factor (CMA - conservative minus aggressive):** The CMA factor captures the tendency of conservatively investing firms to outperform those that reinvest aggressively (Fama & French, 2015). Sin firms often face regulatory limits on growth, leading to cautious capital allocation. Blitz & Fabozzi (2017) find that this conservative approach contributes to financial stability. A positive CMA loading would indicate that sin stocks' returns are partly tied to their restrained investment behavior, which reduces volatility but may cap expansion.

4.5.2 Limitations of Factor Models

While factor models provide a structured framework for analyzing stock returns, several limitations may prevent them from fully capturing the drivers of sin stock performance:

- **Omitted Variables**: Traditional models overlook risks unique to sin industries, such as litigation, regulatory scrutiny, or ethical exclusion, which can materially affect returns.
- **Model Instability**: The influence of certain factors can shift over time and across various economic conditions. Additionally, factor loadings often differ by region, which limits the models' generalizability and makes cross-market comparisons less reliable.
- **Overfitting and Data Mining**: Expanding models with multiple factors can improve in-sample fit, but often fail to predict future performance. Many factors are empirically driven with limited theoretical justification, raising concerns about robustness and spurious correlations.
- **Theoretical Limitations**: Factor models are based on assumptions of rational pricing and efficient markets. However, sin stocks are frequently excluded from portfolios due to non-financial considerations, suggesting that pricing may also reflect social norms, reputation concerns, or institutional policies, factors outside standard risk frameworks.
- **Neglect of Behavioral and Social Dynamics**: These models do not account for investor biases, identity-driven behavior, or the effects of norm-based exclusion. For example, sin stocks may be under-owned not due to risk, but because certain investors avoid them for ethical or reputational reasons. This effect lies outside the scope of typical factor-based explanations.

Despite these limitations, factor models continue to serve as a useful benchmark in asset pricing. Still, their inability to fully explain persistent stock outperformance points to the need for complementary approaches that integrate behavioral, social, and institutional perspectives.

4.6 Risk-Adjusted Performance Ratios

Risk-adjusted return ratios measure excess returns relative to risk exposure, providing insight into whether sin stocks' outperformance is a reward for higher risk or a result of market inefficiencies. These ratios enable a more comprehensive evaluation of returns, providing insights beyond raw performance figures.

The Sharpe Ratio by Sharpe (1966) measures excess return per unit of total risk (standard deviation), making it a valuable metric for comparing investments with different volatility

levels. However, it assumes a normal return distribution, which may not always hold in practice. The Treynor Ratio, introduced by Treynor (1965), refines this approach by adjusting for systematic risk, using beta to assess the amount of excess return generated per unit of market risk. This makes it particularly relevant for studies based on asset pricing models.

Since both ratios penalize upside and downside volatility equally, the Sortino Ratio by Sortino & Price (1994) improves upon them by considering only downside risk, making it more suitable for evaluating stock portfolios if their return distributions are skewed.

The ratios are defined as follows:

$$SR = \frac{R_p - R_f}{\sigma_p}, \qquad TR = \frac{R_p - R_f}{\beta_p}, \qquad SoR = \frac{R_p - R_f}{\sigma_d}$$

Where R_p is the portfolio return, R_f is the risk-free rate, σ_p is the standard deviation, β_p represents systematic risk exposure, and σ_d captures downside risk.

By comparing these ratios across different portfolio constructions, this study aims to determine whether sin stocks' excess returns are justified by their risk profile or indicate persistent pricing anomalies.

4.7 Theoretical Summary and Empirical Relevance

Together, these theories provide a multidimensional lens for analyzing sin stock performance. EMH raises the question of whether observed returns reflect mispricing or risk-based compensation. At the same time, behavioral finance and utility theory suggest that investor biases and ethical preferences may cause persistent underpricing. MPT highlights the diversification benefits sin stocks can offer, and multi-factor models help isolate whether known risk factors explain returns. However, limitations in these models, particularly their inability to capture non-financial drivers, underscore the need for broader analytical approaches. These combined perspectives form the foundation for the empirical analysis that follows.

5 Methodology

This section outlines the methodological framework used to investigate whether European sin stocks deliver abnormal returns after accounting for systematic risk. It begins by detailing the selection and classification of alcohol, tobacco, and gambling stocks, followed by the construction of sin stock portfolios under multiple weighting schemes. The study then introduces the benchmark index and describes the regression models applied, ranging from CAPM to the extended Fama-French 5-Factor + a defensive factor (FF5+DEF) specification. Data handling procedures, diagnostic tests, and robustness checks, such as subsample analysis and industry-specific tests, are also discussed to ensure the validity and reliability of the results.

5.1 Sample Selection

This section outlines the approach used to identify and construct the European sin stock portfolios analyzed in this study. Focusing on alcohol, tobacco, and gambling firms, the selection process combines Standard Industrial Classification (SIC), North American Industry Classification System (NAICS), and FactSet's Revere Business Industry Classification System classifications to ensure accurate industry representation.

Unlike much of the existing literature focused on U.S. markets, this study examines European-listed sin stocks to offer a regional perspective. Key steps include defining the geographic and time scope, applying consistent classification criteria, and constructing portfolios using multiple weighting schemes. These steps provide a solid foundation for the empirical analysis that follows.

5.1.1 Geographic Scope

This study focuses on sin stocks listed in European markets, covering stocks from 24 countries. While alcohol, tobacco, and gambling industries have been widely examined in the literature, most empirical research has concentrated on U.S. data. As a result, less is known about how sin stocks perform in Europe, where regulatory frameworks, investor behavior, and cultural norms differ significantly.

Focusing on Europe helps address this gap and allows for the use of region-specific models, such as the Fama-French European 5-Factor model, ensuring more accurate risk adjustment and more relevant insights for European markets.

5.1.2 Period

The sample encompasses monthly return data from December 2005 to December 2024, spanning 19 years and 228 observations. This timeframe includes key euro area recessions, as identified by the European Central Bank (ECB): the Global Financial Crisis (2008 - 2009), the European Sovereign Debt Crisis (2011 - 2013), and the COVID-19 recession (2020). These events ensure that the analysis reflects a variety of market conditions. The dataset provides sufficient length and variation for robust time-series regression analysis.

5.1.3 Industry Classification

This study defines sin stocks as publicly listed European firms operating in the alcohol, tobacco, and gambling sectors. These industries are widely recognized in the literature as the core of so-called "sin investing." Hong & Kacperczyk (2009) refer to them as the “triumvirate of sin,” noting their association with addictive products and negative social consequences when overconsumed.

Companies are identified using a combination of SIC and NAICS codes, both of which categorize firms based on their primary business activities. These codes are used to screen firms involved in the targeted sin sectors, which are typically excluded from ethical portfolios using exclusionary screening (see Tables 1 and 2 for industry classifications by SIC and NAICS codes, respectively).

Table 1: Sin Stock Classification by SIC Codes

Industry	Description	SIC-Code	Stocks	Beginning Market Cap
Alcohol	Malt Beverages	2082	19	43.936
	Malt	2083	0	-
	Wines, Brandy, and Brandy Spirits	2084	10	858
	Distilled and Blended Liquors	2085	6	51.232
	Beer and Ale	5181	0	-
	Wine and Distilled Alcoholic Beverages	8182	2	310
	Drinking Places (Alcoholic Beverages)	5813	1	58
	Liquor Stores	5921	2	982
Tobacco	Cigarettes	2111	5	20.380
	Cigars	2121	1	39.660
	Chewing and smoking Tobacco	2131	0	-
	Tobacco Stemming and Redrying	2141	0	-
	Tobacco and tobacco products	5194	0	-
	Tobacco Stores and Stands	5993	0	-
Gambling	Hotels and Motels	7011	2	772
	Coin-Operated Amusement Devices	7993	2	293
	Amusement and Recreation Services, Not Elsewhere Classified	7999	8	13.406

Sin stocks are classified by Standard Industrial Classification (SIC) codes into the alcohol, tobacco, and gambling industries. The table reports the SIC code, number of included stocks, and beginning market capitalization (in millions). Firms are included only if both SIC and NAICS codes align with sin sectors and at least 50% of revenue comes from these activities.

Table 2: Sin Stock Classification by NAICS Codes

Industry	Description	NAICS-Code	Stocks	Beginning Market Cap
Alcohol	Malt Manufacturing	311213	0	-
	Breweries	312120	19	43.936
	Wineries	312130	10	858
	Distilleries	312140	6	51.232
	Beer and Ale Merchant Wholesalers	424810	0	-
	Wine and Distilled Alcoholic Beverage Merchant Wholesalers	424820	2	310
	Beer, Wine, and Liquor Retailers	445320	3	1.040
	Drinking Places (Alcoholic Beverages)	722410	0	-
Tobacco	Tobacco Manufacturing	312230	6	60.040
	Tobacco Product and Electronic Cigarette Merchant Wholesalers	424940	0	-
	Tobacco, Electronic Cigarette, and other Smoking Supplies Retailers	459991	0	-
Gambling	Casinos (except Casino Hotels)	713210	3	2.899
	Other Gambling Industries	713290	7	10.799
	Casino Hotels	721120	2	772

This table uses North American Industry Classification System (NAICS) codes to categorize sin stocks. It includes the NAICS code, number of stocks, and beginning market capitalization (in millions). As with SIC, firms are included based on code alignment and a minimum 50% revenue share from alcohol, tobacco, or gambling.

Due to the broad nature of some SIC categories, for example, 7011 ("Hotels and Motels") includes both casino and non-gambling businesses, firms are only included if both their SIC and NAICS codes clearly align with sin-related activities.

To further ensure that a company's primary business is sin-related, a revenue threshold is applied. Firms must derive at least 50% of their total revenue from alcohol, tobacco, or gambling operations. This is verified using FactSet's RBICS, which provides detailed revenue segmentation. When RBICS data is unavailable, company annual reports are reviewed to confirm the revenue source manually.

5.1.4 Portfolio Construction

This study constructs portfolios using 58 publicly listed sin stocks from 24 European countries, divided into three categories: 40 alcohol-related, 6 tobacco, and 12 gambling firms. At the end of 2005, their market capitalizations were €97 billion (alcohol), €60 billion (tobacco), and €14 billion (gambling). These disparities naturally concentrate alcohol in portfolios when they are weighted equally and by market value.

To analyze performance, three portfolio construction methods are applied:

- **Equal-Weighted (EW):** Each stock receives the same weight, regardless of size or industry. This method emphasizes smaller firms and avoids large-cap bias.
- **Value-Weighted (VW):** Stocks are weighted by market capitalization, resulting in a concentrated portfolio—over 56% of the weight comes from the top three firms, and the top five exceed 75%. Individual stock weights range from <0.01% to over 20%.
- **Industry-Weighted (IW):** Each sin industry receives one-third of the portfolio weight, with stocks equally weighted within each group.

Table 3 summarizes the industry-level portfolio weights and average market capitalizations under each strategy. Table 4 complements this by showing the average stock weight within each industry across the three weighting methods.

Table 3: Portfolio Weights and Average Market Capitalization by Strategy

Industry	EW	VW	IW
Alcohol	69%	57%	33%
Tobacco	10%	35%	33%
Gambling	21%	8%	33%
Avg. Market Cap.	3.0	24.0	1.5

The table shows industry weights and average market caps (in € billions) for Equal-Weighted (EW), Value-Weighted (VW), and Industry-Weighted (IW) portfolios.

Table 4: Average Individual Stock Weights by Industry and Portfolio Strategy

Industry	EW	VW	IW
Alcohol	1,72%	1,42%	0,83%
Tobacco	1,72%	5,82%	5,56%
Gambling	1,72%	0,70%	2,78%

The table displays the average stock weight within each industry for each portfolio type.

Each weighting method creates distinct portfolio characteristics. EW emphasizes smaller firms and overrepresents industries with a higher number of constituents, such as the alcohol industry. VW is dominated by large-cap stocks and significantly underweights sectors with fewer or smaller firms, such as the gambling industry. IW balances industry representation but gives greater weight to individual stocks in sectors with fewer constituents, such as tobacco. These structural differences influence exposure to firm size and sector concentration, with implications for return behavior and risk. Notably, the limited number of tobacco stocks and the concentration of VW heighten exposure to idiosyncratic risk, potentially affecting performance stability and model explanatory power.

EW and IW portfolios are rebalanced monthly to maintain consistent weights—standard practice in empirical studies, though such frequency may not be realistic due to transaction costs (Kim & Kose, 2014). This thesis adopts the EW portfolio as the primary specification, as it offers a more balanced view of aggregate stock performance without being skewed by a few dominant firms. VW and IW serve as robustness checks. In addition, each sin industry is evaluated individually using equal-weighted portfolios to explore sector-specific return patterns.

5.1.5 Benchmark Selection

To assess sin stock performance, this study uses the STOXX Europe 600 Index as the benchmark, as it offers broad market coverage of 600 European stocks, including small-cap companies. It is preferred over the MSCI Europe Index as it includes a larger number of stocks and captures a wider range of small-cap firms. Given that the sin portfolio primarily consists of stocks with a market capitalization below €300 million, the STOXX Europe 600 Index serves as a more representative benchmark for evaluating sin stock returns.

The index is free-float market-cap weighted, as outlined in the STOXX index methodology guide, with the constructed sin portfolio accounting for approximately 3% of the total index by the end of 2024.[1] However, there may be additional sin stocks within the index that are not included in the sin portfolio. The greater the proportion of sin stocks in the index, particularly those included in the sin portfolio, the more closely their returns will align. However, a 3% allocation is considered relatively small and unlikely to have a significant impact on overall index performance.

A key structural difference lies in the weighting method: the sin stock portfolio is equal-weighted, giving greater influence to smaller firms, whereas the benchmark is value-weighted. This may result in performance differences, especially if small-cap sin stocks behave differently from their larger counterparts.

5.1.6 Data Cleaning

This study uses logarithmic returns rather than simple returns, as they allow for easier multi-period analysis, improve statistical properties, and align with continuous compounding, making them well-suited for regression-based modeling. While less intuitive than simple returns, particularly in volatile markets, their advantages in consistency and analytical precision justify their use.

To address extreme values, winsorization is applied at the 1st and 99th percentiles. This method limits the influence of outliers without removing data, helping to preserve overall integrity. Winsorization is applied to both individual sin stock returns and the market portfolio, ensuring that unusually large price movements do not skew the analysis. This step enhances regression stability and provides a more accurate reflection of average stock performance relative to the market.

[1] The total free-float market capitalization of the STOXX Europe 600 Index was approximated using the top 10 constituents. Their combined free-float market cap was divided by their cumulative index weight to estimate the index's total capitalization. The sin stocks' share was then calculated as a proportion of this estimate. Due to methodological approximations, the actual figure may be slightly below 3%

5.1.7 Data Sources and Tools

Monthly return data is sourced from FactSet and adjusted for dividends and stock splits. Factor data is retrieved from Kenneth French's data library to ensure compatibility with standard asset pricing models. The ECB provides the 1-year yield, which is used as the risk-free rate, along with market cycle classifications.

Data sources:

- FactSet: sin stock and market returns
- Kenneth French Library: factor data
- ECB: 1-year yield and market cycle periods

Statistical analysis is conducted in R, while Excel is used for data organization, cleaning, and formatting before modeling.

5.2 Regression Models and Empirical Methodology

This subsection describes the empirical methodology used to assess whether the performance of sin stock portfolios can be explained by their exposure to systematic risk factors. A series of time-series regression models is employed, including the single-factor CAPM, the Fama-French 3-factor (FF3) and 5-factor (FF5) models, and an extended version that adds a defensiveness factor (FF5+DEF). These models are estimated using monthly excess returns and established econometric techniques to ensure robustness and reliability. In addition to estimating factor sensitivities and abnormal returns, the models are subjected to a series of validation tests to assess assumptions such as linearity, homoscedasticity, independence of errors, and multicollinearity. This analytical framework forms the foundation for testing the study's hypotheses, including whether sin stocks deliver abnormal returns, exhibit defensive traits during downturns, and whether their performance has declined over time.

5.2.1 Regression Model Specifications

To estimate the relationship between sin stock returns and systematic risk factors, this study employs a series of time-series regression models, each incorporating a different set of explanatory variables. The models range from the single-factor CAPM to an extended six-factor model that includes the DEF factor alongside the FF5 factors.

The following specifications are estimated:

$$R_i - R_f = \alpha_i + \beta_i MKT + \varepsilon_i \quad \text{(CAPM)}$$

$$R_i - R_f = \alpha_i + \beta_i MKT + s_i SMB + h_i HML + \varepsilon_i \quad \text{(FF3)}$$

$$R_i - R_f = \alpha_i + \beta_i MKT + s_i SMB + h_i HML + r_i RMW + c_i CMA + \varepsilon_i \quad \text{(FF5)}$$

$$R_i - R_f = \alpha_i + \beta_i MKT + s_i SMB + h_i HML + r_i RMW + c_i CMA + d_i DEF + \varepsilon_i \quad \text{(FF5+DEF)}$$

where $R_i - R_f$ represents the excess return of the sin stock portfolio, calculated as the portfolio return minus the risk-free rate. The intercept α_i measures abnormal returns beyond risk-based compensation. The explanatory factors include MKT, SMB, HML, RMW, CMA, and DEF. The error term ε_i captures residual variation unexplained by the model.

5.2.2 Risk Factors and Construction of the DEF Variable

The MKT is based on the STOXX Europe 600 Index, representing the developed European equity market. The remaining FF factors, SMB, HML, RMW, and CMA, are sourced from the Kenneth R. French Data Library's European 5-Factor set, covering 16 developed European countries (Appendix 1). Expressed in euros and not continuously compounded, these follow the standard Fama-French 2×3 portfolio construction method: stocks are sorted by size and then by book-to-market, profitability, or investment to form six value-weighted portfolios per dimension. Details are provided in Appendix 2.

To capture risk characteristics not explained by the FF5 model, this study introduces a sixth factor, DEF, which measures relative exposure to defensive versus cyclical industries. This addition is motivated by evidence, such as Salaber (2009), suggesting that sin stocks, particularly in tobacco and alcohol, often behave like defensive assets due to their production of essential or habit-forming goods with inelastic demand. These traits can lead to stable cash flows and greater resilience during economic downturns. The DEF factor is constructed as a

long-short portfolio based on Morningstar's Super Sector classification: the long leg comprises defensive sectors, while the short leg includes cyclical sectors. Monthly value-weighted returns for each leg are sourced from Kenneth French's 49 Industry Portfolios and log-transformed before inclusion in the regression models.

Appendices 4 and 5 list the included industries and their SIC codes for the cyclical and defensive legs, respectively, while Appendix 3 provides background on the Super Sector structure. Note that some gambling-related firms may be grouped into broader cyclical categories such as hotels or entertainment, due to the general nature of SIC classifications.

This factor is integrated into the FF5+DEF model to evaluate whether sin stock returns are driven by defensive sector exposure rather than unexplained abnormal returns.

5.2.3 Hypothesis Testing and Statistical Significance

This study tests whether sin stock returns can be fully explained by standard risk factors or if they exhibit persistent abnormal returns. The hypotheses are defined as:

- **Null Hypothesis (H_0):** Sin stocks do not earn abnormal returns ($\alpha = 0$); risk factors account for all performance.
- **Alternative Hypothesis (H_1):** Sin stocks earn positive abnormal returns ($\alpha > 0$), indicating potential mispricing, market inefficiencies, or behavioral biases.

Significance is evaluated using p-values, with thresholds set at the 1%, 5%, and 10% levels.

Alongside alpha, the estimated factor loadings *(β, s, h, r, c, d)* indicate the portfolio's exposure to systematic risks, such as market movements, firm size, value orientation, profitability, investment conservatism, and defensiveness. Significant coefficients suggest that sin stock returns are systematically influenced by these characteristics, helping to explain their performance patterns relative to the broader market.

5.2.4 Model Fit and Comparison

Model performance is evaluated using Adjusted R^2, which indicates how well each model explains variations in stock returns while accounting for model complexity. A higher Adjusted R^2 implies better explanatory power without overfitting.

Comparing Adjusted R^2 across the models helps assess whether adding more risk factors improves the model's fit. A noticeable increase suggests that the additional factors capture relevant drivers of return.

However, suppose the alpha remains statistically significant in the most comprehensive model. In that case, it implies that sin stocks may deliver abnormal returns not fully explained by traditional risk factors, pointing to potential mispricing or behavioral influences.

5.2.5 Diagnostic Tests & Model Validity

To ensure the validity of the regression models and the robustness of the results, several diagnostic tests are conducted. These tests assess key econometric assumptions, including heteroskedasticity, autocorrelation, functional form specification, multicollinearity, and normality of residuals. Where violations are detected, corrective measures such as robust standard errors are applied to ensure valid inference and model reliability.

- **Heteroskedasticity**: Heteroskedasticity occurs when the variance of the error terms is not constant, potentially leading to inefficient standard errors and unreliable statistical inferences. To test for heteroskedasticity, the White test is employed (White, 1980). If the test detects heteroskedasticity ($p < 0.10$), heteroskedasticity-consistent (HC) standard errors are applied.
- **Autocorrelation**: Autocorrelation, also known as serial correlation, is a common issue in time series regressions, where residuals are correlated over time, thereby violating the assumption of independent errors. To detect autocorrelation, the Durbin-Watson test is performed (Durbin & Watson, 1950). If the test detects autocorrelation ($p < 0.10$), heteroskedasticity and autocorrelation-consistent (HAC) standard errors are applied using the Newey-West estimator to ensure robust inference.
- **Functional Form Misspecification**: To assess whether the linear regression models are appropriately specified, the Ramsey RESET (Regression Equation Specification

Error Test) is applied (Ramsey, 1969). This test checks whether non-linear combinations of the fitted values significantly improve the model, which would suggest omitted variables or structural misspecification. A significant RESET result ($p < 0.10$) indicates potential issues with the model's functional form. While this raises concerns about possible nonlinearities or missing variables, the Fama-French models employed are widely accepted and theoretically grounded. As such, no alternative specification is adopted, and the result is acknowledged as a limitation in order to maintain comparability with prior literature.

- **Multicollinearity**: Multicollinearity arises when explanatory variables are highly correlated, leading to inflated standard errors and unreliable coefficient estimates. To detect multicollinearity, the Variance Inflation Factor (VIF) is computed (O'brien, 2007). High multicollinearity is considered problematic. In such cases, the affected variables are reviewed, but since the Fama-French factors are theoretically orthogonal, no major concerns are expected.
- **Normality of Residuals**: The Jarque-Bera test is used to check if residuals are normally distributed, which is a consideration for inference in small samples (Jarque & Bera, 1987). However, given the large sample size in this study, normality violations are not a critical concern due to the central limit theorem (CLT).

5.3 Robustness checks

To ensure the validity and reliability of the findings, robustness checks are conducted by testing alternative specifications and assessing whether the results hold under different economic conditions. These checks address potential biases and verify the consistency of sin stock performance across various market environments.

5.3.1 Performance During Economic Downturns

To test Hypothesis 2 — that sin stocks exhibit defensive characteristics that make them more resilient during economic downturns — performance is analyzed specifically during periods of recession. This focus isolates how sin stocks behave under adverse macroeconomic conditions and whether they offer downside protection when market and economic stress is elevated.

Recessions are identified using The Euro Area Business Cycle and Its Drivers (Ferroni & Klaus, 2023), published as ECB Occasional Paper No. 354. In this framework, a recession is defined as a period between a peak and a trough, marked by a sustained decline in economic activity, typically measured by at least two consecutive quarters of negative real GDP growth.

The following major synchronized recessions in the EU are used for subsample analysis:

- **Global Financial Crisis (GFC):** 2008 Q1 – 2009 Q1
- **European Debt Crisis:** 2011 Q2 – 2013 Q1
- **COVID-19 Pandemic:** 2019 Q4 – 2020 Q2

Separate regression models are estimated using only data from these recession periods. This approach helps determine whether sin stocks generate significant abnormal returns when the broader economy contracts. Evidence of positive and significant alpha during recessions would support the view that sin stocks are relatively resilient and possess defensive qualities. Conversely, weak or negative performance would suggest vulnerability to economic downturns and challenge the notion of defensiveness.

5.3.2 Structural Breaks and ESG Integration

To examine whether the performance of sin stocks has experienced structural change, potentially in response to the rise of ESG investing, this study conducts robustness checks using both time-varying and subperiod regression techniques. These include 48-month rolling regressions, Chow tests, and pre-/post-2016 performance comparisons (Chow, 1960).

Rolling regressions based on the FF5+DEF model allow for the estimation of evolving factor sensitivities, capturing shifts in market behavior or investor preferences. Special attention is paid to key ESG milestones, notably the Paris Agreement (2015) and the SFDR (2021), to identify potential inflection points.

To formally test for a structural break in sin stock return dynamics, Chow tests are applied using January 1, 2016, as the breakpoint. In parallel, regressions are run separately for the pre- and post-2016 periods to compare changes in alpha and factor exposures. These are compared directly to assess whether performance deterioration reflects a temporary shift or a lasting

structural change. Finally, cumulative alpha from rolling regressions is plotted to visualize whether sin stock outperformance has declined over time.

5.3.3 Weighting Methods and Industry Composition

While portfolio construction methods are introduced in Section 5.1.4, additional robustness checks are conducted to ensure that methodological choices or industry-specific biases do not drive the main results.

This study primarily adopts the EW portfolio to avoid large-cap dominance and to reflect the average performance of sin stocks more evenly. To test the sensitivity of results to portfolio weighting, both VW and IW portfolios are included as robustness checks. VW portfolios tend to emphasize larger firms and may overrepresent dominant players, whereas IW portfolios ensure equal industry representation, thereby mitigating the influence of disparities in constituent count.

To further assess whether any particular sector drives aggregate results, the alcohol, tobacco, and gambling industries are also analyzed independently using equal-weighted portfolios. If performance varies meaningfully across industries or weighting schemes, it would indicate that sin stock returns are not homogeneous and may be shaped by structural characteristics specific to each sector or by the influence of firm size.

5.3.4 Risk-Adjusted Performance

To assess whether sin stock excess returns sufficiently compensate for risk, risk-adjusted return ratios are computed as an additional robustness check. The Sharpe Ratio, Treynor Ratio, and Sortino Ratio are applied to the EW, VW, and IW portfolios, as well as the three industry-specific portfolios, ensuring consistency across different weighting methodologies and sector classifications.

By evaluating these ratios, the study examines whether sin stock returns remain attractive after adjusting for total risk, systematic risk, and downside risk. If sin stocks consistently exhibit strong risk-adjusted performance across portfolio types and industries, it would suggest that their excess returns are not merely compensation for elevated risk but may reflect structural mispricing or unique return characteristics.

5.4 Biases and Limitations

Despite employing rigorous regression techniques and robustness checks, this study is subject to several potential biases that may impact the interpretation of results. One possible concern is survivorship bias, as the dataset consists only of stocks that have remained publicly traded throughout the sample period. Firms that exited the market due to bankruptcy or delisting are not included, which could result in an overestimation of sin stock performance. As highlighted by Brown et al. (1992), excluding failed firms can create the illusion of persistent performance, as only the most successful stocks remain in the sample. While this limitation ensures a consistent dataset for long-term performance analysis, it may distort actual risk-return characteristics.

Additionally, selection bias arises from the specific subset of sin stocks analyzed, potentially limiting the generalizability of the results. The benchmark used in this study, the STOXX Europe 600 index, includes a significantly broader range of stocks across various sectors and market capitalizations. In theory, this broader inclusion makes it a better-diversified benchmark, reducing potential bias in performance comparisons. However, because the sin stock portfolio is more concentrated, its risk-return profile may differ structurally from the market as a whole.

Another issue is omitted variable bias, where factors not included in the regression models could influence the results. While the study incorporates widely accepted risk factors, other variables such as liquidity risk, ESG sentiment shifts, or macroeconomic shocks might also play a role in explaining sin stock returns.

Furthermore, endogeneity concerns could arise due to potential feedback loops between sin stock returns and investor behavior. If investor preferences for or against sin stocks evolve, this could affect both returns and factor exposures, leading to dynamic relationships that static regression models do not fully capture. Lastly, this study relies on historical data, assuming that past relationships between sin stocks and risk factors will persist. Structural changes in financial markets, regulatory shifts, or evolving social norms around sin industries may alter these relationships in the future, limiting the predictive power of the models.

6 Results

This section presents the core empirical findings of the thesis. It begins with descriptive statistics that compare the performance and risk characteristics of sin stock portfolios and the broader market. The analysis then proceeds to test Hypothesis 1 using time-series regressions based on multiple asset pricing models to evaluate the existence of a persistent sin premium. To ensure robustness, results are assessed across different portfolio weighting methods and complemented by alternative risk-adjusted performance metrics. Hypothesis 2 is addressed through recession-focused regressions that examine whether sin stocks offer downside protection during economic downturns. Finally, structural changes in performance are analyzed by comparing pre- and post-2016 periods, in line with Hypothesis 3. Collectively, the section evaluates whether the sin premium holds across industries, conditions, and time.

6.1 Descriptive Statistics

This section presents a summary of the return and risk characteristics of the sin stock portfolios compared to the broader market. Descriptive statistics offer a preliminary view of whether sin stocks provide superior performance and how their risk profiles differ by industry.

Table 5 presents summary statistics for the individual sin industry portfolios, the EW sin portfolio, and the market. These statistics offer insight into performance, volatility, and the distributional characteristics of returns.

Table 5: Descriptive Statistics of Sin Portfolios and Market

Portfolio	Return	SD	Skewness	Kurtosis	Min	Max
Alcohol	7,42%	10,98%	-1,15	7,99	-48,3%	39,9%
Tobacco	9,67%	14,12%	-0,36	3,56	-29,1%	40,2%
Gambling	9,90%	19,42%	-0,55	4,73	-51,2%	42,8%
EW	8,45%	11,16%	-1,23	8,37	-46,4%	40,8%
Market	5,91%	14,39%	-0,68	4,33	-56,4%	27,1%

This table presents summary statistics for the sin industry portfolios (Alcohol, Tobacco, Gambling), the equal-weighted (EW) sin portfolio, and the Market portfolio. Returns, standard deviations (SD), and extremes (Min, Max) are annualized, while skewness and kurtosis are based on monthly returns. The statistics offer insight into the return distribution and risk profiles across portfolios.

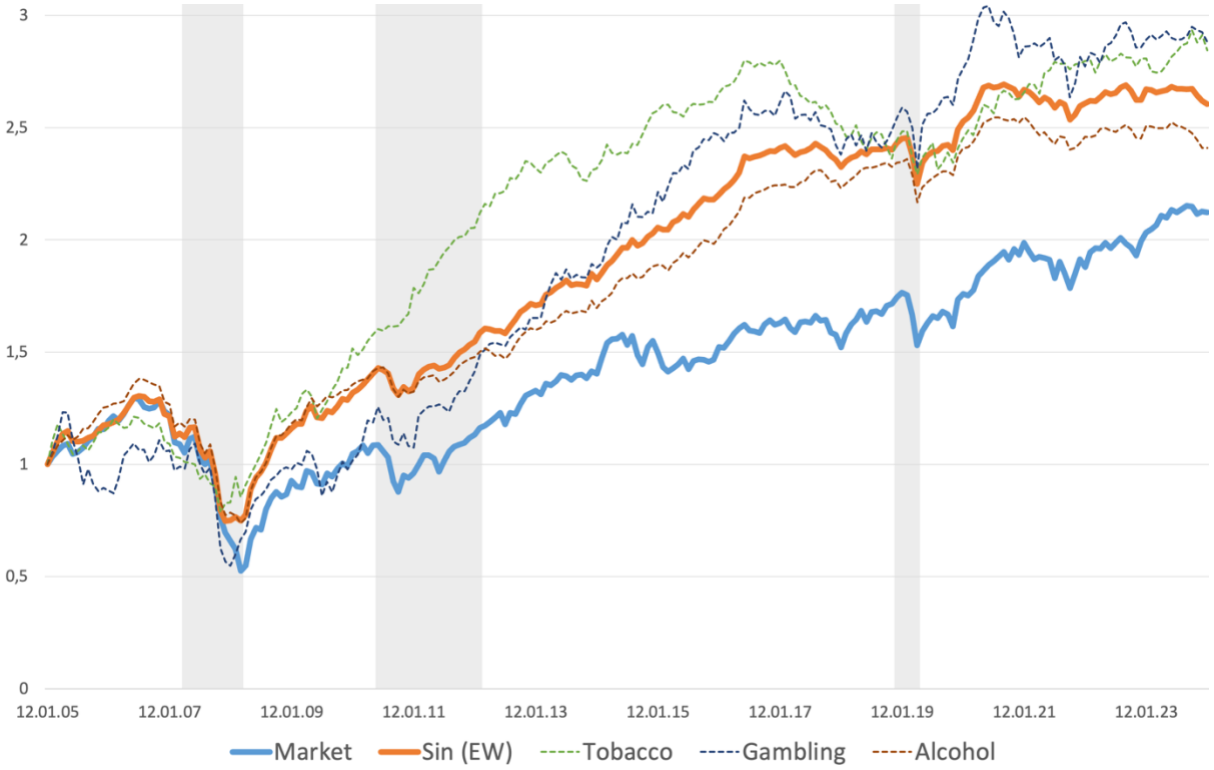
Sin stocks outperform the market on average, with tobacco and gambling showing strong returns. However, this outperformance comes with distinct risk profiles. Gambling exhibits the

greatest volatility and the widest return swings, consistent with a higher risk-reward dynamic. Tobacco offers a more stable profile, combining strong returns with relatively limited downside. Alcohol shows high dispersion, marked by frequent large negative and positive returns.

The EW sin portfolio balances characteristics across industries, offering higher average returns than the market but also greater exposure to negative tail risk, as reflected in its return asymmetry. Collectively, the sin sectors demonstrate that higher returns are attainable but come with varying patterns of risk depending on the industry.

Figure 1 plots the cumulative return performance of the sin stock portfolios and the market index over the sample period. All portfolios experienced sharp declines during the 2007–2008 Global Financial Crisis. However, sin portfolios recovered more rapidly and maintained a consistent lead over the market in the following years. The close alignment between the EW and alcohol portfolios, both visually and statistically, is evident, with a reported correlation of 0.94 (see Appendix 18).

Figure 1: Cumulative Return Performance of Sin Portfolios vs. Market



This figure plots the cumulative performance of the alcohol, tobacco, gambling, and equal-weighted (EW) sin portfolios relative to the market from 2005 to 2024. Index values are normalized to 1 at the start of the period. Shaded areas indicate global recession periods.

6.2 Testing Hypothesis 1

European sin stocks outperform the broader European market in terms of risk-adjusted returns.

This section presents the time series regression results for the EW and industry-level sin stock portfolios to evaluate whether they generate statistically and economically significant alpha. Using the CAPM, FF3, FF5, and FF5+DEF models, this section assesses whether systematic risk factors fully explain sin stock returns or if a persistent sin premium remains. The regressions are based on monthly excess returns, with corrections for heteroskedasticity and autocorrelation applied using HC and HAC standard errors where appropriate.

6.2.1 Equal-Weighted Sin Portfolio

Table 6 presents the regression estimates for the EW sin portfolio. In all models, the alpha is positive and statistically significant, indicating persistent abnormal returns beyond what is captured by standard risk factors.

Table 6: Equal-weighted sin portfolio regression results

	CAPM	FF3	FF5	FF5+DEF
Alpha	0,35**	0,34***	0,28**	0,27**
	(0,14)	(0,12)	(0,12)	(0,12)
MKT	62,53***	61,99***	61,04***	63,86***
	(4,87)	(4,55)	(4,19)	(3,89)
SMB		62,51***	63,56***	66,48***
		(6,48)	(6,02)	(5,89)
HML		3,53	15,39**	18,36***
		(4,06)	(6,97)	(6,97)
RMW			23,09**	21,82*
			(11,5)	(11,65)
CMA			-2,33	-6,69
			(11,16)	(10,57)
DEF				8,13**
				(3,65)
Adjusted R^2	64,1%	76,1%	76,4%	76,6%
N	228	228	228	228

This table presents time-series regression estimates for the equal-weighted sin portfolio over the full sample period, using asset pricing models: CAPM, Fama-French 3-Factor (FF3), Fama-French 5-Factor (FF5), and FF5 + Defensive (DEF) factor. The dependent variable is the portfolio's monthly excess return. Reported values are factor loadings (in percentage points) with standard errors in parentheses. All models are estimated with heteroskedasticity- and autocorrelation-consistent (HAC) standard errors. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

The portfolio exhibits strong exposure to the MKT factor, with highly significant and stable loadings across all models, indicating a clear link to broad equity market movements. The SMB factor is consistently positive and significant, suggesting that the portfolio has a meaningful tilt toward smaller firms, likely reflecting the lower average market capitalizations of many sin stocks.

The HML factor becomes statistically significant in the FF5 and FF5+DEF models. This positive loading on value implies that sin stocks tend to be associated with high book-to-market ratios, consistent with the notion that these firms trade at valuation discounts due to social stigma or ESG exclusions, in line with findings from Hong and Kacperczyk (2009).

The positive and significant RMW coefficients in the FF5 models suggest that the portfolio tilts toward firms with higher operating profitability. This aligns with the notion that some sin industries, particularly tobacco and alcohol, generate consistent cash flows and maintain strong margins.

The CMA factor is insignificant throughout, suggesting that variation in investment intensity does not explain sin stock returns.

Crucially, the inclusion of the DEF factor in the final specification yields a positive and significant loading, indicating that sin stocks behave more like defensive assets — that is, they perform relatively better when defensive industries outperform cyclicals. This supports the idea that sin stocks offer downside protection, aligning with Hypothesis 2.

Model fit improves with additional factors, as reflected in rising adjusted R^2 values, from 64.1% under CAPM to 76.6% in the FF5+DEF model. While the incremental gain from DEF is modest in statistical terms, its economic interpretation is meaningful.

These results provide strong support for Hypothesis 1. The EW sin portfolio consistently delivers statistically and economically meaningful alpha, suggesting a persistent sin premium not fully explained by standard risk exposures, and one that may partially be attributed to value and defensive characteristics.

6.2.2 Alcohol Portfolio

Table 7 reports regression results for the alcohol portfolio. Alpha is positive in all models and statistically significant in the multi-factor models, indicating modest abnormal returns after adjusting for risk factors.

Table 7: Alcohol portfolio regression results

	CAPM	FF3	FF5	FF5+DEF
Alpha	0,28	0,27**	0,22*	0,2*
	(0,18)	(0,12)	(0,12)	(0,12)
MKT	59,31***	58,82***	55,88***	59,4***
	(6,78)	(3,85)	(3,77)	(3,7)
SMB		53,95***	52,85***	56,49***
		(6,83)	(6,12)	(6,42)
HML		3,15	20,13**	23,82***
		(4,18)	(8,09)	(8,21)
RMW			24,91**	23,32*
			(12,06)	(11,94)
CMA			-13,95	-19,37
			(12,2)	(12,5)
DEF				10,13**
				(4,36)
Adjusted R^2	59,6%	68,7%	69,3%	69,6%
N	228	228	228	228

This table presents time-series regression estimates for the alcohol portfolio over the full sample period, using asset pricing models: CAPM, Fama-French 3-Factor (FF3), Fama-French 5-Factor (FF5), and FF5 + Defensive (DEF) factor. The dependent variable is the portfolio's monthly excess return. Reported values are factor loadings (in percentage points) with standard errors in parentheses. CAPM is estimated using heteroskedasticity- and autocorrelation-consistent (HAC) standard errors, while the remaining models use heteroskedasticity-consistent (HC) standard errors. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

The alcohol portfolio shows consistent and significant exposure to the MKT and SMB factors, indicating strong sensitivity to overall market trends and a tilt toward smaller firms, similar to the broader EW portfolio.

What distinguishes the alcohol portfolio from the other industry portfolios is its particularly strong loading on HML and RMW in the FF5 and FF5+DEF models. The positive and significant HML coefficient indicates a pronounced value tilt, consistent with alcohol firms trading at discounted valuations, likely due to persistent ESG-related exclusions. Meanwhile, the positive RMW loading suggests that these firms exhibit solid operating profitability, which aligns with the stable cash flow profiles and high margins typically observed in the alcohol

sector. The CMA factor remains statistically insignificant, reinforcing earlier findings that investment intensity does not meaningfully explain sin stock returns.

Notably, the inclusion of the DEF factor in the final model results in a positive and significant loading, indicating that alcohol stocks tend to behave defensively. This means they are likely to perform relatively well in periods where defensive sectors outperform, lending further support to their resilience characteristics.

While the model fit improves with each specification, rising from an adjusted R^2 of 59.6% under CAPM to 69.6% in the FF5+DEF model, the persistence of significant alpha in the multi-factor models suggests that a portion of the portfolio's return remains unexplained by systematic risk exposures.

Overall, these findings provide additional support for Hypothesis 1, indicating that the alcohol portfolio delivers statistically significant abnormal returns that cannot be fully attributed to risk factor loadings and may reflect the pricing impact of non-financial considerations.

6.2.3 Tobacco Portfolio

Table 8 reports regression estimates for the tobacco portfolio. Alpha is positive and statistically significant across all models, although its magnitude gradually declines as more risk factors are introduced, suggesting that part of the outperformance is absorbed by systematic exposures, though not entirely explained by them.

The portfolio exhibits consistent and significant exposure to the MKT factor, with coefficients slightly increasing in magnitude as the model complexity increases. This indicates that tobacco stocks are moderately sensitive to general market movements, though less so than alcohol or the EW sin portfolio.

The SMB factor becomes statistically significant in the FF5 and FF5+DEF models, implying some degree of exposure to smaller-cap stocks within the tobacco industry. However, SMB loadings are weaker and less stable compared to those observed in the EW and alcohol portfolios.

Table 8: Tobacco portfolio regression results

	CAPM	FF3	FF5	FF5+DEF
Alpha	0,56**	0,55**	0,47*	0,43*
	(0,25)	(0,25)	(0,26)	(0,25)
MKT	42,07***	42,09***	47,99***	55,48***
	(5,93)	(6,2)	(7,33)	(7,92)
SMB		19,17	27,64*	35,39**
		(13,64)	(14,46)	(14,69)
HML		0,11	-5,77	2,1
		(9,54)	(17,19)	(17,34)
RMW			16,65	13,27
			(24,66)	(24,45)
CMA			37,71	26,16
			(23,33)	(23,61)
DEF				21,58**
				(9,17)
Adjusted R^2	17,9%	17,8%	18,2%	19,6%
N	228	228	228	228

This table presents time-series regression estimates for the tobacco portfolio over the full sample period, using asset pricing models: CAPM, Fama-French 3-Factor (FF3), Fama-French 5-Factor (FF5), and FF5 + Defensive (DEF) factor. The dependent variable is the portfolio's monthly excess return. Reported values are factor loadings (in percentage points) with standard errors in parentheses. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

The HML, RMW, and CMA factors are statistically insignificant across all specifications, suggesting that tobacco stock returns are not meaningfully explained by standard value, profitability, or investment exposures. This is somewhat counterintuitive given that tobacco firms often exhibit high margins and low valuations.

Importantly, the DEF factor enters positively and significantly in the FF5+DEF specification. This reinforces the interpretation of tobacco stocks as defensive assets, capable of providing stability during periods when cyclical stocks underperform. This is consistent with their non-cyclical demand and stable cash flow profiles.

Overall model fit remains relatively low, with adjusted R^2 values ranging between 17.9% and 19.6%. This reflects a high level of idiosyncratic return variation, possibly stemming from firm-specific regulation, litigation risks, or concentrated industry structure, all of which may not be fully captured by standard factor models.

With only six equally weighted firms, the tobacco portfolio is exposed to firm-level outliers. Bulgartabac's poor performance and high volatility contrast with Karelia's strong returns,

while global firms like BAT and Philip Morris are more stable. This dispersion suggests that idiosyncratic effects may distort results and limit generalizability.

These findings provide strong support for Hypothesis 1. The tobacco portfolio consistently generates statistically significant alpha, confirming tobacco's central role in generating the sin premium.

6.2.4 Gambling Portfolio

Table 9 presents the regression results for the gambling portfolio. Across all model specifications, alpha is positive but statistically insignificant, indicating no evidence of persistent abnormal returns beyond what is explained by standard risk factors.

Table 9: Gambling portfolio regression results

	CAPM	FF3	FF5	FF5+DEF
Alpha	0,37	0,34	0,27	0,28
	(0,33)	(0,26)	(0,27)	(0,27)
MKT	83,84***	82,68***	84,97***	82,89***
	(10,51)	(6,58)	(7,81)	(8,54)
SMB		112,39***	117,04***	114,88***
		(14,47)	(15,41)	(15,84)
HML		7,31	11,11	8,93
		(10,12)	(18,32)	(18,7)
RMW			20,87	21,81
			(26,28)	(26,36)
CMA			16,77	19,99
			(24,86)	(25,46)
DEF				-6
				(9,89)
Adjusted R^2	38,1%	50,9%	50,7%	50,6%
N	228	228	228	228

This table presents time-series regression estimates for the gambling portfolio over the full sample period, using asset pricing models: CAPM, Fama-French 3-Factor (FF3), Fama-French 5-Factor (FF5), and FF5 + Defensive (DEF) factor. The dependent variable is the portfolio's monthly excess return. Reported values are factor loadings (in percentage points) with standard errors in parentheses. CAPM is estimated using heteroskedasticity- and autocorrelation-consistent (HAC) standard errors. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

The portfolio exhibits strong and highly significant exposure to both the MKT and SMB factors across all models. This suggests that gambling stocks are closely tied to general equity market fluctuations and disproportionately tilted toward smaller-cap firms, likely reflecting the presence of several regionally focused or niche operators within the sector.

In contrast, the HML, RMW, and CMA factors are statistically insignificant throughout. This implies that gambling stocks do not exhibit consistent value, profitability, or investment characteristics as defined by the Fama-French framework. One potential reason is the sector's heterogeneity and high earnings volatility, which can obscure clear structural patterns in book-to-market ratios or profit margins. Many gambling firms operate in rapidly evolving regulatory environments, particularly in online segments, which may weaken the explanatory power of traditional factor models.

Notably, the DEF factor is also insignificant, with a negative but non-significant loading. This contrasts with the alcohol and tobacco portfolios and indicates that gambling stocks lack defensive characteristics, a finding consistent with their more cyclical business models.

While the adjusted R^2 increases substantially from the CAPM to the FF3 model, rising from 38.1% to 50.9%, it plateaus or slightly declines in the FF5 and FF5+DEF models, reflecting diminishing returns from additional factor complexity.

In summary, the gambling portfolio's returns appear to be largely explained by market and size exposures, with no evidence of a persistent sin premium. These findings do not support Hypothesis 1 in the case of gambling stocks, highlighting that sin stock outperformance is not uniform across industries, and may be concentrated in sectors with more stable cash flows and defensive characteristics.

Hypothesis 1 Summary:

The regression results provide broad support for Hypothesis 1: that European sin stocks earn positive and, in several cases, statistically significant risk-adjusted returns. The EW, alcohol, and tobacco portfolios all deliver economically meaningful alphas, particularly under multi-factor models.

Table 10 summarizes alpha estimates across all portfolios and models, with the EW sin and tobacco portfolios showing the strongest and most consistent significance, followed by alcohol. In contrast, the gambling portfolio does not exhibit significant alpha in any model, suggesting its returns are fully explained by market and size exposures.

Across portfolios, there is consistent sensitivity to market and size factors, while exposures to value and profitability are more industry-specific. Notably, the DEF factor loads positively for

tobacco and alcohol, reinforcing their defensive profiles. Gambling, however, shows no defensive behavior or abnormal returns.

These findings are consistent with the presence of a sin premium, though it appears concentrated in sectors characterized by relatively stable fundamentals and inelastic demand. The observed outperformance is not uniform across all sin stocks but is more pronounced in industries such as tobacco and alcohol.

Table 10: Summary of Alpha Estimates Across Portfolios and Models

Portfolio	CAPM	FF3	FF5	FF5+DEF
EW	0,35**	0,34***	0,28**	0,27**
	(0,14)	(0,12)	(0,12)	(0,12)
Alcohol	0,28	0,27**	0,22*	0,20*
	(0,18)	(0,12)	(0,12)	(0,12)
Tobacco	0,56**	0,55**	0,47*	0,43*
	(0,25)	(0,25)	(0,26)	(0,25)
Gambling	0,37	0,34	0,27	0,28
	(0,33)	(0,26)	(0,27)	(0,27)

This table presents monthly time-series regression alpha coefficients (in percentage points) and their standard errors (in parentheses) for each sin stock portfolio under four asset pricing models. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

6.3 Testing Hypothesis 2

Sin stocks exhibit defensive characteristics that make them more resilient during economic downturns.

Hypothesis 2 explores whether sin stocks demonstrate defensive characteristics during recessions, such as milder losses, lower sensitivity to market movements, or relatively higher returns, compared to the broader market. To examine this, the analysis isolates recession periods and evaluates the return behavior of sin portfolios using both descriptive statistics and time-series regressions.

The objective is to assess whether sin stocks tend to offer downside protection. The analysis begins with summary metrics, followed by regression results for the EW sin portfolio and its industry components, enabling both aggregate and sector-level insights. As the recession

subsample comprises only 38 months, compared to 228 in the full sample, statistical power is limited, and results should be interpreted accordingly.

Table 11 presents annualized returns, standard deviations, and market betas during recessions. On average, sin stock portfolios experience smaller losses than the market. The EW sin portfolio shows a return of -11.4%, while the tobacco portfolio stands out with a positive return of 9.4%. The alcohol portfolio records the largest decline among sin sectors but does so with lower volatility. Gambling combines higher volatility with moderately negative returns.

Market beta values help gauge sensitivity to downturns. Tobacco shows a beta of 0.37, significantly below 1, indicating that it tends to move less with the broader market during recessions. Alcohol and EW also exhibit lower-than-market betas, suggestive of more muted responses to economic contractions.

Table 11: Descriptive statistics during recession periods

Metrics	Market	EW	Tobacco	Gambling	Alcohol
Mean	-21,3%	-11,4%	9,4%	-6,3%	-16,5%
SD	19,4%	17,1%	18,0%	25,7%	16,3%
Beta	1,00	0,72	0,37	0,96	0,70

This table reports annualized mean returns, standard deviations (SD), and market betas for the Market, EW sin portfolio, and individual sin industries during recession periods.

Table 12 presents recession-period regression results for the EW sin portfolio and its underlying sectors. The EW portfolio generates statistically significant alpha of 0.52% per month implies an annual excess return of over 6%, which is substantial in a low-yield environment and indicates material outperformance not captured by common risk factors. While it maintains significant exposure to market and size factors, the loading on the DEF factor is negative and insignificant. This suggests that the portfolio's outperformance is not driven by traits typically associated with defensive stocks, such as low volatility or stable earnings, but may instead reflect other, unmodeled characteristics.

The sector-level regressions reveal more differentiated patterns. Among the three industries, tobacco aligns most closely with classical defensive behavior. It records a statistically significant alpha along with a positive and significant DEF coefficient. These results imply that the portfolio not only outperforms during recessions but does so through exposure to attributes commonly linked with defensiveness, such as non-cyclical demand and lower earnings

sensitivity. This is consistent with prior expectations based on the industry's consumer staple classification and stable cash flow profile.

In contrast, gambling also exhibits significant abnormal returns during recessions, yet its DEF loading is negative and statistically insignificant. This indicates that while the sector performs well, it does not exhibit defensiveness in the traditional sense. Instead, the persistence of alpha despite the removal of the best-performing stocks suggests resilience may stem from alternative sources—such as demand substitution effects, firm-specific factors, or structural underpricing—rather than standard defensive attributes.

The alcohol sector shows neither significant alpha nor a positive DEF coefficient. Despite relatively stable fundamentals and lower observed volatility, its regression profile does not point to defensiveness as captured by the factor model. This suggests that the sector behaves more cyclically during downturns, and its returns are largely indistinguishable from those of the broader market.

Table 12: Recession-Period Regression Results for EW and Industry Portfolios

	EW	Tobacco	Gambling	Alcohol
Alpha	0,52*	1,24*	1,6**	0,06
	(0,29)	(0,72)	(0,6)	(0,31)
MKT	77,4***	101,29***	88,34***	70,59***
	(8,03)	(19,62)	(16,49)	(8,44)
SMB	67,67***	59,87*	152,26***	42,88***
	(12,66)	(30,93)	(26)	(13,3)
HML	-15,37	-85,16*	-16,41	-4,1
	(19,44)	(47,48)	(39,92)	(20,42)
RMW	-6,74	-54,06	-6,77	0,53
	(24,01)	(58,66)	(49,32)	(25,23)
CMA	13,95	90,95*	14,57	2,01
	(21,71)	(53,02)	(44,58)	(22,8)
DEF	-7,75	41,42*	-22,28	-10,84
	(9,67)	(23,62)	(19,86)	(10,16)
Adjusted R^2	89,0%	41,0%	79,3%	86,7%
N	38	38	38	38

This table reports time-series regression estimates for the equal-weighted (EW) sin portfolio and its industry components (tobacco, gambling, and alcohol) during recession periods using the FF5 plus the DEF (defensive) factor model. Reported coefficients represent monthly factor loadings (in percentage points) with standard errors in parentheses. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

Table 13 presents the difference in alpha estimates between the full period and the recession subsample. Gambling records the largest gain (+1.32%), significant at the 5% level. Tobacco follows with a gain of +0.81%. The EW sin portfolio shows a modest increase, while alcohol sees a small decline. These results suggest that, on average, sin portfolios perform more strongly during recessions, though the underlying mechanisms vary across sectors and may not align with standard defensive factor models.

Table 13: Change in Alpha Estimates – Recession vs. Full Period

Period	EW	Alcohol	Tobacco	Gambling
Full Period/Recession	0,25	-0,15	0,81	1,32**

This table reports the difference in alpha estimates between the full sample period and the recession subsample for the EW sin portfolio and individual sin industries. A positive value reflects a higher monthly alpha during recessions, indicating improved downturn performance. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

To test robustness, sensitivity checks that adjust the recession windows by ±3 months and vary their duration confirm that the results are not materially driven by specific start and end definitions (see Appendices 6 and 7).

Additional support is provided by an examination of individual recession episodes (Appendix 8). During the Global Financial Crisis (2008–2009), all portfolios experienced sharp losses, with alcohol performing worst among the sin sectors. Conversely, the European Sovereign Debt Crisis (2011–2013) saw above-average returns for most portfolios, particularly tobacco. Maximum drawdown data (Appendix 9) reinforce these observations, showing that all sin portfolios experienced smaller peak-to-trough losses than the market during the financial crisis period. Among them, tobacco stood out with the mildest drawdown and a shorter recovery horizon, further underscoring its comparatively defensive characteristics.

Hypothesis 2 Summary:

The empirical evidence provides support for Hypothesis 2: sin stocks exhibit defensive characteristics during economic downturns, though the effect is sector-specific. The EW sin portfolio outperforms the market during recessions and shows higher alpha estimates compared to the full-sample results. However, this excess return is not explained by traditional defensive factors, suggesting alternative drivers of resilience.

Among individual industries, tobacco stands out as the most defensive component, consistently delivering strong and statistically significant alpha, coupled with low market beta and a positive

loading on the DEF factor. These traits underscore its robustness in downturns. In contrast, alcohol fails to exhibit defensive behavior, showing neither significant alpha nor DEF exposure, despite stable fundamentals. Gambling demonstrates surprising strength during recessions, with the largest increase in alpha and potential countercyclical behavior, though without a clear link to the DEF factor.

Robustness checks, including varying recession definitions and drawdown analysis, affirm the stability of these findings. Overall, the results validate the hypothesis that sin stocks, particularly tobacco, offer downside protection in recessions, but also highlight that defensiveness is not uniform across the sin universe.

6.4 Testing Hypothesis 3

The abnormal performance of European sin stocks has declined over time, potentially reflecting increased ESG integration or changing investor preferences.

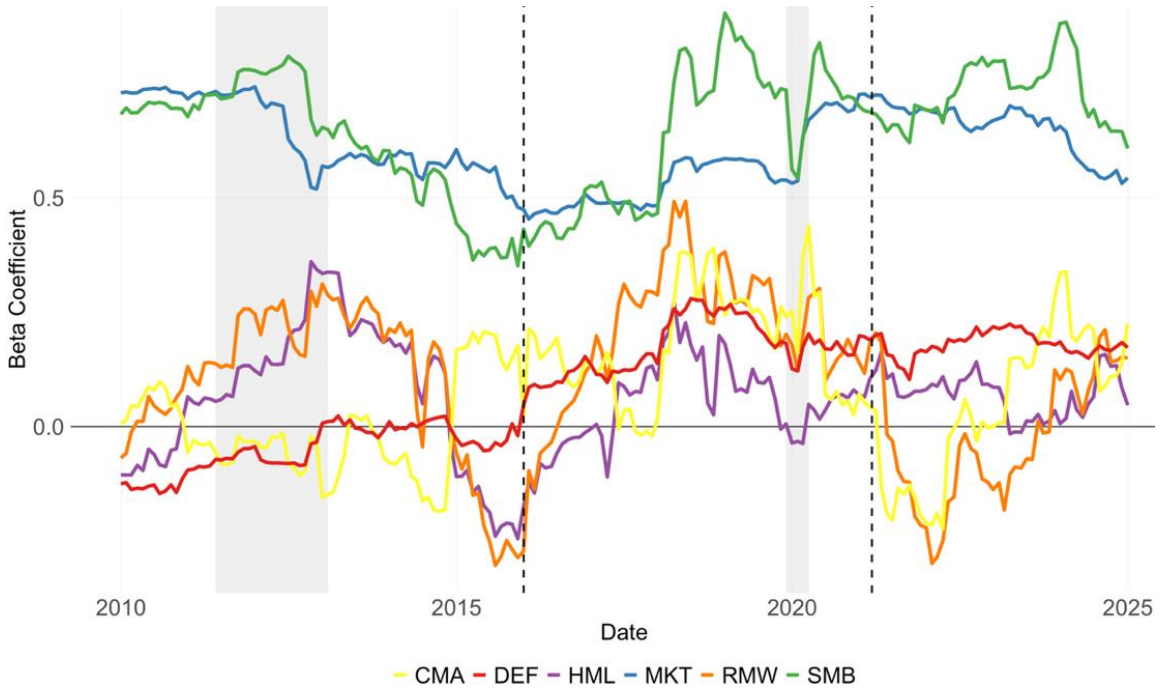
This section tests whether sin stock outperformance has weakened over time, focusing on structural changes after the Paris Agreement in 2016. The analysis combines rolling regressions to track changes in factor exposures and alpha with structural break tests (Chow tests and subperiod regressions) to detect significant shifts post-2016. These methods capture both gradual and abrupt changes.

6.4.1 Rolling Regressions and Factor Dynamics

Figure 2 displays 48-month rolling beta coefficients from FF5+DEF regressions on the EW sin portfolio, allowing for an assessment of how the portfolio's factor exposures evolve over time. Throughout the sample period, the MKT and SMB factors exhibit consistently positive loadings, though their magnitudes fluctuate, suggesting ongoing sensitivity to broad equity market movements and smaller firm effects. The DEF factor shows a gradual upward trend in loading over time, particularly after 2016, which may reflect increasing alignment with defensive characteristics, although this interpretation should be approached cautiously, as the loading remains modest and at times unstable.

Other factors—HML, RMW, and CMA—display greater volatility and lack consistent significance, highlighting the time-varying and sometimes transitory nature of exposures to value, profitability, and investment characteristics. These patterns underscore the dynamic risk profile of the sin stock portfolio, which does not maintain fixed relationships with any single set of factors but instead appears responsive to broader shifts in market conditions and, potentially, investor sentiment.

Figure 2: 48-Month Rolling Factor Loadings — FF5+DEF Model for EW Sin Portfolio



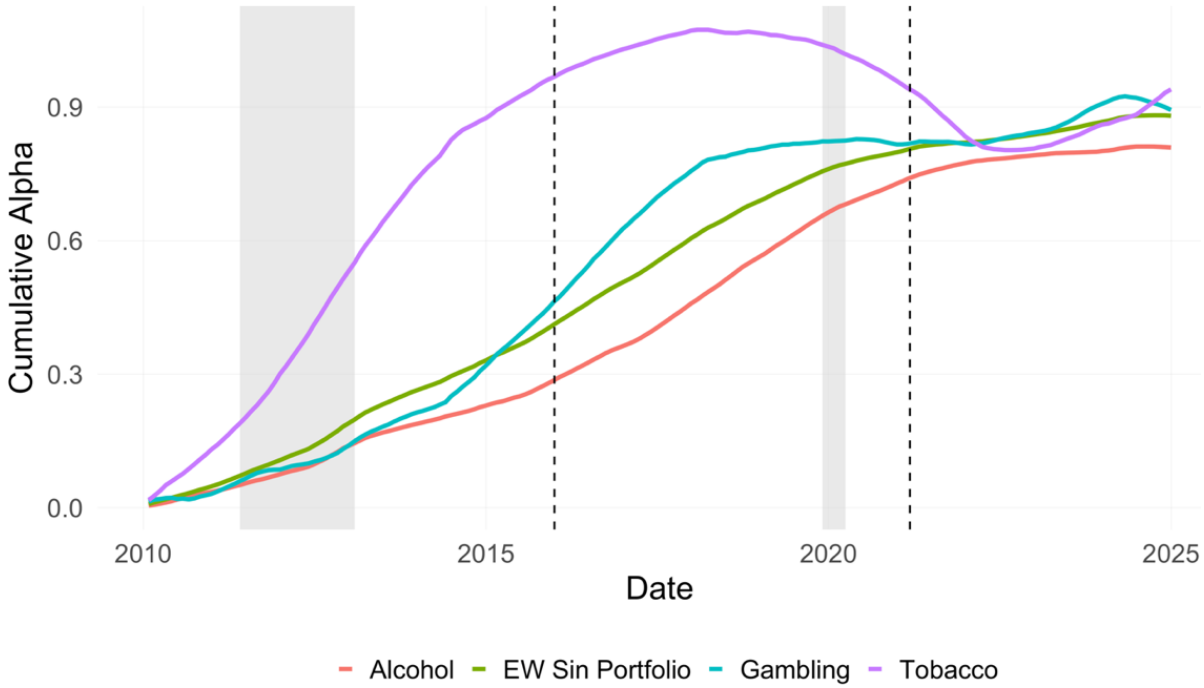
This figure shows 48-month rolling beta coefficients from time-series regressions of the FF5+DEF model on the equal-weighted (EW) sin stock portfolio. The chart plots exposures to six risk factors: MKT (market), SMB (size), HML (value), RMW (profitability), CMA (investment), and DEF (defensive). Shaded areas indicate periods of economic downturns. Betas are estimated using overlapping monthly windows to capture time-varying factor sensitivities.

Figure 3 presents the cumulative alpha series from the same rolling regressions for the EW portfolio and its three sin industry components. Before 2016, the cumulative alpha steadily increased for all portfolios, with tobacco exhibiting the strongest trajectory. However, after 2016, and particularly following the 2021 implementation of the SFDR, the accumulation of alpha slows, flattens, or even declines. This shift is most pronounced in the tobacco portfolio, whose cumulative alpha peaks and then begins to decline after the Paris Agreement and SFDR milestones.

These trends indicate that the cumulative alpha of sin portfolios, particularly tobacco, has grown at a slower pace or declined in more recent years. While the visual evidence does not

imply causality, the timing overlap may reflect broader changes in the investment landscape, including regulatory developments and shifts in investor preferences.

Figure 3: 48-Month Cumulative Alpha for Sin Portfolios



This figure plots cumulative alpha from rolling 48-month FF5+DEF regressions for the equal-weighted sin portfolio and its three constituent industries. The dashed vertical lines mark the timing of major ESG policy events, the Paris Agreement (2016) and the SFDR (2021), while the shaded areas indicate periods of economic recession. Together, these visual cues contextualize the observed slowdown in alpha accumulation, particularly for Tobacco, suggesting that both regulatory shifts and macroeconomic conditions have influenced the evolving performance of sin stocks.

6.4.2 Subperiod Analysis and Structural Breaks

To test for a shift in return dynamics around key ESG-related events, Chow tests were performed using January 1, 2016, as the breakpoint. Table 14 shows significant breaks for the EW sin and alcohol portfolios, suggesting a shift in return-risk relationships coinciding with the post-2016 period, associated with rising ESG integration. Tobacco and gambling do not exhibit significant breaks at conventional levels.

Table 14: Chow Test P-Values

	EW	Tobacco	Gambling	Alcohol
Chow Test P-Value	0,0%	20,4%	63,6%	0,0%

This table reports p-values from Chow tests for structural breaks in FF5+DEF regressions of various sin stock portfolios using January 1, 2016, as the breakpoint. Statistically significant values suggest a structural shift in the return-generating process,.

The statistically significant p-values for the EW and alcohol portfolios (0.0%) provide strong evidence of structural breaks in their return-generating processes around 2016. This coincides with the Paris Agreement and the rise of ESG-driven capital reallocation in Europe, suggesting that ESG developments may have influenced investor behavior and asset pricing in certain sin sectors. In contrast, the lack of significant breaks for tobacco and gambling may reflect a more gradual repricing or sector-specific dynamics. For tobacco, existing exclusion policies and regulatory pressure before 2016 may have led to earlier or slower shifts not captured by the breakpoint.

To better understand these structural shifts, Table 15 presents descriptive return statistics for sin portfolios before and after 2016. The data show a clear drop in average returns post-2016 across all sin industries, with the most pronounced decline observed in the tobacco portfolio.

Table 15: Descriptive Statistics Pre- and Post-2016

Period	Metrics	Market	EW	Tobacco	Gambling	Alcohol
< 2016	Mean	4,3%	10,4%	15,9%	11,6%	8,8%
	SD	15,4%	12,1%	14,2%	19,7%	12,2%
	Beta	1,00	0,65	0,46	0,73	0,65
≥ 2016	Mean	7,7%	6,3%	2,8%	8,0%	5,9%
	SD	13,2%	10,1%	13,9%	19,2%	9,4%
	Beta	1,00	0,59	0,36	1,00	0,51

This table presents the annualized mean returns, standard deviations (SD), and market betas of the equal-weighted sin portfolio and its components, Tobacco, Gambling, and Alcohol, compared to the market, across pre- and post-2016 January periods.

The EW portfolio's average return declines from 10.4% to 6.3% after 2016, despite a market improvement, indicating relative underperformance. Tobacco's average return falls sharply from 15.9% to 2.8%, suggesting a substantial loss of alpha. Although gambling and alcohol also experience declines, they retain a relatively strong post-2016 return.

To complement these results, Table 16 provides regression results from the FF5+DEF model estimated separately for the pre- and post-2016 periods. The regression results show that alpha estimates decline across all portfolios post-2016. For the EW portfolio, alpha falls from 0.43% to 0.22%, reflecting a substantial reduction in abnormal returns. Tobacco exhibits the most dramatic drop, with alpha shrinking from 0.93% to 0.05%, effectively eliminating its sin premium. In contrast, alcohol maintains a stable alpha of around 0.24%, suggesting it is relatively resilient to ESG-driven shifts.

Table 16: Regression Results Before and After 2016

	EW Before	EW After	Tobacco Before	Tobacco After	Gambling Before	Gambling After	Alcohol Before	Alcohol After
Alpha	0,43***	0,22	0,93**	0,05	0,57	0,13	0,28	0,24
	(0,15)	(0,15)	(0,37)	(0,37)	(0,44)	(0,36)	(0,17)	(0,16)
MKT	66,61***	60,89***	60,5***	47,61***	76,48***	91,87***	64,62***	53,57***
	(4,43)	(4,91)	(10,6)	(12,31)	(12,58)	(12,11)	(4,96)	(5,33)
SMB	67,27***	76,32***	40,47**	31,16	109,88***	111,14***	58,42***	72,59***
	(7,8)	(10,11)	(18,68)	(25,34)	(22,16)	(24,94)	(8,75)	(10,98)
HML	10,06	8,49	-13,67	-6,53	-17,73	7,61	22,17*	11,19
	(11,17)	(10,04)	(26,75)	(25,16)	(31,74)	(24,76)	(12,52)	(10,9)
RMW	12,31	28,4**	-17,35	32,84	-12,36	26,24	24,86	28,14*
	(15,23)	(14,07)	(36,47)	(35,24)	(43,26)	(34,69)	(17,07)	(15,27)
CMA	-16,62	26,13	-0,55	69,64*	-16,93	53,13	-18,4	11,52
	(12,77)	(15,83)	(30,58)	(39,65)	(36,27)	(39,03)	(14,31)	(17,18)
DEF	-1,49	16,84***	18,73	18,79	-11,1	-2,75	-2,02	22,4***
	(5,19)	(5,51)	(12,42)	(13,8)	(14,73)	(13,59)	(5,81)	(5,98)
Adjusted R^2	82,4%	73,3%	27,0%	11,6%	46,1%	55,4%	78,5%	64,1%
N	120	108	120	108	120	108	120	108

This table presents regression coefficients (in percentage points) and standard errors (in parentheses) for sin stock portfolios estimated before and after January 1, 2016, using the FF5+DEF model. This comparison highlights changes in alpha generation and factor loadings around the ESG inflection point marked by the Paris Agreement.

Factor loadings also evolve meaningfully. The DEF factor becomes more strongly positive post-2016, especially for the EW and alcohol portfolios, indicating increased similarity to defensive stocks. Loadings on CMA and RMW—proxies for investment conservatism and profitability—also rise, pointing to a growing alignment with high-quality characteristics. The decline in HML exposure implies a reduced association with traditional value stocks.

Table 17 quantifies the change in alpha estimates before and after 2016. The decline is statistically significant for the tobacco portfolio, with smaller, non-significant reductions observed for the EW and gambling portfolios. These patterns are consistent with a potential weakening of the sin premium in recent years and may coincide with increased ESG integration, such as investor exclusions and regulatory developments like the SFDR.

Table 17: Change in Alpha Estimates – Pre-2016 vs. Post-2016

Period	EW	Alcohol	Tobacco	Gambling
Pre/Post 2016	-0,21	-0,04	-0,87*	-0,44

This table shows the difference in alpha estimates between the pre-2016 and post-2016 periods for the equal-weighted (EW) sin portfolio and individual sin industries. Negative values indicate a decline in alpha after 2016. Values represent the change in monthly alpha (in percentage points). Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

Hypothesis 3 Summary:

The results provide evidence consistent with Hypothesis 3: the abnormal performance of European sin stocks has declined over time. Rolling regressions reveal that cumulative alpha accumulation slowed after 2016, most notably for tobacco, coinciding with major ESG policy events. Chow tests confirm significant structural breaks in the EW and alcohol portfolios, and regression estimates show broad declines in alpha across all portfolios in the post-2016 period, with the tobacco portfolio experiencing the sharpest reduction. While these shifts do not establish causality, their timing aligns with the growing influence of ESG regulations and investor reallocation, suggesting a potential role in reshaping sin stock performance. Nonetheless, some sectors, like alcohol, appear less affected, indicating that the erosion of the sin premium is uneven across industries.

6.5 Robustness Checks

This section tests the robustness of the sin premium by examining how portfolio weighting (EW, VW, IW) and risk-adjusted metrics affect performance. Sharpe, Sortino, and Treynor ratios are analyzed across the full sample, recessions, and pre-/post-2016 periods.

Results support Hypothesis 1, showing superior risk-adjusted returns for portfolios emphasizing smaller or diversified firms. Limited recession resilience offers some support for Hypothesis 2, while post-2016 declines align with Hypothesis 3, potentially reflecting growing ESG influence. Overall, the sin premium varies with portfolio design and market conditions.

6.5.1 Portfolio Construction Effects

This subsection examines how different portfolio weighting methods—equal-weighted (EW), value-weighted (VW), and industry-weighted (IW)—influence the performance of sin stock portfolios. The purpose is to assess whether the observed sin premium is sensitive to portfolio construction. The analysis draws on both descriptive statistics and regression-based factor model estimates to evaluate return profiles, volatility, and market sensitivity.

Table 18 highlights apparent differences in performance across weighting methods. All sin portfolios deliver higher returns than the market and exhibit lower market sensitivity. The IW portfolio appears most favorable overall, while the EW strategy also performs well, both

benefiting from greater exposure to smaller firms. The VW portfolio underperforms slightly, reflecting its bias toward large-cap, stable firms and concentration in a few dominant stocks. These variations underscore the importance of weighting choice in capturing the sin premium.

Table 18: Descriptive Statistics by Weighting Method

Metrics	Market	EW	VW	IW
Mean	5,91%	8,45%	8,13%	9,47%
SD	14,39%	11,16%	13,84%	11,85%
Beta	1,00	0,62	0,64	0,61

This table presents annualized mean returns, standard deviations (SD), and CAPM betas for sin stock portfolios constructed using equal-weighted (EW), value-weighted (VW), and industry-weighted (IW) approaches, as well as the overall market.

Figure 4 shows cumulative returns for the three weighting strategies over the sample period, alongside the market index. The EW and IW portfolios are closely aligned, consistent with their high return correlation (0.94; see Appendix 18). Overall, all weighting methods perform relatively similarly, though the VW portfolio appears to have held up best during the financial crisis period.

Figure 4: Cumulative Returns by Weighting Strategy

This figure shows cumulative return trajectories for equal-weighted (EW), value-weighted (VW), and industry-weighted (IW) sin portfolios, compared to the market benchmark. Shaded regions represent recession periods.

Table 19 shows that the VW portfolio generates low and statistically insignificant alphas across all model specifications, indicating that its returns are largely accounted for by standard risk factors. As additional factors are included, alpha estimates decline, suggesting that systematic exposures, rather than unexplained performance, drive returns in this portfolio.

Table 19: Value-weighted sin portfolio regression results

	CAPM	FF3	FF5	FF5+DEF
Alpha	0,32	0,3	0,11	0,05
	(0,2)	(0,2)	(0,2)	(0,19)
MKT	64,5***	67,77***	77,33***	88,37***
	(4,76)	(4,9)	(5,59)	(5,83)
SMB		-21,4**	-5,47	5,96
		(10,78)	(11,03)	(10,81)
HML		-17,48**	-17,08	-5,48
		(7,54)	(13,11)	(12,77)
RMW			50,44**	45,46**
			(18,81)	(18)
CMA			64,54***	47,5***
			(17,79)	(17,38)
DEF				31,81***
				(6,75)
Adjusted R^2	44,5%	46,3%	50,2%	53,9%
N	228	228	228	228

This table presents time-series regression estimates for the value-weighted sin portfolio over the full sample period, using asset pricing models: CAPM, Fama-French 3-Factor (FF3), Fama-French 5-Factor (FF5), and FF5 + Defensive (DEF) factor. The dependent variable is the portfolio's monthly excess return. Reported values are factor loadings (in percentage points) with standard errors in parentheses. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

The significant negative loading on SMB in the FF3 model implies a tilt toward larger-cap firms, consistent with the VW portfolio's construction. However, this effect becomes weaker in the FF5 and FF5+DEF models. The positive and significant coefficients on RMW, CMA, and DEF indicate that the portfolio has exposure to firms with higher profitability, more conservative investment behavior, and some defensive characteristics. These associations reflect underlying traits of the dominant large-cap firms in the portfolio, rather than providing evidence of abnormal performance.

As noted in Section 5.1.4, the VW portfolio is highly concentrated, with over 75% of its weight in just five firms. British American Tobacco alone accounts for approximately 2.36 percentage points of the average return, followed by Diageo (1.86%) and Imperial Brands (0.95%). Most other stocks contribute less than 0.1%. This concentration suggests that the VW portfolio's performance is shaped by a few large-cap firms, limiting the generalizability of its results to the broader sin stock universe.

Table 20 presents the regression estimates for the IW portfolio. Alpha remains statistically significant across all models, suggesting that the portfolio achieves returns not fully explained by standard factor exposures. The consistently positive and significant SMB loading reflects the portfolio's tilt toward smaller firms, while the DEF factor indicates alignment with defensive characteristics, such as relatively stable performance during downturns. In contrast, loadings on HML, RMW, and CMA are not statistically significant, implying that value, profitability, and investment intensity have less explanatory power for this portfolio's returns. These results highlight that the IW portfolio's performance may be more closely linked to size and defensiveness than to other firm characteristics typically captured in multi-factor models.

Table 20: Industry-weighted sin portfolio regression results

	CAPM	FF3	FF5	FF5+DEF
Alpha	0,44**	0,43***	0,36**	0,34**
	(0,19)	(0,15)	(0,14)	(0,14)
MKT	61,59***	61,1***	62,85***	65,89***
	(6,37)	(4,63)	(4,54)	(4,15)
SMB		61,92***	65,9***	69,05***
		(8,06)	(7,66)	(7,7)
HML		3,24	8,15	11,34
		(6,06)	(9,57)	(10,18)
RMW			20,64	19,26
			(14,68)	(15,12)
CMA			13,44	8,75
			(12,17)	(12,25)
DEF				8,75**
				(4,27)
Adjusted R^2	55,2%	65,6%	65,8%	66,2%
N	228	228	228	228

This table presents time-series regression estimates for the industry-weighted sin portfolio over the full sample period, using asset pricing models: CAPM, Fama-French 3-Factor (FF3), Fama-French 5-Factor (FF5), and FF5 + Defensive (DEF) factor. The dependent variable is the portfolio's monthly excess return. Reported values are factor loadings (in percentage points) with standard errors in parentheses. All models are estimated with heteroskedasticity- and autocorrelation-consistent (HAC) standard errors. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

The IW closely mirrors the EW portfolio (Table 6), with both maintaining statistically significant alpha estimates across time and model complexity, as confirmed by recession regressions for the IW portfolio (Appendix 11). In contrast, the VW portfolio fails to produce significant alpha in any model or economic condition (Appendix 10), suggesting that large-cap sin stocks do not drive the observed outperformance. These findings provide partial support for

Hypothesis 1, indicating that superior risk-adjusted returns are more evident among sin stock portfolios not dominated by large-cap firms.

6.5.2 Risk-Adjusted Performance Metrics

To complement regression-based findings, this section examines the risk-return characteristics of sin stock portfolios using standard risk-adjusted performance metrics: the Sharpe ratio, Sortino ratio, and Treynor ratio. These measures capture different dimensions of performance—overall volatility, downside risk, and market exposure, respectively—and serve as a robustness check for Hypotheses 1 through 3. Results are presented for the full sample, recession periods, and pre- and post-2016 subsamples.

As shown in Table 21, all three sin weighting methods outperform the market across all three metrics over the full period. The IW and EW portfolios deliver the strongest risk-adjusted performance, while the VW portfolio lags, consistent with its weaker regression-based alpha. These differences underscore the role of portfolio construction in capturing the sin premium, in line with Hypothesis 1.

Table 21: Risk-Adjusted Performance Metrics — Total Period and Recession

Period	Ratio	Market	EW	VW	IW	Alcohol	Tobacco	Gambling
Total Period	Sharpe	0,35	0,68	0,53	0,73	0,60	0,63	0,47
	Sortino	0,50	0,98	0,81	1,09	0,85	0,98	0,69
	Traynor	0,05	0,12	0,11	0,14	0,11	0,21	0,11
Recession	Sharpe	0,00	0,00	0,00	0,00	0,00	0,48	0,00
	Sortino	0,00	0,00	0,00	0,00	0,00	0,98	0,00
	Traynor	0,00	0,00	0,00	0,00	0,00	0,16	0,00

This table reports Sharpe, Sortino, and Treynor ratios for the market, sin stock portfolios (EW, VW, IW), and individual sin industries over the full sample and recession periods. Values of zero reflect non-positive average excess returns.

At the industry level, all three sectors exceed market performance over the full period, though with variation in risk profiles. The tobacco portfolio achieves the highest risk-adjusted performance across all three ratios, followed by alcohol, while the gambling portfolio records the lowest

During recession periods, risk-adjusted returns drop to zero across all portfolios, except for the tobacco industry, which maintains strong values on all three metrics, indicating some downside resilience. While this pattern is not broad enough to generalize as sector-wide defensiveness, it provides some empirical support for Hypothesis 2 when interpreted cautiously.

Table 22 presents risk-adjusted performance before and after 2016**.** In the pre-2016 period, all sin portfolios exhibit higher Sharpe, Sortino, and Treynor ratios, with particularly strong Sortino values indicating high returns relative to downside risk. In contrast, post-2016 results show a broad decline in all three metrics across sin portfolios, most notably in the VW specification, while the market portfolio improves. This shift is consistent with the observed drop in alpha and provides further support for Hypothesis 3

Table 22: Risk-Adjusted Performance Metrics — Pre- vs. Post-2016

Period	Ratio	Market	EW	VW	IW	Alcohol	Tobacco	Gambling
< 2016	Sharpe	0,19	0,75	0,85	0,91	0,61	1,02	0,52
	Sortino	0,32	1,43	1,25	1,34	1,24	1,55	0,85
	Traynor	0,03	0,14	0,18	0,18	0,12	0,31	0,14
≥ 2016	Sharpe	0,56	0,60	0,17	0,51	0,60	0,18	0,40
	Sortino	0,67	0,65	0,27	0,78	0,60	0,29	0,54
	Traynor	0,07	0,10	0,04	0,09	0,11	0,07	0,08

This table reports Sharpe, Sortino, and Treynor ratios for the market, sin stock portfolios (EW, VW, IW), and individual sin industries before and after 2016.

Although industry-level ratios decline after 2016, particularly in the tobacco sector, alcohol continues to exhibit moderate performance relative to the market. This suggests that ESG repricing has been uneven across sectors. These findings support Hypothesis 3 and underscore the time-dependent nature of the sin premium.

Summary

Overall, the results from risk-adjusted metrics are broadly consistent with regression-based findings. Sin portfolios, particularly those emphasizing smaller or less institutionally held firms, outperform the market over the full sample period, in line with Hypothesis 1. Limited evidence of recession-period resilience points to qualified support for Hypothesis 2, concentrated in a single industry. The clear reduction in performance ratios after 2016 aligns with Hypothesis 3, suggesting that changes in ESG integration and market segmentation have altered return dynamics over time.

While these ratios offer useful descriptive insights, they should be interpreted as complementary to, rather than substitutes for, regression-based alpha estimates, especially given their sensitivity to distributional assumptions and sample volatility.

6.6 Model Diagnostics and Validity Assessment

To assess the reliability of the regression findings, several diagnostic tests were conducted.

The White test for heteroskedasticity detects significant heteroskedasticity ($p < 0.10$) in multiple models, particularly in the EW and Alcohol portfolios and in CAPM specifications. To address this, HC standard errors were applied where necessary. Importantly, all portfolios and their respective models retained their original alpha significance levels at the 1%, 5%, or 10% thresholds following the correction. See Appendix 12 for White test results.

The Durbin-Watson test for autocorrelation indicates mild serial correlation in certain models, particularly in the CAPM specifications ($p < 0.10$). To address this, HAC standard errors were applied to ensure robust inference. Notably, the CAPM models for the alcohol and IW portfolios experienced declines in alpha significance levels following the correction. Alcohol CAPM went from 5% to above 10%, and IW CAPM went from 10% to above 10%. See Appendix 13 for Durbin-Watson test results.

The RESET test results reveal several instances of misspecification, particularly in the CAPM model and within the EW and Alcohol portfolios. These findings suggest that simpler models may fail to capture relevant nonlinearities or omitted variable dynamics, thereby reinforcing the suitability of more comprehensive specifications such as the FF5+DEF model. See Appendix 15 for RESET test results across all portfolios and periods.

The Jarque-Bera test for normality suggests deviations from normality in some models, particularly in the EW portfolio and generally in the CAPM models ($p < 0.10$). However, given the CLT and the large sample size, this does not meaningfully impact inference. See Appendix 14 for Jarque-Bera test results.

The VIF test for multicollinearity confirms that all factor loadings remain low, indicating that multicollinearity is not a concern (see Appendix 16).

Overall, the tests confirm that corrections for heteroskedasticity and autocorrelation were effectively applied. Although some misspecification and non-normality were detected, mainly in simpler models, no adjustments were made to maintain consistency with established asset pricing frameworks. Multicollinearity was not an issue. The results remain robust, though specification limitations should be noted.

7 Discussion

This section interprets the central empirical results of the thesis by evaluating each of the three hypotheses in turn. The analysis draws on multifactor regressions, risk-adjusted performance metrics, and structural industry characteristics to assess whether European sin stocks deliver abnormal returns, how they behave under economic stress, and how their performance has evolved. Each hypothesis is discussed with reference to relevant literature and economic rationale, highlighting not only statistical findings but also underlying sector-level dynamics and portfolio design considerations. In doing so, the discussion links empirical results with broader implications for investors, market efficiency, and ethical investing frameworks.

7.1 Hypothesis 1: Risk-Adjusted Outperformance

Hypothesis 1 proposes that European sin stocks outperform the broader market in terms of risk-adjusted returns. The results offer partial but compelling support, particularly through the EW portfolio, which serves as the primary specification in this thesis. The EW portfolio consistently generates statistically significant alpha across all asset pricing models, indicating that sin stocks, when smaller, potentially underpriced firms are given equal influence, deliver excess returns not captured by conventional risk factors.

The role of portfolio construction is critical. The IW portfolio, which balances exposure across alcohol, tobacco, and gambling, also produces significant alpha. This robustness indicates that the sin premium is not solely an artifact of a single weighting strategy. In contrast, the VW portfolio fails to generate statistically significant alpha in any of the models. This underperformance appears to be linked to a concentration in large-cap stocks, which may be more efficiently priced. These findings align with those of Adamsson and Hoepner (2015), who demonstrate that sin premium effects are weaker in VW portfolios and reinforce the view that performance differences stem in part from the construction of these portfolios.

These differences align with findings by Blitz and Fabozzi (2017), who contend that sin stock returns are often attributable to standard risk factor exposures. In this thesis, the VW portfolio, unlike the EW and IW portfolios, is the only one significantly exposed to RMW, CMA, and DEF simultaneously, suggesting its returns are largely driven by these priced risks. By contrast,

EW and IW portfolios show strong and significant exposure to SMB, reflecting their tilt toward smaller firms. Yet despite accounting for these exposures, both portfolios continue to deliver positive and statistically significant alpha, implying that risk premia alone cannot fully explain the outperformance. These results support the view that sin stocks, especially smaller and potentially less institutionally held ones, benefit from persistent mispricing.

At the industry level, performance is heterogeneous. Tobacco and alcohol both generate statistically significant alpha, reinforcing prior findings (e.g., Fabozzi et al., 2008; Richey, 2017) that these sectors possess structural advantages such as inelastic demand and concentrated market power. Gambling, by contrast, fails to deliver significant alpha despite relatively high raw returns and instead shows elevated volatility, suggesting returns are more reflective of exposure to systematic risk than to pricing anomalies. These differences caution against treating sin stocks as a homogeneous category and underscore the importance of sector-level analysis in both research and portfolio management.

Risk-adjusted performance metrics further support these findings. All sin portfolios and industries outperform the market on Sharpe, Sortino, and Treynor ratios. Even portfolios without significant alpha, such as those of VW and gambling, achieve relatively efficient returns in relation to risk.

For investors, these results carry practical implications. The evidence suggests that portfolio design, particularly the inclusion of smaller and potentially less institutionally held firms, can materially influence exposure to the sin premium. Actively managed or quantitatively structured strategies that deviate from standard cap-weighted benchmarks may benefit from including such stocks, especially if they are unconstrained by ESG mandates. Conversely, rigid exclusionary screening may forgo return opportunities, particularly when applied uniformly across sectors. For ESG-conscious investors, this invites a reassessment of screening frameworks and opens the door to more nuanced strategies, such as best-in-class or engagement-based investing.

Taken together, the results provide robust evidence in support of Hypothesis 1, albeit with certain qualifications. The sin premium is concentrated in specific portfolio constructions and industries, especially those emphasizing smaller firms. This supports the idea that investor norms and capital flow restrictions, rather than fundamental risk, are central to explaining persistent abnormal returns in European sin stocks.

7.2 Hypothesis 2: Defensive Traits and Economic Downturns

Hypothesis 2 suggests that sin stocks exhibit defensive traits that enhance their resilience during economic downturns. The empirical results present a mixed but nuanced picture. In the full sample period, all three composite sin portfolios—EW, VW, and IW—exhibit significant positive loadings on the DEF factor, alongside the alcohol and tobacco industry portfolios. This suggests that sin stocks generally exhibit defensive behavior when evaluated over the entire period. However, only the tobacco portfolio retains significant DEF exposure during recessionary periods, suggesting that its defensiveness is more robust and persistent under economic stress.

This result aligns closely with findings from Salaber (2009), who highlights that sin stock outperformance during recessions is concentrated in industries with stable demand. Tobacco fits this pattern: it is often classified as a consumer staple, benefits from inelastic demand, and is characterized by low price elasticity. These features support continued profitability across recessions and help explain the persistence of both alpha and DEF exposure during downturns. Additionally, the tobacco industry's quasi-monopolistic structure and pricing power may further reinforce its defensive role.

In contrast, the alcohol industry shows a more conditional form of defensiveness. While it loads positively on the DEF factor in the full sample, this relationship breaks down during recessions, where it fails to generate statistically significant alpha. This may reflect its hybrid nature, straddling both discretionary and staple consumption, which makes demand more elastic across income brackets or cultural contexts. These findings complicate its classification as a reliably defensive sector and suggest that its risk-return profile is more cyclical than often assumed.

Gambling presents a distinctive case. Despite high volatility and a lack of DEF exposure, the portfolio generates statistically significant alpha during recessions and shows a significant increase in alpha relative to the full sample. While this could point to firm-specific dynamics, such as strong performance by online operators or increased demand for low-cost entertainment, a robustness test shows that the alpha persists even after removing the top performers. This indicates that the result is not driven by outliers, but reflects a broader pattern of sector resilience not captured by traditional defensive factors.

Interestingly, both the EW and IW portfolios deliver significant positive alpha during recessions despite losing their DEF exposure. This suggests that sin stocks may exhibit defensiveness not in the traditional sense captured by the DEF factor—typically associated with low-volatility, stable cash flow sectors like utilities—but through alternative mechanisms. These include inelastic demand, regulatory protections, pricing power, or institutional neglect. In essence, sin stocks may be defensive in terms of outcome, but not in terms of factor profile.

The tilt toward smaller firms in EW and IW portfolios could also play a role. Size exposure and diversification benefits may allow these portfolios to exploit persistent mispricings that are less sensitive to macroeconomic cycles. This highlights how non-traditional defensive behavior can emerge even in the absence of standard defensive loadings.

From a practical standpoint, these findings offer important implications for investors and asset allocators. Tobacco stands out as the most consistent defensive asset among the sin industries, potentially serving as a stabilizing force in diversified portfolios. For investors seeking downside protection, particularly those unconstrained by ESG mandates, its inclusion may improve portfolio resilience. In contrast, alcohol's more cyclical behavior and gambling's speculative characteristics raise questions about their defensive nature.

Overall, while sin stocks exhibit certain defensive properties, these attributes are unevenly distributed and not fully captured by traditional asset pricing factors. Tobacco combines structural resilience with persistent alpha and significant DEF exposure during downturns, making it the most consistent defensive asset among the sin sectors. Alcohol demonstrates weaker, context-dependent defensiveness, with mixed results across economic conditions. Gambling, although lacking DEF exposure, shows statistically significant and robust outperformance during recessions, even after excluding top-performing firms, indicating broader sector resilience. These findings challenge the notion of a uniform "defensive sin stock" category and underscore the importance of sector-specific analysis when designing resilient portfolios.

7.3 Hypothesis 3: Evolving Returns and ESG Pressures

Hypothesis 3 proposes that the abnormal performance of sin stocks has declined over time, potentially reflecting growing ESG integration, regulatory change, or evolving investor preferences. The empirical evidence strongly supports this hypothesis. Rolling regressions reveal a noticeable deceleration in alpha accumulation after 2016, particularly in the tobacco portfolio. Subperiod regressions confirm that the previously significant alphas in both the EW and tobacco portfolios lose statistical significance in the post-2016 period. Chow tests further detect structural breaks in the performance of EW and alcohol portfolios, marking a shift in return dynamics.

These patterns might reflect ESG-driven repricing. Since 2016, coinciding with the Paris Agreement and the rise of sustainable finance regulation, sin portfolios have shown increasing exposures to priced risk factors such as RMW, CMA, and DEF. Meanwhile, HML loadings have declined across all portfolios. This shift suggests that a growing share of return variation is now explained by traditional quality and defensive characteristics rather than market mispricing.

These findings resonate with those of Sagbakken and Zhang (2022), who document a weakening sin premium in Europe as ESG frameworks become more embedded in investor mandates. This thesis supports that narrative, demonstrating that alpha declines are accompanied by increasing factor explanatory power, particularly in portfolios composed of large-cap or heavily scrutinized firms.

However, the implications of this shift are not uniform across industries. Tobacco and gambling show the steepest post-2016 declines in alpha. At the same time, alcohol appears more resilient, potentially due to softer ESG treatment, greater investor tolerance, or broader acceptance of alcohol consumption as culturally embedded or discretionary rather than ethically unacceptable. This variation underscores the importance of industry-specific ESG sensitivity in shaping the persistence of the sin premium.

Importantly, these changes may not signal the permanent erosion of pricing inefficiencies. ESG-led divestment can exert sustained downward pressure on prices, but if valuations overshoot fundamentals, sin stocks may become undervalued, setting the stage for a renewed sin premium. This aligns with the logic presented by Hong and Kacperczyk (2009), who argue

that norm-driven exclusion creates a risk premium precisely because it distorts the risk-return relationship away from fundamentals. In this light, the post-2016 decline in alpha may reflect intensified segmentation rather than its resolution.

Additionally, survivorship bias could have inflated pre-2016 returns. Because the sample omits delisted or bankrupt firms, which are more likely to have underperformed, earlier results may overstate historical alpha and exaggerate the apparent post-2016 decline. This caveat underscores the need for caution when interpreting the data as evidence of a permanent shift.

For investors, these findings carry practical implications. ESG-conscious strategies appear to be gaining traction in European markets and may be influencing pricing efficiency in sectors with controversy. This could reduce the risk-adjusted returns previously associated with sin stocks, particularly those most subject to divestment and reputational screening. However, for unconstrained investors, this evolving landscape may present opportunities for contrarian investment. As prices adjust under ESG pressure, misalignments between valuation and fundamentals could open the door to excess returns, especially in smaller, less institutionally held firms where alpha has historically persisted.

In summary, the sin premium has weakened in recent years, with increasing exposure to standard risk factors and declining abnormal returns across several portfolios. However, the evidence does not suggest a uniform or permanent decline. Sector-specific differences, valuation dynamics, and persistent segmentation among smaller firms point to an evolving rather than disappearing phenomenon, one that remains shaped by a complex interplay between ethics, policy, and market structure.

7.4 Ethics and Efficiency

This thesis raises a deeper question that lies at the intersection of finance and philosophy: can markets be efficient if investor behavior is shaped by ethical values? The persistent alpha observed in sin stock portfolios, especially under EW and IW constructions, suggests that prices may not fully reflect all risks and return expectations. If ESG-oriented investors systematically exclude certain stocks for moral reasons, this can lead to market segmentation, distorting prices and creating opportunities for less constrained investors to earn excess returns.

From this perspective, ethical investing introduces friction into the price discovery process. Values-based exclusions, while morally motivated, may result in underpricing of shunned assets, offering a structural source of alpha. Such outcomes challenge the traditional view of efficient markets where all relevant information, including risk preferences, is assumed to be rational and return-maximizing.

At the same time, the observed risk-adjusted outperformance of sin portfolios raises an important counterpoint: these returns may not come without cost. Investors who hold sin stocks may be bearing additional non-financial risks that are not fully captured by standard factor models. The persistence of alpha, even after accounting for size, value, quality, and defensiveness, underscores the possibility that these risks are real but not easily quantified.

This tension highlights a central philosophical trade-off: socially responsible investors may be willing to sacrifice some financial return to remain aligned with their ethical principles, thereby deviating from the purely rational agent assumed in classical finance. Conversely, investors seeking to maximize returns may earn a premium by accepting assets avoided by others, either because they are mispriced, or because they carry real but unconventional risks.

Ultimately, the findings in this thesis suggest that ethics and efficiency are not always aligned. The existence of a sin premium and its partial persistence despite evolving ESG pressures illustrates how moral values can influence capital flows and challenge the assumptions of traditional asset pricing. In this light, market outcomes are shaped not only by information and risk, but by social norms, investor identity, and the limits of rational choice.

8 Conclusion

This thesis examined whether European sin stocks—defined as firms in the alcohol, tobacco, and gambling sectors—outperform the broader market and what drives that performance. It also explored their behavior during economic downturns and analyzed how return dynamics have evolved, particularly before and after 2016, a period marked by increased ESG awareness. Using descriptive analysis, multifactor regressions, and portfolio-level risk metrics, the study provides a detailed assessment of the sin premium in Europe.

The findings offer qualified support for a sin premium. EW and IW portfolios consistently produced statistically significant alpha, even after adjusting for standard risk factors. This outperformance was more pronounced in portfolios less dominated by large-cap stocks, suggesting that potential pricing inefficiencies are more visible when market-cap influence is reduced. In contrast, VW portfolios showed no significant alpha, with returns explained mainly by exposures to profitability, investment, and defensive factors, underscoring the role of portfolio design in capturing the sin premium.

Performance varied across the components of the sin stock portfolio, with differences in risk-adjusted returns and volatility. Some industries contributed more consistently to alpha, while others exhibited higher volatility and less robust outperformance. These disparities highlight that the sin premium is not uniform and reinforce the importance of analyzing underlying portfolio characteristics rather than treating sin stocks as a single, homogeneous category.

The evidence on defensive traits was mixed. While all sin portfolios but gambling loaded positively on the DEF factor in the full period, only tobacco maintained this in recessions. Alcohol lost its defensiveness during downturns, failing to produce significant alpha, while gambling delivered recession alpha without defensive exposure, suggesting that non-traditional or idiosyncratic forces may shape crisis performance. Overall, defensiveness appears to be sector-specific, rather than inherent to sin stocks as a group.

A notable structural shift occurred after 2016, coinciding with intensified ESG integration. Abnormal performance disappeared, especially in tobacco and gambling, while exposures to quality and defensive factors increased, and value exposure declined. This suggests returns have become more aligned with priced risks, reflecting a move toward market efficiency. However, ESG-led divestment may suppress valuations below fundamentals, creating potential

for a renewed sin premium under shifting investor norms or policy. These findings should be interpreted with caution, as the analysis may be affected by survivorship bias, which could overstate the sin performance.

In summary, this thesis finds that the sin premium in European markets is real but conditional. It is influenced by portfolio construction, sector-specific traits, and market conditions, including business cycles and periods. While returns have become increasingly driven by risk factors over time, valuation distortions may persist, suggesting that the sin premium is not vanishing, but evolving.

8.1 Contributions and Implications

This thesis contributes to the literature by offering a comprehensive assessment of the sin premium in European equity markets, incorporating dynamic asset pricing models, portfolio weighting schemes, and macroeconomic regimes. While prior research has often treated sin stocks as a homogeneous group or focused on U.S. markets, this study shows that performance is shaped by portfolio design, industry structure, and time-specific factors. The observed decline in abnormal returns after 2016 suggests a structural shift in return dynamics, reframing the sin premium as a context-dependent phenomenon shaped by market segmentation and changing capital conditions.

The results also highlight practical lessons for investors. Chief among them is the importance of portfolio construction: sin stock returns vary meaningfully depending on weighting methodology and sector balance. Standard cap-weighted approaches may obscure mispricing opportunities that remain accessible through EW and IW strategies. Additionally, the evidence suggests that sector-specific screening, rather than broad exclusion, may better balance ethical goals with financial outcomes, particularly as ESG integration continues to reshape valuations.

For unconstrained investors, this evolving environment may present opportunities to capture mispricing in overlooked segments, though these must be approached with an awareness of heightened regulatory and reputational risk. At the same time, ESG-conscious investors should recognize that excluding certain stocks may involve a trade-off between ethical alignment and financial performance, especially in contexts where market segmentation persists.

8.2 Limitations and Future Research

This study, while comprehensive in scope, is subject to several limitations. First, the analysis is based entirely on historical data, which reflects past market dynamics and investor behavior. As such, the findings may not fully anticipate how ongoing regulatory changes, evolving social norms, or future macroeconomic shifts will influence sin stock performance. The small sample size during recession periods limits the statistical power and generalizability of conclusions on cyclical resilience. This is further constrained by the limited number of stocks in some industry portfolios, particularly tobacco, which includes only six firms.

Second, the study focuses exclusively on European-listed firms. While this regional scope enhances relevance for European investors, it constrains the global applicability of the results. Differences in regulation, cultural attitudes, and ESG integration across geographies suggest that sin stock dynamics may diverge significantly in other markets, particularly in North America or emerging economies.

Third, although the thesis discusses ESG-related pressures as a potential driver of performance shifts, it does not incorporate explicit ESG ratings or scores in the empirical analysis. This omission limits the ability to isolate the direct impact of ESG perceptions and screening intensity on the returns of sin stocks. Relatedly, the dataset includes only surviving firms, introducing potential survivorship bias that may have inflated pre-2016 performance and distorted post-2016 comparisons.

To address these issues, future research could incorporate ESG scores into asset pricing models to more precisely capture their impact on valuation and risk. Rolling regressions could test whether ESG sensitivity has increased over time and whether it systematically explains changes in sin stock pricing. Expanding the dataset to include delisted firms would also reduce survivorship bias and offer a more accurate view of return persistence and failure risk.

Further exploration of liquidity factors could clarify whether observed alpha reflects mispricing or compensation for illiquidity, particularly relevant for smaller, less-followed sin stocks more likely to face institutional exclusion. Lastly, extending the analysis to include other controversial sectors, such as weapons, adult entertainment, or fossil fuels, and comparing results across regions would help assess whether similar return patterns apply across a broader ethical and institutional spectrum.

9 Reference List

Adamsson, H., & Hoepner, A. G. F. (2015). The Price of Sinn Aversion: Ivory Tower Illusion or Real Investable Alpha? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2659098

Akerlof, G. A., & Kranton, R. E. (2000). Economics and Identity. *Quarterly Journal of Economics*, *115*(3), 715–753. https://doi.org/10.1162/003355300554881

Barberis, N., & Thaler, R. (2003). *Chapter 18 A survey of behavioral finance* (pp. 1053–1128). https://doi.org/10.1016/S1574-0102(03)01027-6

Becker, G. S. (1976). *The Economic Approach to Human Behavior*. University of Chicago Press.

Blitz, D., & Fabozzi, F. J. (2017). Sin Stocks Revisited: *Resolving the Sin Stock Anomaly*. *The Journal of Portfolio Management*, *44*(1), 105–111. https://doi.org/10.3905/jpm.2017.44.1.105

Blitz, D., & Swinkels, L. (2023). Does excluding sin stocks cost performance? *Journal of Sustainable Finance & Investment*, *13*(4), 1693–1710. https://doi.org/10.1080/20430795.2021.1972789

Brown, S. J., Goetzmann, W., Ibbotson, R. G., & Ross, S. A. (1992). Survivorship Bias in Performance Studies. *Review of Financial Studies*, *5*(4), 553–580. https://doi.org/10.1093/rfs/5.4.553

Chow, G. C. (1960). Tests of Equality Between Sets of Coefficients in Two Linear Regressions. *Econometrica*, *28*(3), 591. https://doi.org/10.2307/1910133

Clark, G. L., Feiner, A., & Viehs, M. (2014). From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Outperformance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2508281

Courtwright, D. T. (2001). *Forces of Habit*. Harvard University Press. https://doi.org/10.4159/9780674029903

De Bondt, W., & Thaler, R. (1985). Does the Stock Market Overreact? *The Journal of Finance*, *40*(3), 793–805. https://doi.org/10.1111/j.1540-6261.1985.tb05004.x

Durbin, J., & Watson, G. S. (1950). TESTING FOR SERIAL CORRELATION IN LEAST SQUARES REGRESSION. I. *Biometrika*, *37*(3–4), 409–428. https://doi.org/10.1093/biomet/37.3-4.409

El Ghoul, S., Guedhami, O., Kwok, C. C. Y., & Mishra, D. R. (2011). Does corporate social responsibility affect the cost of capital? *Journal of Banking & Finance*, *35*(9), 2388–2406. https://doi.org/10.1016/j.jbankfin.2011.02.007

European SRI Study. (2018). *European SRI Study 2018. Eurosif. https://www.eurosif.org/news/eurosif-2018-sri-study-is-out/*.

European Sustainable Investment Forum (Eurosif). (n.d.). *About Eurosif. https://www.eurosif.org/sustainable-investment-3/*.

Fabozzi, F. J., Ma, K. C., & Oliphant, B. J. (2008). Sin Stock Returns. *The Journal of Portfolio Management*, *35*(1), 82–94. https://doi.org/10.3905/JPM.2008.35.1.82

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*, *25*(2), 383. https://doi.org/10.2307/2325486

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, *33*(1), 3–56. https://doi.org/10.1016/0304-405X(93)90023-5

Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of Financial Economics*, *116*(1), 1–22. https://doi.org/10.1016/j.jfineco.2014.10.010

Ferroni, F., & Klaus, B. (2023). *The euro area business cycle and its drivers (ECB Occasional Paper Series No. 354). European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op354~c8083b0b57.en.pdf*.

Filbeck, G., Holzhauer, H. M., & Zhao, X. (2014). Using Social Responsibility Ratings to Outperform the Market: *Evidence from Long-Only and Active-Extension Investment Strategies*. *The Journal of Investing*, *23*(1), 79–96. https://doi.org/10.3905/joi.2014.23.1.079

Financial Reporting Council. (2010). *The UK Stewardship Code - https://www.frc.org.uk/library/standards-codes-policy/stewardship/archive/#uk-stewardship-code-2010-e2b44b3c*.

Global Reporting Initiative. (2021). *GRI Standards. https://www.globalreporting.org/standards/*.

Goetzmann, W. N. (2017). *Money Changes Everything*. Princeton University Press. https://doi.org/10.1515/9781400888719

Hoepner, A. G. F., & Zeume, S. (2014). Fiduciary duty and sin stocks:is vice really nice? In *Cambridge Handbook of Institutional Investment and Fiduciary Duty* (pp. 181–206). Cambridge University Press. https://doi.org/10.1017/cbo9781139565516.019

Hong, H., & Kacperczyk, M. (2009). The price of sin: The effects of social norms on markets. *Journal of Financial Economics*, *93*(1), 15–36. https://doi.org/10.1016/j.jfineco.2008.09.001

Humphrey, J. E., & Tan, D. T. (2014). Does it Really Hurt to be Responsible? *Journal of Business Ethics*, *122*(3), 375–386. https://doi.org/10.1007/s10551-013-1741-z

Jarque, C. M., & Bera, A. K. (1987). A Test for Normality of Observations and Regression Residuals. *International Statistical Review / Revue Internationale de Statistique*, *55*(2), 163. https://doi.org/10.2307/1403192

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, *47*(2), 263. https://doi.org/10.2307/1914185

Kempf, A., & Osthoff, P. (2007). The Effect of Socially Responsible Investing on Portfolio Performance. *European Financial Management*, *13*(5), 908–922. https://doi.org/10.1111/j.1468-036X.2007.00402.x

Kim, S. H., & Kose, M. A. (2014). Welfare implications of trade liberalization and fiscal reform: A quantitative experiment. *Journal of International Economics*, *92*(1), 198–209. https://doi.org/10.1016/j.jinteco.2013.10.009

Liston, D. P., & Soydemir, G. (2010). Faith-based and sin portfolios. *Managerial Finance*, *36*(10), 876–885. https://doi.org/10.1108/03074351011070242

Lobe, S., & Walkshäusl, C. (2011). Vice vs. Virtue Investing Around the World. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1089827

Luo, H. A., & Balvers, R. J. (2014). Social Screens and Systematic Boycott Risk. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2474255

Markowitz, H. (1952). PORTFOLIO SELECTION*. *The Journal of Finance*, *7*(1), 77–91. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x

Morningstar. (n.d.). *Morningstar Stock Sector Structure. Retrieved May 9, 2025, from https://www.morningstar.com/content/dam/marketing/apac/au/pdfs/Legal/StockSectorStructure_Factsheet.pdf*.

O'brien, R. M. (2007). A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Quality & Quantity*, *41*(5), 673–690. https://doi.org/10.1007/s11135-006-9018-6

Paris Agreement. (2015). *Paris Agreement. United Nations Framework Convention on Climate Change. https://unfccc.int/process-and-meetings/the-paris-agreement*.

Principles for Responsible Investment. (2006). *Principles for Responsible Investment. United Nations. https://www.unpri.org/about-us/what-are-the-principles-for-responsible-investment*.

Ramsey, J. B. (1969). Tests for Specification Errors in Classical Linear Least-Squares Regression Analysis. *Journal of the Royal Statistical Society Series B: Statistical Methodology*, *31*(2), 350–371. https://doi.org/10.1111/j.2517-6161.1969.tb00796.x

Renneboog, L., Ter Horst, J., & Zhang, C. (2008). Socially responsible investments: Institutional aspects, performance, and investor behavior. *Journal of Banking & Finance*, *32*(9), 1723–1742. https://doi.org/10.1016/j.jbankfin.2007.12.039

Richey, G. M. (2016). Sin Is In: *An Alternative to Socially Responsible Investing? The Journal of Investing*, *25*(2), 136–143. https://doi.org/10.3905/joi.2016.25.2.136

Sagbakken, S. T., & Zhang, D. (2022). European sin stocks. *Journal of Asset Management*, *23*(1), 1–18. https://doi.org/10.1057/s41260-021-00247-9

Salaber, J. M. (2007). The Determinants of Sin Stock Returns: Evidence on the European Market. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1071746

Salaber, J. M. (2009). Sin Stock Returns Over the Business Cycle. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1443188

Schueth, S. (2003). Socially Responsible Investing in the United States . *Journal of Business Ethics*, *43*(3), 189–194. https://doi.org/10.1023/A:1022981828869

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance*, *19*(3), 425. https://doi.org/10.2307/2977928

Sharpe, W. F. (1966). Mutual Fund Performance. *The Journal of Business*, *39*(S1), 119. https://doi.org/10.1086/294846

Sortino, F. A., & Price, L. N. (1994). Performance Measurement in a Downside Risk Framework. *The Journal of Investing*, *3*(3), 59–64. https://doi.org/10.3905/joi.3.3.59

Sparkes, R., & Cowton, C. J. (2004). The Maturing of Socially Responsible Investment: A Review of the Developing Link with Corporate Social Responsibility. *Journal of Business Ethics*, *52*(1), 45–57. https://doi.org/10.1023/B:BUSI.0000033106.43260.99

Statman, M. (2004). The Diversification Puzzle. *Financial Analysts Journal*, *60*(4), 44–53. https://doi.org/10.2469/faj.v60.n4.2636

Statman, M., & Glushkov, D. (2009). The Wages of Social Responsibility. *Financial Analysts Journal*, *65*(4), 33–46. https://doi.org/10.2469/faj.v65.n4.5

Sustainable Finance Disclosure Regulation. (2021). *Regulation (EU) 2019/2088 on sustainability-related disclosures in the financial services sector. Official Journal of the European Union. https://finance.ec.europa.eu/sustainable-finance/disclosures/sustainability-related-disclosure-financial-services-sector_en*.

Townsend, B. (2020). From SRI to ESG: *The Origins of Socially Responsible and Sustainable Investing*. *The Journal of Impact and ESG Investing*, *1*(1), 10–25. https://doi.org/10.3905/jesg.2020.1.1.010

Trinks, P. J., & Scholtens, B. (2017). The Opportunity Cost of Negative Screening in Socially Responsible Investing. *Journal of Business Ethics*, *140*(2), 193–208. https://doi.org/10.1007/s10551-015-2684-3

U.S. Government Publishing Office. (1977). *Community Reinvestment Act of 1977, Public Law No. 95-128*.

White, H. (1980). A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica*, *48*(4), 817. https://doi.org/10.2307/1912934

10 Appendices

Appendix 1: Overview of countries included in the European FF5 factors

Country	Developed	Developed ex US	Europe	Japan	Asia Pacific ex Japan	North America
Australia	✔	✔			✔	
Austria	✔	✔	✔			
Belgium	✔	✔	✔			
Canada	✔	✔				✔
Switzerland	✔	✔	✔			
Germany	✔	✔	✔			
Denmark	✔	✔	✔			
Spain	✔	✔	✔			
Finland	✔	✔	✔			
France	✔	✔	✔			
Great Britain	✔	✔	✔			
Greece	✔	✔	✔			
Hong Kong	✔	✔			✔	
Ireland	✔	✔	✔			
Italy	✔	✔	✔			
Japan	✔	✔		✔		
Netherlands	✔	✔	✔			
Norway	✔	✔	✔			
New Zealand	✔	✔			✔	
Portugal	✔	✔	✔			
Sweden	✔	✔	✔			
Singapore	✔	✔			✔	
United States	✔					✔

Note: This table lists the countries that comprise the regional scope of the Fama-French 5 factors used in the analysis. It provides transparency on the geographic coverage and ensures the consistency of factor definitions with the thesis's European focus.

Appendix 2: Construction of FF5 factors

Universe and Sorting Process

The sorting methodology follows the standard procedure from the Kenneth R. French Data Library. Stocks are first split into two size groups based on market capitalization:

- Small stocks (S): bottom 10% of the region's market cap distribution
- Big stocks (B): top 90% of the region's market cap distribution

Then, for each of the following characteristics, book-to-market equity (B/M), operating profitability (OP), and investment (INV), stocks are further sorted into three groups:

- Low / Neutral / High, based on the 30th and 70th percentiles among big stocks

This results in six value-weighted portfolios per sorting dimension (2 × 3 combinations).

Factor Calculations

MKT

$$MKT = R_m - R_f$$

Where:

- R_m = value-weighted return on the regional (European) market portfolio
- R_f = U.S. 1-month Treasury bill rate

SMB

SMB is the average of three separate size-based factor spreads:

$$SMB = 1/3\ (SMB_{B/M} + SMB_{OP} + SMB_{INV})$$

Each component is defined as:

$$SMB_{B/M} = 1/3\ (Small\ Value + Small\ Neutral + Small\ Growth) - 1/3\ (Big\ Value + Big\ Neutral + Big\ Growth)$$

$$SMB_{OP} = 1/3\ (Small\ Robust + Small\ Neutral + Small\ Weak) - 1/3\ (Big\ Robust + Big\ Neutral + Big\ Weak)$$

$$SMB_{INV} = 1/3\ (Small\ Conservative + Small\ Neutral + Small\ Aggrasive) - 1/3\ (Big\ Conservative + Big\ Neutral + Big\ Aggrasive)$$

HML

$$HML = 1/2\ (Small\ Value + Big\ Value) - 1/2\ (Small\ Growth + Big\ Growth)$$

HML captures the return premium for stocks with high book-to-market (value) relative to those with low book-to-market (growth).

RMW

$$RMW = 1/2\ (Small\ Robust + Big\ Robust) - 1/2\ (Small\ Weak + Big\ Weak)$$

RMW captures the excess return on profitable firms relative to unprofitable ones, based on operating profitability.

CMA

$$CMA = 1/2\ (Small\ Conservative + Big\ Conservative)$$

$$-1/2\ (Small\ Aggrasive + Big\ Aggrasive)$$

CMA reflects the return premium for firms with low historical asset growth (conservative) over those with high investment rates (aggressive).

Note: This appendix outlines the methodology for constructing the Fama-French 5 factors. It explains the size and characteristic-based portfolio formation and factor calculations, providing clarity on the theoretical foundations and empirical inputs used in the regression analysis.

Appendix 3: Morningstar cyclical and defensive super Sector Structure

Cyclical Super Sector
Sectors that roll up into the Cyclical Super Sector are highly sensitive to business cycle peaks and troughs.

Basic Materials
Companies that manufacture chemicals, building materials, and paper products. This sector also includes companies engaged in commodities exploration and processing. Companies in this sector include BHP Billiton and Rio Tinto, and Nufarm.

Consumer Cyclical
This sector includes retail stores, auto and auto parts manufacturers, companies engaged in residential construction, lodging facilities, restaurants, and entertainment companies. Companies in this sector include Hyundai Motor Company, McDonald's, and News Corporation.

Financial Services
Companies that provide financial services, including banks, savings and loans, asset management companies, credit services, investment brokerage firms, and insurance companies. Companies in this sector include Allianz, Commonwealth Bank, and IOOF.

Real Estate
This sector includes mortgage companies, property management companies, and REITs. Companies in this sector include Westfield Retail Trust, Vornado Realty Trust, and Simon Property Group, Inc.

Defensive Super Sector
Sectors that roll up into the Defensive Super Sector are anticyclical stocks.

Consumer Defensive
Companies engaged in the manufacturing of food, beverages, household and personal products, packaging, or tobacco. Also includes companies that provide services such as education & training services. Companies in this sector include Woolworths, Procter & Gamble, and Coca Cola.

Health Care
This sector includes biotechnology, pharmaceuticals, research services, home health care, hospitals, long-term care facilities, and medical equipment and supplies. Companies in this sector include Johnson & Johnson and Pfizer Inc.

Utilities
Electric, gas, and water utilities. Companies in this sector include AGL, APA Group and Envestra.

Note: This figure presents the classification scheme used to distinguish between cyclical and defensive sectors, based on Morningstar's sector taxonomy. This classification underpins the construction of the DEF factor used in extended regressions.

Appendix 4: Used industries and their SIC-codes from the cyclical super sector

Banking	Construction Materials	Retail	Restaurants, Hotels, Motels	Printing and Publishing
6000	0800-0899	5200-5231	5800-5829	2700-2749
6010-6036	2400-2439	5250-5251	5890-5899	2780-2799
6040-6062	2450-2459	5260-5261	7000	Precious Metals
6080-6082	2490-2499	5270-5271	7010-7019	1040-1049
6090-6100	2660-2661	5300	7040-7049	Insurance
6110-6113	2950-2952	5310-5311	7213	6300
6120-6179	3200-3200	5320	Entertainment	6310-6331
6190-6199	3210-3211	5330-5331	7800-7833	6350-6351
Shipping Containers	3240-3241	5334	7840-7841	6360-6361
2440-2449	3250-3259	5340-5349	7900	6370-6379
2640-2659	3261	5390-5400	7910-7911	6390-6411
3220-3221	3264	5410-5412	7920-7933	Automobiles and Trucks
3410-3412	3270-3275	5420-5469	7940-7949	2296
Fabricated Products	3280-3281	5490-5500	7980	2396
3400	3290-3293	5510-5579	7990-7999	3010-3011
3443-3444	3295-3299	5590-5700	Business Supplies	3537
3460-3479	3420-3433	5710-5722	2520-2549	3647
Real Estate	3440-3442	5730-5736	2600-2639	3694
6500	3446	5750-5799	2670-2699	3700
6510	3448-3452	5900	2760-2761	3710-3711
6512-6515	3490-3499	5910-5912	3950-3955	3713-3716
6517-6532	3996	5920	Non-Metallic and Industrial Metal Mining	3790-3792
6540-6541	Steel Works Etc	5920-5932	1000-1039	3799
6550-6553	3300	5940-5990	1050-1119	Construction
6590-6599	3310-3317	5992-5995	1400-1499	1520-1549
6610-6611	3320-3325	5999	Apparel	1600-1799
Recreation	3330-3341	Trading	2300-2390	Rubber and Plastic Products
0920-0999	3350-3357	6200-6299	3020-3021	3031
3650-3652	3360-3379	6700	3100-3111	3041
3732	3390-3399	6710-6722	3130-3131	3050-3053
3930-3931	Chemicals	6723-6726	3140-3151	3060-3099
3940-3949	2800-2829	6730-6733	3963-3965	
	2850-2879	6740-6779		
	2890-2899	6790-6795		
		6798-6799		

Note: This table identifies the specific industries and their corresponding SIC codes classified as cyclical. It supports the DEF factor construction by clarifying which industries are shorted in the long-defensive/short-cyclical strategy.

Appendix 5: Used industries and their SIC-codes from the defensive super sector

Healthcare	Pharmaceutical Products	Consumer Goods	3262-3263	Medical Equipment
8000-8099	2830-2831	2047	3269	3693
Food Products	2833-2836	2391-2092	3230-3231	3840-3849
2000 - 2046	Utillities	2510-2519	3630-3639	3850-3851
2050 - 2063	4900	2840-2844	3750-3751	3860-3861
2070 - 2079	4910-4911	3160-3161	3800	3870-3873
2090-2092	4920-4925	3170-3172	Candy & Soda	3910-3911
2095	4930-4932	3190-3199	2064-2068	3914-3915
2098-2099	4939-4942	3229	2087-2087	3960-3962
		3260	2096-2097	3991
				3995

Note: This table lists the industries considered defensive, along with their SIC codes. These industries constitute the long leg of the DEF factor, contributing to its interpretation as a proxy for defensiveness in equity returns.

Appendix 6: Return Sensitivity to Recession Timing

Window Shift (months)	Market	EW	Tobacco	Gambling	Alcohol
-3	-13,3%	-7,8%	8,3%	-1,6%	-12,5%
-1	-13,6%	-7,0%	11,6%	-3,1%	-11,3%
0	**-21,3%**	**-11,4%**	**9,4%**	**-6,3%**	**-16,5%**
1	-17,9%	-8,1%	12,0%	-1,8%	-13,6%
3	-10,2%	-3,1%	17,0%	2,5%	-8,3%

This table presents portfolio returns based on shifts in the start and end dates of recession periods by up to ± 3 months. The row marked "0" reflects the baseline recession window used throughout the analysis.

Appendix 7: Return Sensitivity to Recession Duration

Window Lenght (months)	Market	EW	Tobacco	Gambling	Alcohol
-3	-17,6%	-15,8%	11,4%	-20,9%	-18,8%
-1	-17,3%	-11,0%	11,5%	-10,1%	-15,1%
0	**-21,3%**	**-11,4%**	**9,4%**	**-6,3%**	**-16,5%**
1	-14,7%	-5,0%	12,0%	3,0%	-10,5%
3	-8,4%	-0,7%	12,2%	8,9%	-5,9%

This table presents portfolio returns using recession windows that vary in length from the baseline period by up to ± 3 months. The row marked "0" reflects the baseline duration used in the core analysis.

Appendix 8: Average Returns by Recession Period

Period	Market	EW	Tobacco	Gambling	Alcohol
2008-2009	-50,4%	-34,5%	-10,1%	-28,3%	-40,8%
2011-2013	5,0%	10,0%	31,9%	14,6%	5,0%
2020	-35,8%	-21,0%	-18,6%	-7,3%	-26,3%

This table presents average returns during each of the three recessionary episodes identified in the sample. Returns are shown for the Market, EW sin portfolio, and individual sin industries.

Appendix 9: Maximum drawdown and their periods

	Market	EW	Tobacco	Gambling	Alcohol
Maximum Drawdown	-59%	-43%	-35%	-50%	-47%
Months	21	20	17	14	20
Beginning	31.05.07	29.06.07	31.05.07	31.10.07	29.06.07
Ending	27.02.09	27.02.09	31.10.08	31.12.08	27.02.09

This table shows the maximum drawdowns for the Market, EW sin portfolio, and individual sin industries. It includes the drawdown, the number of months from peak to trough, and the corresponding start and end dates.

Appendix 10: Regression Results for Value-Weighted Sin Portfolio During Recession Periods

	CAPM	FF3	FF5	FF5+DEF
Alpha	1,08*	0,99	0,73	0,63
	(0,54)	(0,59)	(0,55)	(0,54)
MKT	73,49***	77,4***	99,65***	110,08***
	(8)	(11,37)	(13,79)	(14,78)
SMB		-2,83	17,48	21,88
		(24,26)	(23,8)	(23,3)
HML		-14,05	-53,66	-39,7
		(21,42)	(35,76)	(35,77)
RMW			16,31	12,61
			(45,37)	(44,19)
CMA			98,68**	77,6*
			(38,99)	(39,95)
DEF				29,89
				(17,79)
Adjusted R^2	60,9%	59,2%	64,7%	66,6%
N	38	38	38	38

This table presents time-series regression estimates for the value-weighted sin portfolio over the recession periods, using asset pricing models: CAPM, Fama-French 3-Factor (FF3), Fama-French 5-Factor (FF5), and FF5 + Defensive (DEF) factor. The dependent variable is the portfolio's monthly excess return. Reported values are factor loadings (in percentage points) with standard errors in parentheses. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

Appendix 11: Regression Results for Industry-Weighted Sin Portfolio During Recession Periods

	CAPM	FF3	FF5	FF5+DEF
Alpha	0,99**	1,07***	1,01***	1,01***
	(0,45)	(0,34)	(0,34)	(0,35)
MKT	77,19***	76,93***	85,63***	86,58***
	(11,01)	(6,61)	(8,53)	(9,55)
SMB		78,35***	85,14***	85,54***
		(14,1)	(14,73)	(15,05)
HML		-10,53	-37,25	-35,99
		(12,45)	(22,14)	(23,11)
RMW			-20,07	-20,41
			(28,09)	(28,55)
CMA			38,24	36,33
			(24,13)	(25,8)
DEF				2,71
				(11,5)
Adjusted R^2	73,1%	85,1%	85,4%	84,9%
N	38	38	38	38

This table presents time-series regression estimates for the industry-weighted sin portfolio over the recession periods, using asset pricing models: CAPM, Fama-French 3-Factor (FF3), Fama-French 5-Factor (FF5), and FF5 + Defensive (DEF) factor. The dependent variable is the portfolio's monthly excess return. Reported values are factor loadings (in percentage points) with standard errors in parentheses. CAPM is estimated with heteroskedasticity- and autocorrelation-consistent (HAC) standard errors. Factor abbreviations: MKT = market excess return, SMB = size, HML = value, RMW = profitability, CMA = investment, DEF = defensive. Statistical significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively.

Appendix 12: White Test P-Values by Portfolio and Period

Portfolio	Model	Total	Recession	Pre 2016	Post 2016
EW	CAPM	0,0%	2,8%	0,0%	76,7%
	FF3	0,0%	15,7%	9,3%	46,7%
	FF5	0,1%	29,2%	18,3%	78,6%
	FF5+DEF	0,1%	42,0%	27,1%	69,7%
VW	CAPM	78,8%	13,5%	64,3%	51,4%
	FF3	60,4%	38,3%	60,7%	96,9%
	FF5	78,0%	18,4%	14,0%	68,7%
	FF5+DEF	30,0%	20,4%	8,9%	88,7%
IW	CAPM	0,0%	4,9%	0,0%	64,2%
	FF3	3,4%	13,4%	0,8%	56,0%
	FF5	5,5%	26,1%	2,7%	35,5%
	FF5+DEF	4,8%	12,2%	1,3%	37,1%
Alcohol	CAPM	0,0%	2,4%	0,2%	12,0%
	FF3	0,0%	12,3%	34,7%	23,9%
	FF5	0,2%	24,2%	26,5%	97,0%
	FF5+DEF	0,2%	35,4%	35,3%	80,9%
Gambling	CAPM	3,7%	90,0%	1,1%	27,1%
	FF3	95,5%	76,1%	86,4%	26,5%
	FF5	97,4%	46,7%	39,4%	41,5%
	FF5+DEF	98,5%	35,0%	12,4%	51,1%
Tobacco	CAPM	24,5%	8,5%	2,9%	62,1%
	FF3	40,8%	56,9%	4,1%	20,4%
	FF5	56,4%	37,6%	3,9%	32,7%
	FF5+DEF	76,5%	33,6%	5,5%	28,8%

Note: This table reports p-values from the White test for heteroskedasticity, conducted on regression residuals across different models, portfolios, and economic conditions. It aids in evaluating the validity of homoskedasticity assumptions in OLS regression.

Appendix 13: Durbin-Watson Test P-Values by Portfolio and Period

Portfolio	Model	Total	Recession	Pre 2016	Post 2016
EW	CAPM	0,3%	9,4%	0,8%	11,9%
	FF3	6,1%	37,1%	5,3%	23,3%
	FF5	9,2%	31,3%	16,5%	21,5%
	FF5+DEF	10,0%	30,4%	16,4%	19,7%
VW	CAPM	59,7%	7,0%	45,8%	68,0%
	FF3	61,1%	75,7%	60,8%	67,0%
	FF5	65,1%	68,0%	51,2%	66,0%
	FF5+DEF	55,1%	62,7%	57,2%	40,7%
IW	CAPM	0,1%	2,6%	0,6%	6,4%
	FF3	4,7%	58,6%	6,5%	24,0%
	FF5	5,3%	34,1%	7,6%	25,0%
	FF5+DEF	6,5%	35,7%	8,1%	31,5%
Alcohol	CAPM	6,3%	0,8%	4,2%	35,5%
	FF3	19,9%	19,9%	8,6%	29,9%
	FF5	30,2%	11,5%	19,1%	32,7%
	FF5+DEF	26,4%	11,5%	19,8%	17,1%
Gambling	CAPM	5,4%	15,7%	7,1%	6,8%
	FF3	21,1%	13,1%	26,4%	20,9%
	FF5	18,8%	32,2%	29,2%	18,6%
	FF5+DEF	16,9%	21,9%	24,1%	18,2%
Tobacco	CAPM	48,7%	3,3%	45,5%	64,9%
	FF3	60,2%	66,3%	58,4%	66,5%
	FF5	68,5%	50,1%	54,1%	75,0%
	FF5+DEF	67,5%	47,4%	42,2%	81,6%

Note: This table provides Durbin-Watson test p-values to assess autocorrelation in regression residuals. The results inform decisions on whether robust standard errors are needed due to serial correlation.

Appendix 14: Jarque-Bera Test P-Values by Portfolio and Period

Portfolio	Model	Total	Recession	Pre 2016	Post 2016
EW	CAPM	0,4%	94,4%	2,4%	5,3%
	FF3	0,4%	66,4%	18,2%	0,0%
	FF5	0,1%	57,8%	8,7%	0,1%
	FF5+DEF	0,0%	83,8%	10,0%	0,0%
VW	CAPM	7,1%	4,6%	8,3%	51,5%
	FF3	6,2%	38,4%	0,0%	71,1%
	FF5	13,8%	36,6%	0,3%	94,3%
	FF5+DEF	0,2%	27,6%	0,0%	71,5%
IW	CAPM	1,4%	61,9%	0,8%	17,7%
	FF3	61,5%	63,9%	80,8%	9,3%
	FF5	56,0%	54,8%	76,4%	7,8%
	FF5+DEF	60,6%	50,1%	77,6%	11,0%
Alcohol	CAPM	41,3%	73,1%	64,8%	99,2%
	FF3	31,1%	84,5%	20,2%	76,7%
	FF5	28,2%	81,5%	16,8%	73,3%
	FF5+DEF	14,0%	77,7%	19,0%	85,7%
Gambling	CAPM	0,3%	21,1%	6,2%	17,4%
	FF3	66,2%	7,2%	63,0%	59,7%
	FF5	73,0%	9,1%	47,3%	44,3%
	FF5+DEF	81,5%	0,0%	66,9%	41,0%
Tobacco	CAPM	25,8%	15,6%	31,3%	29,2%
	FF3	22,3%	54,4%	83,8%	34,4%
	FF5	22,8%	58,1%	90,2%	26,6%
	FF5+DEF	14,6%	46,4%	99,2%	14,9%

Note: This appendix reports the p-values from the Jarque-Bera test for normality of residuals. It helps assess whether regression residuals conform to the assumption of normally distributed errors.

Appendix 15: RESET Test P-Values by Portfolio and Period

Portfolio	Model	Total	Recession	Pre 2016	Post 2016
EW	CAPM	0,0%	0,1%	0,0%	0,2%
	FF3	0,0%	4,4%	0,0%	1,5%
	FF5	0,1%	3,0%	0,0%	11,7%
	FF5+DEF	0,1%	3,6%	0,0%	10,7%
VW	CAPM	22,3%	29,4%	67,2%	13,4%
	FF3	41,0%	26,6%	96,7%	3,8%
	FF5	24,9%	58,3%	91,3%	60,2%
	FF5+DEF	70,0%	75,1%	58,5%	51,3%
IW	CAPM	0,0%	1,1%	0,1%	5,5%
	FF3	1,4%	38,9%	1,9%	29,7%
	FF5	8,8%	27,5%	3,1%	73,5%
	FF5+DEF	9,2%	36,4%	3,2%	75,7%
Alcohol	CAPM	0,0%	0,2%	0,0%	0,1%
	FF3	0,0%	5,1%	0,1%	0,3%
	FF5	0,0%	5,0%	0,0%	3,4%
	FF5+DEF	0,0%	3,7%	0,0%	1,7%
Gambling	CAPM	4,8%	2,8%	4,1%	41,9%
	FF3	30,0%	63,7%	16,0%	95,1%
	FF5	43,9%	56,4%	22,3%	73,9%
	FF5+DEF	43,6%	72,2%	23,7%	73,9%
Tobacco	CAPM	43,7%	10,8%	72,4%	57,4%
	FF3	56,4%	22,6%	94,3%	63,7%
	FF5	76,7%	47,9%	82,3%	66,1%
	FF5+DEF	92,3%	90,3%	66,9%	54,8%

Note: This table summarizes p-values from the Ramsey RESET test for model specification. The results guide the evaluation of whether non-linear effects are omitted from the linear regression models.

Appendix 16: VIF test for multicollinearity

Period	MKT	SMB	HML	RMW	CMA	DEF
Total	1,828	1,189	3,701	2,622	2,163	1,767
Recession	2,777	1,148	4,626	2,381	2,419	2,529
Pre 2016	2,092	1,254	3,756	3,036	1,720	1,865
Post 2016	1,704	1,318	4,437	2,590	3,241	1,731

Note: This appendix displays Variance Inflation Factors (VIFs) for the explanatory variables across models. It assesses multicollinearity risk, ensuring model stability and interpretability of coefficients.

Appendix 17: Correlation matrix

	MKT	SMB	HML	RMW	CMA
SMB	0,00				
HML	0,29	-0,01			
RMW	-0,17	-0,07	-0,78		
CMA	-0,27	-0,23	0,52	-0,43	
DEF	-0,56	-0,24	-0,33	0,27	0,21

Note: This table provides the correlation coefficients between the independent variables used in regressions. It supports the diagnostics on multicollinearity and helps interpret relationships among factors.

Appendix 18: Correlation Matrix of Returns Across Sin Portfolios and Industries

	Market	EW	VW	IW	Tobacco	Gambling
EW	0,80					
VW	0,67	0,65				
IW	0,75	0,94	0,65			
Tobacco	0,43	0,54	0,56	0,71		
Gambling	0,62	0,80	0,43	0,86	0,34	
Alcohol	0,77	0,94	0,62	0,80	0,43	0,59

Note: This matrix shows return correlations across the different sin industries and portfolios. It highlights the degree of co-movement, which is relevant for understanding diversification benefits within sin stock investments.