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# Can ESG Redeem the Sinners? Exploring the Relationship Between ESG and Sin Stocks

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**Abstract**

The purpose of this thesis is to investigate whether sin firms in the U.S. market earn excess returns and to examine whether ESG scores influence their financial performance. To conduct this analysis, a sample of U.S. sin firms from 2007 to 2023 is analyzed using a quantitative research design based on multivariate regression models. Excess returns of the sin stocks are tested as well as differences in returns within the sin stocks, related to ESG scores. These are analyzed through the Capital Asset Pricing Model (CAPM), the Fama-French Three-Factor Model, and the Fama-French Five-Factor Model, allowing for a thorough assessment of return drivers and the role of ESG across different empirical specifications. The results show no evidence that sin firms outperform comparable companies during the selected period, and ESG scores do not affect the sin stocks' returns. However, the results indicate that ESG can provide downside resilience for sin firms, similar to its effect for non-sin firms. The conclusion is that the sin label does currently not provide a financial advantage in the U.S. market and that ESG engagement by sin firms does not affect their financial performance, but may offer some protection during periods of market stress.

**Keywords:** Sin stocks, Sin premium, ESG, U.S. market, Multifactor models.

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# 1. Introduction

Doing harm, it seems, can be remarkably good business. Industries associated with controversial products, such as tobacco, alcohol, and gambling, have historically outperformed broader markets, consistently delivering higher long-term returns to investors (Reuters, 2015). These so-called "sin stocks" continue to attract capital, even as ethical investment frameworks grow in popularity. At the same time, some of these firms have been involved in serious ethical and legal violations. A BBC investigation revealed that British American Tobacco (BAT) engaged in systematic bribery of politicians and civil servants in East Africa, including efforts to gain access to draft legislation and undermine tobacco control policies (BBC Panorama, 2015). Despite such revelations, the firm remained financially resilient, raising important questions about the limits of investor ethics and the mechanisms that allow profit to persist in the face of public harm.

The persistent financial success of firms operating in ethically controversial industries has raised important questions within the academic literature about the mechanisms behind their market performance. Rather than attributing this outperformance solely to industry fundamentals, scholars have explored whether systematic exclusion from investment portfolios may in fact contribute to the higher expected returns. This line of reasoning has introduced the concept of the sin premium, the idea that sin stocks may yield superior long-term returns precisely because they are shunned by a significant segment of the investment community. The underlying logic draws on the neglect effect (Arbel et al., 1983), which suggests that firms with limited analyst coverage and reduced investor attention are more likely to be mispriced due to information asymmetries and lower market scrutiny. In this context, exclusion driven by ethical or reputational concerns may unintentionally create the conditions for excess returns (Hong & Kacperczyk, 2009; Leventis et al., 2013).

Initial empirical evidence supports the presence of a sin premium. In their foundational study (Hong and Kacperczyk, 2009) the authors found that U.S.-based sin stocks generated significantly higher returns than non-sin counterparts, both in raw and risk-adjusted terms. Similar patterns have been observed in other contexts, such as Australia and New Zealand, where social values contribute to investor avoidance and limited market coverage (Durand et al., 2013). However, the robustness of these findings has since been questioned. More recent studies that incorporate broader asset pricing frameworks, including the Fama and French five-factor model, report that sin stocks' excess returns often lose statistical significance once

standard risk factors are properly accounted for (Blitz & Fabozzi, 2017; Sagbakken & Zhang, 2021). These conflicting results raise doubts about whether the sin premium represents a genuine market anomaly or merely reflects omitted risk exposures.

Additionally, the environment in which sin firms currently operate is noticeably being reshaped by one important factor: sustainability. More recently, concepts such as environmental, social, and governance (ESG) scores and socially responsible investing (SRI) have changed the conditions in the market. Within SRI there are ***two*** dominant approaches: exclusionary screening and ESG integration and both have gained widespread adoption among especially institutional investors (Zerbib, 2022). Exclusionary screening, which involves deliberately omitting firms based on their industry or practices, reduces investor demand for controversial sectors such as tobacco, alcohol, and gambling. While this can raise the cost of capital for these excluded firms, its effect on corporate behavior depends on the extent of investor participation. Theoretical models suggest that exclusion can incentivize reform, but only if a sufficiently large share of the market applies ethical screens, and if the cost of reform is relatively low (Heinkel et al., 2001). Otherwise, exclusion may simply lead to higher expected returns for unconstrained investors without inducing meaningful change and reinforcing a sin premium.

In contrast, ESG integration allows for a more nuanced strategy, whereby firms including those in controversial industries are evaluated on their actual ESG performance. This has opened the door for sin firms to improve their ESG standing through initiatives focused on governance structures, stakeholder engagement, and social responsibility (Du & Sun, 2023; Cayón & Gutierrez, 2021). Yet, the motivation behind such efforts remains contested. Some researchers suggest that these initiatives are primarily reputational, aimed at preserving legitimacy in the eyes of investors rather than signaling substantive operational change (Kotchen & Moon, 2012). Others argue that many sin firms recognize the growing importance of ESG metrics in capital markets and strategically align their disclosures to attract more diverse investor bases.

Taken together, the existing literature presents a fragmented picture. While early studies emphasize the existence of a sin premium, more recent work challenges its persistence once modern risk factors are included. Similarly, while ESG engagement appears to offer reputational and possibly financial benefits to sin firms, the extent to which it offsets stigma or moderates pricing remains uncertain. Inconsistencies in methodology, time horizon,

regional focus, and even the classification of sin firms make it difficult to draw definitive conclusions. This suggests that the relationship between exclusion, ESG engagement, and abnormal returns in these industries is not only unresolved, but also evolving, driven by shifting investor preferences, regulatory developments, and changing norms around corporate responsibility.

The aim of this study is thus to address the research gap concerning the financial performance of sin firms and also its relation to ESG. Firstly, the existence of a sin premium remains uncertain as some articles find support for it and others do not (Hong & Kacperczyk, 2009; Fabozzi et al, 2008; Blitz & Fabozzi, 2017; Sagbakken & Zhang, 2021; Salaber, 2007). As a result, more studies are needed on the topic to reach a coherent conclusion or to explain the differing results. This study will thus contribute to the existing body of literature by offering evidence on the presence of a sin premium in a more recent market context, where sustainability considerations have become increasingly influential. ESG will likely shape the pricing and profitability of sin firms, but currently there are relatively few studies about the topic. Therefore, this paper also contributes by providing greater clarity regarding how ESG considerations interact with financial returns in morally controversial industries in the US. We hope our findings can offer practical insights for investors trying to balance ethical concerns with financial returns, while also helping to deepen the academic understanding of how market preferences, regulation, and responsible investing interact in shaping firm outcomes in controversial industries.

To address these issues, the following research questions will be examined:

*To what extent do sin stocks in US yield abnormal returns in current times?*

*Does ESG integration affect the profitability of sin stocks in the US?*

We expect that a sin premium continues to exist considering the number of reputable studies that have encountered it and there is strong theoretical evidence for it. Furthermore, we expect that ESG integration will reduce the sin premium since ESG lowers firm risk and stigma which are main drivers of the premium. Consequently, ESG should then have a negative relationship with financial returns when it comes to sin firms.

The analysis will cover the period from 2007 to 2023, as consistent ESG data only becomes available from 2007 onwards. This study applies a quantitative multivariate regression

approach to examine whether sin firms earn excess returns and whether ESG scores influence this performance. The analysis uses a sample of U.S. sin firms from the alcohol, tobacco, and gambling industries, alongside comparable non-sin firms, and evaluates monthly return differentials between these portfolios. To test the existence of a sin premium and the role of ESG, the Capital Asset Pricing Model (CAPM), the Fama and French Three-Factor Model, and the Five-Factor Model are employed.

This thesis finds that sin firms do not earn significantly higher returns than comparable companies, indicating that the traditionally assumed sin premium is not present during the examined period. The analysis also reveals that ESG scores do not significantly affect financial returns within sin industries although they influence how these firms respond to certain risk factors. Sin firms having a higher ESG score prove to be more resilient during market downturns than sin stocks with lower ESG scores. Overall, the results suggest that neither operating in controversial industries nor engaging in ESG activities provide a financial advantage for sin firms in the contemporary U.S. market.

This thesis is structured as follows. We will first go through the key theories and existing research on sin stocks and ESG and develop our hypotheses. Thereafter we will describe our data, sample selection processes and the method used to test the hypotheses. We will then present and analyze our results, followed by a discussion. Finally, we end the thesis with a conclusion and discuss limitations, and ideas for future research.

# 2. Theory and Literature Review

## 2.1 Theoretical Background

### 2.1.1 Sin Firms and The Sin Premium

While there is no uniform definition of sin firms they can generally be described as stigmatized organizations that breach social norms by producing or distributing vice and harmful products or services (Hong and Kacperczyk, 2009; Du & Sun, 2023; Leventis et al., 2013). Historically sin firms have been associated with industries such as tobacco, alcohol, gambling, adult entertainment and firearms. Recent discussions suggest expanding this classification by including for instance nuclear power. In line with the growing emphasis on sustainability, some also argue that carbon-intensive sectors such as coal and gas should be included, or pesticides and other toxins. Depending on the used definition, and which sectors are included, that could potentially yield different results (Fabozzi, 2017).

Conceptually there are several reasons why investors would avoid buying stock in these firms. Firstly, the theory of discrimination. Gary Becker's taste-based discrimination model (1957) posits that employers may choose to discriminate against a certain groups in society according to social norms, even if doing so entails a financial cost (Becker, 1995). Social norms have the power to influence behavior even if it means going against the profit motive. Similarly, there is a social expectation to engage in ethical and corporate social responsibility investing (Leventis et al., 2013) and investing in sin firms would go against that norm. This is especially relevant for institutional investors such as pension funds that care about their reputation more than for instance hedge funds or individual, profit motivated investors (Hong and Kacperczyk, 2009).

Another reason can be the increased litigation risk associated with these stocks which might deter investors (Hong and Kacperczyk, 2009). When sin firms are portrayed in media it is often due to scandals or lawsuits initiated by third parties towards the firms (Leventis et al., 2013) as could already be seen in the introduction of this thesis. Especially risk-averse or institutional investors could view this as a reason not to invest in sin industries.

Consequently, when firms are systematically overlooked by the market, the neglect effect arises. This theory suggests that companies with limited analyst coverage and a smaller investor base tend to earn higher returns because they are affected by pricing inefficiencies

and greater information asymmetry (Arbel et al., 1983). With fewer investors paying attention to them, demand for their shares is lower, causing their stock prices to be undervalued. As these prices eventually adjust toward fundamental value, investors who hold such firms are rewarded with excess returns. Historically, this effect has been particularly visible among smaller firms, which have often been ignored by analysts and institutional investors due to their size and visibility, thereby earning abnormal returns (Arbel et al., 1983). Conceptually similar mechanisms can help explain why sin firms may earn superior returns: their controversial nature can lead some investors to avoid them, leaving them neglected. The excess returns that arise from that are known as the sin premium.

### 2.1.2 Sustainable Practices and sin firms

The neglect effect is exacerbated by modern sustainable practices. The most used sustainable investment practices are exclusionary screening and ESG integration (Zerbib, 2022). Exclusionary screening, also known as negative screening, means that investors filter out firms in controversial industries and in this process many sin stocks will systematically be excluded, further contributing to the neglect effect and the emergence of a sin premium. With the launch of the UN Principles for Responsible Investment (PRI) in 2006, institutional investors began formally integrating ESG considerations into investment decisions. By 2016, the PRI had around 1,400 signatories managing roughly $60 trillion in assets, illustrating the widespread adoption of ESG-based strategies (Amel-Zadeh, 2017). As more capital follows ESG criteria, sin firms are increasingly excluded from investment portfolios, reducing demand for their stocks and reinforcing the neglect mechanism. However, it has been argued that negative screening actually has a counterproductive effect since it prevents sustainable influences on these controversial firms as it excludes sustainability-interested shareholders (de Colle & York, 2008).

The other approach, ESG integration, operates in a different way. ESG scores were officially introduced in 2004 by the United Nations Global Impact and stands for Environmental, Social and Governance (IBM, 2024). It is a score given to firms as a measure for their impact in these areas. When it comes to sin firms there are two ways in which they can address ESG considerations (Paradis and Schiehll, 2021). Similar to other firms, one option is to invest in sustainable practices thus elevating their ESG performance. However, that can be problematic due to their controversial nature. A model developed in earlier research posits that there exists an off-setting behavior (Kotchen, 2009). When individuals engage in

irresponsible behavior, they often compensate through charitable actions, either to ease their conscience or enhance their reputation. Likewise, sin firms may be motivated to invest in ESG initiatives to offset the negative perception associated with selling harmful products. However, investors cannot be certain whether a sin firm's ESG efforts are genuine or if the company continues to engage in harmful operations. Another possibility is that sin firms assume their current investors have already overcome any moral barriers. Therefore, they do not focus on ESG, but on maximizing financial returns for their shareholders. That would result in overall lower ESG scores than comparable firms. There is no knowledge yet on which approach is the predominant one and what determines the pathway of a sin firm.

Furthermore, Morgan Stanley Capital International's (MSCI) has a specific methodology when calculating the ESG score that influences how the scores should be used. Both risk exposure and risk management are considered as part of the score (Paradis and Schiehll, 2021). Naturally, sin firms face higher risk exposure and must implement stronger risk management practices to achieve the same score levels of firms with lower exposure. If sin firms have lower ESG scores that could be a result of the heightened risk and not necessarily signify lacking sustainable practices. To account for this MSCI provides two types of scores: raw ESG data and industry adjusted (MSCI, 2024). The raw data is further weighted using the weights for each pillar. If comparing raw scores between industries that can be misleading and industry adjusted scores are more suitable in those instances. Industry adjusted scores are calculated by comparing firms within the same industry, facing the same risk exposure and where only the risk management differs.

## 2.2 Literature Review

### 2.2.1 The Sin Premium: Evidence for and Against

Empirical research presents a mixed picture when it comes to the existence of a sin premium. Early studies find that sin stocks still tend to outperform on both raw and risk-adjusted returns (Hong & Kacperczyk, 2009). These patterns appear across different time periods and markets, suggesting that exclusion based on ethical concerns may lead to underpricing and, in turn, higher returns for unconstrained investors as according to theory.

Evidence from Australia and New Zealand supports this view, showing that social norms can influence investor behavior and contribute to systematic underinvestment in sin firms (Durand et al., 2013). In other contexts, such as countries with high consumption of alcohol

or gambling, sin stocks have also performed well. These returns seem to be influenced more by investor familiarity than by broad ethical exclusion, as firms operating in culturally accepted sectors tend to face less stigma and stronger demand (Hamdan et al., 2024).

At the same time, results are not consistent across all markets. In Japan and Korea, for instance, sin stocks are more commonly held by institutional and affiliated investors. These firms do not exhibit the same performance advantages, likely due to concentrated ownership structures and weaker cultural stigma (Durand et al., 2013). In contrast, a study focusing on Europe emphasizes institutional and cultural differences in shaping return dynamics (Salaber, 2007). Sin stock returns are significantly influenced by religious norms, legal systems, and excise taxation. The article finds that sin stocks yield stronger risk-adjusted returns in Protestant-majority countries, where investors tend to display greater moral opposition. But such a premium is weaker or absent in Catholic-majority countries. The sin premium is also higher in countries with strong legal enforcement or high sin taxes, reinforcing the role of societal disapproval in shaping investor behavior and pricing.

More recent research also raises doubts about the robustness of the sin premium once standard risk factors are considered. When applying the Fama-French five-factor model, the excess returns often associated with sin stocks become statistically insignificant across U.S., European, and global datasets (Blitz & Fabozzi, 2017). Similar findings emerge in studies focusing on European markets, where neither traditional sin firms nor those in carbon-intensive sectors consistently outperform (Sagbakken & Zhang, 2021). In these cases, returns appear largely explained by profitability and investment factors, rather than investor exclusion.

Other explanations have also been suggested. Some studies point to the role of industry-specific characteristics such as low competition, inelastic product demand, or litigation exposure as possible drivers of performance in sin sectors (Fabozzi et al., 2008). These factors make it more difficult to isolate any premium purely linked to ethical considerations.

Taken together, the evidence on the sin premium is far from conclusive. While some studies find notable return advantages, especially in certain markets or periods, others show that these effects weaken or disappear once risk and context are properly accounted for. The reality appears to depend heavily on regional norms, market structures, and the models used to assess returns.

### 2.2.2 ESG Engagement and Investor Behavior Toward Sin Firms

While sin firms are often excluded from ESG-focused investment strategies, many have still shown strong or improving performance on ESG metrics particularly in social and governance categories. Compared to peers, they frequently score higher on measures such as employee relations and community involvement, especially among large or high-valuation firms (Du & Sun, 2023).

This positive trend is not incidental. Governance scores, in particular, have improved over time among sin firms, suggesting a deliberate response to reputational risk and investor expectations (Cayón & Gutierrez, 2021). Rather than reflecting a shift in core business models, these ESG improvements seem aimed at mitigating the effects of exclusion and maintaining legitimacy in the eyes of stakeholders.

Similarly, firms with controversial exposure often increase ESG activities as a form of reputational insurance. One study shows that companies engaging in more socially irresponsible behavior also tend to engage in more CSR initiatives, particularly in response to public scrutiny and reputational risk (Kotchen & Moon, 2012). This "offsetting" behavior is especially prevalent in visible sectors like tobacco, gambling, and heavy industry, where CSR is used to counterbalance past actions rather than signal moral leadership.

Generally, market reactions to ESG-related controversies also reveal how reputational risks are priced. Firms facing negative ESG events experience stronger stock price penalties when these controversies attract media attention (Capelle-Blancard & Monjon, 2012). Notably, markets tend not to reward CSR proactively, but they do punish visible failures, especially in areas linked to public values. This reinforces the view that ESG strategies function more as defensive tools than as consistent performance drivers.

There's also evidence that ESG engagement offers financial benefits. Firms in controversial sectors that invest in CSR tend to experience lower total and systematic risk compared to those that do not (Jo & Na, 2012). Even just having an ESG rating, regardless of its score, has been linked to reduced firm-specific volatility and increased transparency, which in turn can reassure investors (Horn, 2023). These effects are particularly important during economic downturns when market uncertainty amplifies risk sensitivity.

Still, not all ESG efforts are equally effective. In B2B markets, CSR messaging adds value only when it aligns with how the firm actually operates. For sin firms, inconsistent or

opportunistic ESG narratives, especially those paired with controversial advertising, can undermine credibility and backfire (Gou et al., 2022). This suggests that ESG engagement needs to be not only visible, but coherent and authentic to deliver reputational and financial benefits.

Investor attitudes toward ESG also vary across regions. In Europe, ESG integration tends to be more value-driven, with an emphasis on ethical responsibility and long-term impact. In contrast, U.S. investors often approach ESG from a more financially focused perspective, expressing concerns about data reliability and fiduciary constraints (Amel-Zadeh, 2017). While negative screening remains a common tool, there's a gradual shift toward integration and engagement strategies that aim to influence firm behavior rather than exclude altogether.

Altogether, the evidence suggests that sin firms use ESG engagement selectively and strategically. While these efforts may not reflect fundamental changes to business models, they can reduce risk, broaden investor appeal, and soften the reputational impact of exclusion. Ultimately, the empirical literature shows that value of ESG for sin firms lies less in signaling ethical transformation and more in managing perceptions and improving financial resilience.

### 2.2.3 Capital Costs and Exclusion Effects on Sin Firms

One of the clearest financial effects of exclusionary investing is the impact on firms' cost of capital, particularly the cost of equity. When investors systematically avoid sin firms, these companies are left with a narrower investor base, which raises the return investors demand to hold their stock. As a result, sin firms often rely more heavily on debt, leading to higher leverage ratios compared to comparable non-sin firms (Hong & Kacperczyk, 2009).

These patterns have been formalized through asset pricing models that incorporate sustainability preferences. Within the Sustainable Capital Asset Pricing Model (S-CAPM), firms excluded from portfolios due to ESG concerns face a dual penalty: a taste premium from investor aversion, and an exclusion premium from reduced demand. Empirical applications of this framework estimate the combined premium for sin firms to be as high as 2.79% annually, resulting in a significantly higher cost of equity (Zerbib, 2022). However, returns are not uniformly higher across all sin firms. Some show underperformance, suggesting that reduced investor attention can also create inefficiencies and hinder diversification.

Debt markets, once viewed as a safe alternative for excluded firms, are increasingly influenced by ESG dynamics as well. As credit rating agencies and sustainable bond investors incorporate ESG factors into their evaluations, sin firms may face tighter borrowing conditions or higher yields (Cayón & Gutierrez, 2021). This indicates that exclusionary pressure is no longer limited to equities and that access to debt financing is also becoming more sensitive to sustainability concerns.

Facing higher capital costs, some sin firms adopt strategies to improve their ESG profile or at least appear more transparent to investors. Empirical studies show that engaging in CSR initiatives leads to reductions in both systematic and idiosyncratic risk (Jo & Na, 2012; Horn, 2023). In many cases, simply receiving an ESG rating, regardless of its score, can improve market perception and reduce volatility. While these measures do not necessarily reflect deep operational change, they function as signals that may help mitigate the financial penalty imposed by exclusion.

Still, exclusion alone does not always produce behavioral change. Theoretical simulations suggest that firms are unlikely to reform unless the financial cost of inaction exceeds the cost of adjusting their practices. Research finds that at least 25% of investors must apply exclusionary screens before firms begin to meaningfully shift toward cleaner or more responsible operations (Heinkel et al., 2001). Without this critical mass, exclusion may only succeed in increasing capital costs, without creating incentives for actual transformation.

The extent to which exclusion affects firms also depends heavily on cultural and regional context. In markets where controversial products like alcohol, gambling, or tobacco are more socially accepted, sin firms tend to face less stigma and lower financing penalties (Durand et al., 2013). For instance, in some high-consumption countries, local investor familiarity with sin products appears to offset ethical concerns, resulting in weaker exclusion effects and more favorable financing terms (Hamdan et al., 2024). In contrast, markets where ethical investing is more value-driven, such as parts of Europe, tend to impose stricter capital market constraints on these firms.

Ultimately, the financial consequences of exclusion are shaped by a combination of investor preferences, market structures, and strategic firm responses. While sin firms generally face higher capital costs due to constrained equity demand and growing ESG scrutiny in debt markets, the severity of these penalties varies widely. In markets with strong ESG momentum and coordinated investor action, exclusion can meaningfully reshape firm behavior and

financing conditions. But in environments with fragmented norms or weak enforcement, the effects may be limited to short-term price distortions or symbolic signaling.

## 2.3 Hypotheses

Our hypotheses are grounded in the existing literature on sin stocks, investor behavior, and ESG investing. While the theory behind the sin premium is well established, the empirical findings remain mixed. On one hand, several studies suggest that sin stocks tend to outperform the market, even on a risk-adjusted basis (Hong & Kacperczyk, 2009; Fabozzi et al, 2008). Other research, however, indicates that these abnormal returns may disappear when controlling for more sophisticated risk factors, such as those in the Fama and French five-factor model (Blitz & Fabozzi, 2017; Sagbakken & Zhang, 2021). Additionally, studies highlight the role of regional variation in investor attitudes. Factors such as ESG integration, religion, legal systems, and cultural norms have all been shown to influence the pricing and performance of sin stocks across markets (Salaber, 2007, Durand et al, 2013; Hamdan et al, 2024).

Our first aim of this thesis is to address this issue by contributing to the ongoing research and testing for the sin premium using more current data. One of the main explanations for why there isn't a sin premium is that it can be explained by extended models such as the Fama and French Five-Factor Model. It thus becomes important to apply this model to the new dataset to examine if the increased number of factors can explain the abnormal returns. Considering the number of reputable studies that have found a sin premium for U.S. firms, we believe it exists but will incorporate the Fama-French Five-Factor Model. We formulate our first hypothesis as follows:

**H1:** *The sin premium still exists even when applying the Fama and French five-factor model.*

Beyond establishing whether a sin premium exists, we also aim to explore how ESG integration may influence the financial performance of sin firms over time. ESG scores are increasingly used by investors to assess risk, corporate behavior, and long-term resilience, and previous research shows that ESG engagement can reduce firm-specific risks, improve transparency, and lower capital costs, even for companies operating in controversial industries (Du & Sun, 2023; Amel-Zadeh, 2017; Cayón & Gutierrez, 2021; Horn, 2023; Jo & Na, 2012). As ESG data and practices become more widespread, they offer investors additional dimensions through which to judge firms, shifting the evaluation of sin companies

beyond moral concerns toward measurable sustainability indicators. For firms that face ongoing reputational challenges, this development may influence how they are perceived in the market, enabling them to attract investors who might otherwise avoid them and potentially enhancing confidence in their long-term prospects. If ESG contributes to these changes in perception and leads to more investors buying their shares, that would counteract the neglect effect. Consequently, sin stocks would not earn as abnormal returns. Based on this, we formulate our second hypothesis.

**H2:** *ESG score affects the financial returns of sin stocks.*

# 3. Methodology

## 3.1 Research Design

This study adopts a quantitative research design that relies on a multivariate regression model to examine whether sin stocks continue to generate abnormal returns and whether these returns are influenced by the sin firms' ESG performance. The methodology is grounded in established empirical frameworks, drawing on studies that have examined different aspects of sin firms (Hong & Kacperczyk, 2009; Blitz & Fabozzi, 2017; Du & Sun, 2023). These three studies shape the methodological structure of this thesis by guiding the portfolio construction, the implementation of asset-pricing models of increasing complexity and the integration of ESG metrics into the analysis.

The empirical analysis is carried out in two stages. In the first stage, we test for the existence of a sin premium after controlling for different sets of systematic risk factors. To accomplish this, we use portfolio analysis and employ three well-established return models: the Capital Asset Pricing Model (CAPM), the Fama and French (1993) Three-Factor Model, and the Fama and French (2015) Five-Factor Model. The reason for this choice is based on the fact that previous studies that contest the sin premium use portfolio analysis and the Five-Factor Model for their method (Blitz & Fabozzi, 2017). To obtain comparable and relevant results we choose the same methodology for our main method.

### 3.1.2 Model Specification

Firstly, two equally weighted portfolios will be constructed for the purpose of this analysis: one containing firms classified as sin stocks, and another composed of comparable non-sin firms. In total there will be three different samples of comparable firms as in other literature (Hong & Kacpercyk 2009, Du and Sun 2023). The difference in monthly returns between these two portfolios forms the dependent variable in our regression models.

The first specification follows the Capital Asset Pricing Model (CAPM) and serves as a baseline regression:

$$(1) \qquad R_{SIN,t} - R_{COMP,t} = \beta_0 + \beta_1\left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

The analysis is then extended to the Fama and French (1993) Three-Factor Model, which introduces additional factors for firm size and value effects. The model is specified as:

(2) $$R_{SIN,t} - R_{COMP,t} = \beta_0 + \beta_1(R_{M,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_{i,t}$$

Finally, the Fama and French (2015) Five-Factor Model is applied to control for profitability and investment-related influences. This specification is written as:

(3) $$R_{SIN,t} - R_{COMP,t} = \beta_0 + \beta_1(R_{M,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \varepsilon_{i,t}$$

In the second stage of the analysis, we introduce ESG score into the regression framework to examine whether ESG integration influences the magnitude of the returns. Within the sample of sin firms, we will sort them into five different portfolios ranked by increasing ESG. This sorting process will be repeated every month to sort firms accordingly. The ESG variable will be lagged so that previous month's ESG data is used for the ranking. The extended regression model is defined as:

(4) $$R_{HIGH,t} - R_{LOW,t} = \beta_0 + \beta_1(R_{M,t} - R_{f,t}) + \varepsilon_t$$

(5) $$R_{HIGH,t} - R_{LOW,t} = \beta_0 + \beta_1(R_{M,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t$$

(6 ) $$R_{HIGH,t} - R_{LOW,t} = \beta_0 + \beta_1(R_{M,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \varepsilon_t$$

Additionally, as mentioned, there is a distinction between industry-adjusted ESG scores and weighted scores based on raw ESG data. In this thesis, we aim to further investigate the differences between these two types of data, as there is no clear consensus in the existing literature. Even though we acknowledge that industry-adjusted scores are generally preferred since the sin stocks will belong to different industries, we will run the model twice: once using industry-adjusted scores and once using weighted scores. The correlation between the outputs will then be examined to determine whether the two data types are aligned or if using one over the other produces different results.

As an addition to this model, a robustness check we will performed using a Fama-Macbeth (1973) regression. A cross-sectional model to explicitly test if the ESG score affects the return of the sin firm. All variables will also be lagged by one month to avoid look-ahead bias. The full model is displayed in Eq. (7).

(7) $$R_i = \beta_0 + \beta_1 LOGSIZE_{i,t-1} + \beta_2 LOGMB_{i,t-1} + \beta_3 SINDUM_i + \beta_4 ESG_{i,t-1} + \beta_5(ESG_{i,t-1} \times SINDUM_1) + \beta_6 RET_{i,t-1} + \beta_7 GDUM_i + \beta_8 BETA3M_{i,t-1} + \beta_9 TURN12M_{i,t-1} + \beta_{10} LEVERAGE_{i,t-1} + \varepsilon_i$$

Since we will apply industry fixed effects and time fixed effects we expect the intercept to disappear after regression. According to theory, $\beta_3$ is expected to be positive, reflecting the higher returns of sin firms compared to non-sin firms. However, our sample only includes sin firms with ESG scores, a sample selection bias. Sin firms without ESG scores are excluded and may have different, potentially abnormal returns due to the lack of ESG transparency. Therefore, $\beta_3$ reflects the sin premium conditional on having an ESG score rather than the unconditional sin premium for all sin firms and thus it might not be positive. We expect that higher ESG scores reduce the financial returns of sin firms. This effect is captured by the sum of $\beta_4$ and $\beta_5$, which together measure the total impact of ESG on sin firms. In particular, we expect $\beta_5$ to be negative, ensuring that the total effect is also negative. Higher ESG may lower the perceived risk of sin firms, reducing their stigma and, consequently, associated abnormal returns. We want to test if this mechanism exists by performing this robustness check. The controls are inspired by one of our anchor papers (Hong and Kacperczyk (2009) and we will also be running the regressions in several steps gradually adding more variables as done in the study.

## 3.2 Variables

### 3.2.1 Dependent Variable

The dependent variable in the first part of the analysis is the excess return differential between the portfolio of sin firms and that of comparable non-sin firms. This variable captures the monthly performance difference adjusted for the risk-free rate and serves as a direct measure of the sin premium.

It is defined as $R_{SIN,t} - R_{COMP,t}$, where $R_{SIN,t}$ represents the monthly return of a portfolio consisting of firms operating in alcohol, tobacco, and gaming industries, and $R_{COMP,t}$ denotes the return of a portfolio constructed from comparable non-sin industries. Each portfolio is equally weighted to avoid domination by large firms, and monthly returns are expressed in excess of the risk-free rate to align with asset pricing conventions.

The excess return differential thus captures the additional compensation investors earn for holding sin stocks relative to comparable firms after adjusting for risk-free returns. For these regressions (1-3) we expect $\beta_0$ to be positive and significant since that would indicate the difference in returns cannot fully be explained by the market or common firm specific

factors. Such a result would support our first hypothesis: that a sin premium continues to exist in the 2007–2023 period. The remaining coefficients are difficult to estimate since they will depend on the character of the sample.

In the second part of the analysis, the dependent variable is defined as $R_{HIGH,t} - R_{LOW,t}$. This variable measures the difference in monthly excess returns between the portfolio of sin firms with the highest ESG scores and the portfolio with the lowest ESG scores. A positive value would indicate that high-ESG sin firms outperform their low-ESG counterparts, whereas a negative value suggests the opposite.

As mentioned, ESG scores function as indicators of a firm's sustainability practices and broader non-financial performance. Previous research shows that ESG engagement can lower a firm's perceived risk, mitigate reputational concerns, and reduce capital costs, even for companies operating in controversial sectors (Du & Sun, 2023; Amel-Zadeh, 2017; Jo & Na, 2012). If such effects hold for sin firms, stronger ESG performance should make them appear less risky and more acceptable to investors. As a result, these firms would no longer require the same return compensation as those with weaker ESG profiles. Consequently, we expect a negative relationship between ESG scores and returns among sin firms. In empirical terms, this implies that the intercept $\beta_0$ in the regressions (4-6) should be negative and statistically significant, indicating that sin firms with higher ESG scores earn lower returns than those with lower ESG scores. This would also support our second hypothesis: that ESG score affects the financial returns of sin stocks

### 3.2.2 Independent Variables

The independent variables consist of the standard market and factor components from the CAPM and the Fama–French multifactor models. These variables capture systematic sources of risk and are obtained from Kenneth R. French's Data Library (Fama & French, 2025), measured at a monthly frequency to correspond with the dependent variable.

The market excess return, $R_{M,t} - R_{f,t}$ represents the value-weighted return on the overall market portfolio minus the one-month Treasury bill rate. This variable measures the general risk premium investors require for holding risky assets over risk-free alternatives. A positive relationship between this factor and the return differential is expected, as higher market returns should lead to higher portfolio performance.

The SMB (Small Minus Big) factor captures the return difference between small-cap and large-cap firms and reflects the size effect in asset pricing. If sin firms tend to be smaller on average, a characteristic observed in earlier studies such as Fama and French (1993), a positive coefficient on this factor is anticipated. Similarly, the HML (High Minus Low) factor measures the return spread between firms with high and low book-to-market ratios. Because sin stocks often exhibit value-oriented characteristics, this factor is also expected to be positively associated with the portfolio return differential.

To account for profitability and investment-related influences, the analysis also includes the two additional factors introduced by Fama and French (2015). The RMW (Robust Minus Weak) factor captures differences in returns between firms with strong and weak operating profitability. Given that sin industries are typically characterized by high margins and stable cash flows, a positive relationship between this factor and returns is expected (Blitz & Fabozzi, 2017). The CMA (Conservative Minus Aggressive) factor measures the return difference between firms with conservative and aggressive investment policies. Sin firms typically load negatively on this factor, reflecting their conservative reinvestment behavior and operation within mature industries with limited growth opportunities. Therefore, a negative relationship between CMA and sin stock returns is expected.

Together, these independent variables capture the key systematic risk dimensions that explain variation in stock returns. By incorporating these factors, the models provide a comprehensive framework for assessing whether the excess performance of sin stocks persists even after controlling for widely recognized risk factors in financial markets.

*Table 1: Overview and definitions of variables*

| *Variable* | *Explanation* |
|---|---|
| Dependent Variable | |
| $R_{SIN,t}$ | Monthly return of the sin portfolio. Source: CRSP |
| $R_{COMP,t}$ | Monthly return of the comparable portfolio. Source: CRSP |
| $R_{SIN,t} - R_{COMP,t}$ | Excess return differential. Source: CRSP |
| $R_{HIGH,t} - R_{LOW,t}$ | Return difference between high- and low-ESG sin portfolios. This variable will be computed using both industry adjusted scores and weighted ESG scores. Source: CRSP |
| Independent Variables | |
| $R_{M,t} - R_{f,t}$ (MKT -RF) | Market Excess Return. Frequency monthly Source: Kenneth R. French Data Library |
| SMBt | Small Minus Big size factor. Frequency monthly Source: Kenneth R. French Data Library |
| HMLt | High Minus Low value factor. Frequency monthly Source: Kenneth R. French Data Library |
| RMWt | Robust Minus Weak profitability factor. Frequency monthly Source: Kenneth R. French Data Library |
| CMAt | Conservative Minus Aggressive investment factor Frequency monthly Source: Kenneth R. French Data Library |
| Fama-Macbeth (1973) | |
| LOGSIZE | Defined as the natural logarithm of the market value of equity at the end of the month. Source: Compustat |
| LOGMB | The natural logarithm of the market-to-book ratio at the end of the month Source: Compustat |
| SINDUM | Dummy variable. Equal to one for sin firms and zero for non-sin firms |
| ESG | Defined as monthly ESG score. Will both be industry adjusted and weighted. Source:MSCI |
| RET | Previous month's return. Source: CRSP |
| GDUM | Dummy variable. Equal to one if a firm is a sin firm or belongs to Fama-French Group 2 (food), Group 3 (soda), Group 7 (entertainment) or Group 43 (hotels). Zero otherwise. |
| BETA3M | A stock's Beta calculated using the previous 3 months' return data and market data. Source:CRSP |
| TURN12M | Daily share turnover during the past 12 months Source: CRSP |
| LEVERAGE | Debt-to-asset ratio. Frequency annual. Source: Compustat |

Table 1 provides an overview of the variables and their definitions. The variables are sorted into dependent and independent ones and there is a separate part for the robustness check.

### 3.2.3 Statistical considerations

Since this study relies on Ordinary Least Squares (OLS) regressions, several statistical assumptions are important to keep in mind. The models are based on the classical Gauss–Markov framework, which assumes that relationships between variables are linear, the explanatory variables are exogenous, and that there is no perfect multicollinearity. To test these assumptions, initial diagnostic checks were performed, including scatterplots to visually inspect linearity and the Variance Inflation Factor (VIF) to detect multicollinearity and ensure that each variable contributes unique information to the model.

Monthly stock return data often display characteristics such as heteroskedasticity, where the variance of the residuals changes over time, and autocorrelation, meaning that current values are influenced by past observations. Both phenomena can distort conventional standard errors and lead to misleading conclusions. To address these risks, the Durbin–Watson test was used to examine serial correlation in the residuals, while the Breusch–Pagan test assessed whether the variance of the errors was constant. In order to make sure that these assumptions were met, Newey–West adjusted standard errors were applied. This adjustment allows the regression estimates to remain reliable even when error terms are correlated or exhibit non-constant variance.

Another important assumption concerns the distribution of residuals. Although financial data seldom follow perfect normality, assessing whether residuals deviate substantially from a normal distribution helps gauge the appropriateness of the regression model. This was examined using Q–Q plots and formally tested through the Shapiro–Wilk test.

Finally, the sample period spans from 2007 to 2023 and includes several major economic events, such as the global financial crisis and Covid-19 recession. While no statistical procedure can entirely remove the influence of such regime changes, using well-established return models and consistent estimation techniques should provide a stable analytical foundation. Altogether, these procedures help ensure that the regression results are both credible and interpretable considering the study’s objectives.

## 3.3 Sample Selection

### 3.3.1 Sin Stock Selection

In this study, the sample of sin firms will consist of US firms belonging to the alcohol, tobacco, and gambling industries as consistent with previous research (Hong and Kacperczyk, 2009; Du and Sun, 2023). We will use SIC codes to identify the industries. The SIC codes for alcohol are 2080–2085, for tobacco 2100–2199 and since there are no SIC codes for gambling we will use the following NAICS codes 7132, 71312, 713210, 71329, 72112, and 721120. We want to have firms that have the traditional sin label and therefore we exclude industries that have only recently begun to be viewed as sinful such as coal or nuclear power.

We will however exclude firms in adult entertainment since they are relatively few, and they are difficult to identify as many databases do not have that listed as a separate industry. Furthermore, we will also exclude defense and firearms as US c might not perceive those industries as sinful (Hong and Kacperczyk, 2009). Additionally, it is also difficult to distinguish firms belonging to this industry. For instance, space companies gain a significant part of their revenues from defense industry (Paradis and Schiehll, 2021).

### 3.3.2 Selection of Comparable Firms

Inspired by Hong and Kacperczyk, 2009 we will also have several benchmark groups to compare with when estimating the existence of a sin premium. In total we will have three benchmark groups that we will be selected in the following way.

The first group will be a sample of Fama-French Industry Matched Firms (Consumer-Facing Control). These firms are from non-sin consumer sectors that are similar in visibility and market structure but lack the ethical controversy. Specifically, we include firms from the following Fama and French (1997) industry groups: Group 2 Food, Group 3 Soda, Group 7 Fun and Group 43 Meals and Hotels. These industries are used in previous literature as suitable non-sin comparisons because they are consumer-facing, branded sectors subject to similar reputational scrutiny and marketing strategies, but do not suffer from moral stigma.

The second control group will be extracted by using propensity score matching (PSM). Our matching process will use key covariates such as firm size, leverage, ROA, MB, Kaplan-Zingales Index and Herfindahl-Hirschman Index and the detailed process is described in Appendix A. This is an important control group since it will control for observable firm

characteristics that may influence financial returns. In this way we can observe if the effects are specific to sin firms.

Lastly, the third control group will be SIC-Matched Firms (Industry-Level Control). That is non-sin firms that share the same 2-digit SIC codes as sin firms. Naturally this sample will be the largest of them all.

### 3.3.3 Data collection

Firstly, we collected all the U.S. sin firms from Compustat's historical segment data. If a firm had, either in the past or at present, segments classified under the SIC or NAICS codes mentioned above, it was included in the sample. During the period 2007-2023 there were in total 20 alcoholic beverage companies, 12 tobacco firms and 52 gambling/gaming firms. Furthermore, return data was collected from CRSP and since the database only includes firms traded on NYSE, NASDAQ or AMEX smaller firms and those traded on OTC markets were excluded. That left us with 35 casino gambling, 15 unique alcohol companies and 9 tobacco firms. An overview can be found in *Table 1*.

The same procedure was repeated for the comparable firms as they were extracted from Compustat through SIC Codes and their corresponding returns from CRSP. Once again, this procedure reduced the number of available firms as CRSP only includes firms traded on the larger U.S markets. In the end there were 361 Fama-French Industry Matched Firms and 1394 SIC-matched firms. The number of firms for the PSM sample varied every year as described in Appendix A. Fama and French Factors for the US market were gathered from the Kenneth R. French Data Library. These observations were monthly and in total there were 204 monthly observations ( t= 1,2,….,204) corresponding to the number of months over the period 2007-2023.

*Table 2: Number of sin firms per year*

| Year | Gambling | Alcohol | Tobacco | Total |
|---|---|---|---|---|
| *2007* | 24 | 11 | 3 | 38 |
| *2008* | 24 | 11 | 5 | 40 |
| *2009* | 24 | 9 | 5 | 38 |
| *2010* | 22 | 9 | 5 | 36 |
| *2011* | 21 | 9 | 5 | 35 |
| *2012* | 22 | 9 | 5 | 36 |
| *2013* | 21 | 10 | 5 | 36 |
| *2014* | 21 | 10 | 6 | 37 |
| *2015* | 20 | 9 | 6 | 35 |
| *2016* | 22 | 9 | 6 | 37 |
| *2017* | 22 | 9 | 6 | 37 |
| *2018* | 21 | 9 | 5 | 35 |
| *2019* | 23 | 9 | 5 | 37 |
| *2020* | 21 | 7 | 5 | 33 |
| *2021* | 21 | 9 | 5 | 35 |
| *2022* | 22 | 9 | 6 | 37 |
| *2023* | 21 | 8 | 7 | 36 |

*Table 2 shows an overview of the number of sin firms per year decomposed into the three sin industries*

For the second part of the study the data for ESG scores were collected as well. Data was taken from Morgan Stanley Capital International (MSCI). The frequency of the data was monthly and thus missing values could not cause any problems since the portfolio sorting was performed once every month. During the research period there were in total 59 unique sin firms of which 38 had at least one monthly ESG score. Sin firms that did not have an ESG score during the period were thus excluded from this part of the study.

# 4. Findings and Analysis

## 4.1 Descriptive Statistics

Below follow descriptive statistics which are divided into two tables: each table corresponding to the first or second part of the method.

We begin with an overview of data employed in the regression analyses used to detect the sin premium (Table 3). Stock returns are a volatile form of data and thus there were many outliers in all datasets including those of both sin firms but also comparable firms. For instance, some monthly returns of portfolios amounted to -2000% or 4900%. During regressions these outliers were removed until removing an outlier did not considerably affect the regression results. The final datasets that were used for the regressions after adjusting for outliers are the ones depicted in Table 3 meaning that values for min max value have been

adjusted to not distort the other statistics and do not reflect the actual values. Furthermore, the table displays average returns for all the portfolios and Fama and French factors that they were regressed against. The sin portfolio is further decomposed into three industries, and on average gambling stocks have higher overall returns but are more volatile and the number of gambling stocks is also higher. In general, the descriptive statistics show that sin stocks on average have higher mean returns.

*Table 3: Descriptive Statistics Portfolio Data*

| **Variable** | **Mean** | **Median** | **SD** | **Min** | **Max** | **N** |
|---|---|---|---|---|---|---|
| $R_{SIN}$ | 0.0104 | 0.00404 | 0.153 | -0.713 | 2.60 | 7162 |
| *Gambling* | 0.0113 | 0.00154 | 0.168 | -0.713 | 2.60 | 4307 |
| *Alcohol* | 0.00942 | 0.00439 | 0.137 | -0.634 | 1.28 | 1817 |
| *Tobacco* | 0.00801 | 0.0119 | 0.112 | -0.595 | 1.19 | 1038 |
| $R_{COMP}$ *(FF48)* | 0.00496 | 0.00249 | 0.155 | -1.00 | 2 | 34734 |
| $R_{COMP}$ *(PSM)* | 0.00506 | 0.00506 | 0.154 | -0.900 | 2.0894 | 5229 |
| $R_{COMP}$ *(SIC)* | 0.00687 | 0.00536 | 0.130 | -1.00 | 2.92 | 155335 |
| *MKT-RF* | 0.007962 | 0.01315 | 0.0473 | -0.172 | 0.136 | 204 |
| *SMB* | 0.000174 | 0.0007 | 0.0263 | -0.0818 | 0.0727 | 204 |
| *HML* | -0.00168 | -0.0041 | 0.0336 | -0.138 | 0.129 | 204 |
| *RMW* | 0.00367 | 0.00345 | 0.0193 | -0.0478 | 0.0719 | 204 |
| *CMA* | 0.000467 | -0.0006 | 0.0200 | -0.0708 | 0.0773 | 204 |
| *RF* | 0.000885 | 0.0001 | 0.00131 | 0 | 0.0047 | 204 |

*Table 3 is a summary of descriptive statistics for the sin portfolio (and its decomposition into three industry-specific portfolios), the three comparable portfolios and the Fama and French factors during the period 2007-2023. N is the aggregated number of monthly observations over the period. For the Fama–French factors, they have one monthly observation, whereas for the portfolios they have several monthly observations corresponding to the number of firms for that month.*

When it comes to ESG, the data was divided into two parts. As mentioned, we wanted to investigate the difference between using the industry adjusted ESG score and weighted raw ESG scores and hence data was gathered for both. Table 4 shows average scores in both categories and also descriptive statistics

*Table 4: Descriptive Statistics ESG*

| Variable | Mean | Median | SD | Min | Max | N |
|---|---|---|---|---|---|---|
| ***ESG_adj*** | 3.899 | 3.900 | 1.95 | 0.000 | 9.300 | 3456 |
| *Gambling* | 4.15 | 4.1 | 1.75 | 0 | 8.4 | 1919 |
| *Alcohol* | 4.09 | 3.7 | 2.09 | 1.43 | 9.3 | 806 |
| *Tobacco* | 3.03 | 3.3 | 2.03 | 0 | 7.07 | 731 |
| ***ESG_weight*** | 3.96 | 4.07 | 1.16 | 0.3 | 6.9 | 3456 |
| *Gambling* | 4.17 | 4.2 | 0.820 | 1.5 | 6.56 | 1919 |
| *Alcohol* | 4.55 | 4.5 | 1.06 | 2.3 | 6.9 | 806 |
| *Tobacco* | 2.76 | 3.1 | 1.21 | 0.3 | 4.9 | 731 |
| ***HIGH-LOW (adj)*** | -0.002891 | -0.011613 | 0.09587468 | -0.396267 | 0.446502 | 195 |
| ***HIGH-LOW (weight)*** | -0.0003116 | -0.0040714 | 0.1295378 | -1.1654157 | 0.6838575 | 195 |

*Table 4 provides an overview of the both industry-adjusted and value-weighted ESG scores for the sin firms over the period 2007–2023. There is also a decomposition of the scores into the three sin industries. N represents the total number of monthly ESG observations for the sin firms during this period. For the HIGH–LOW portfolios, N represents the number of monthly portfolios."*

The two different types of ESG scores provide slightly different data. Using the industry-adjusted scores firms belonging to the gambling industry have the highest ESG score, but weighted ESG data shows that on average alcohol firms have the highest ESG score. However, in both cases A portfolio of sin stocks with good ESG performance tends to on average underperform a portfolio with lower ESG scores as seen in Table 4.

## 4.2 Correlation matrix

The correlation matrices for the variables included in the main regressions are presented in Table 5. Panel A shows that certain Fama and French factors have slightly higher correlations with the portfolio returns which is promising since it increases the factors' explanatory power. The most powerful factors in that case are MKT-RF, SMB and HML while RMW and CMA have lower correlations. Generally, the independent variables i.e. the Fama and French factors have low correlations but there are exceptions such as Cor (CMA, HML) =0.609. Consequently, it will be important to test for multicollinearity in the models using the Variance Inflation Factor test (VIF) to ensure this is not a major problem.

Panel B shows correlation between ESG-related data. This matrix can give insights into our inquiry regarding the differences between using industry adjusted ESF and weighted ESG scores. The two types of scores appear to have slight correlation but are not strongly

correlated meaning that these types of scores differ. The end result, the sorted portfolio differences are more strongly correlated.

***Table 5: Correlation matrices***

*Panel A: Correlation for sin premium regressions*

| | $R_{SIN}$ | $R_{COMP}$ *(FF48)* | $R_{COMP}$ $(PSM)$ | $R_{COMP}$ *(SIC)* | *MKT-RF* | *SMB* | *HML* | *RMW* | *CMA* | *RF* |
|---|---|---|---|---|---|---|---|---|---|---|
| $R_{SIN}$ | 1.000 | | | | | | | | | |
| $R_{COMP}$ *(FF48)* | *0.013* | *1.000* | | | | | | | | |
| $R_{COMP}$ $(PSM)$ | *0.791* | *0.026* | *1.000* | | | | | | | |
| $R_{COMP}$ *(SIC)* | *0.118* | *0.036* | *0.100* | *1.000* | | | | | | |
| *MKT-RF* | *0.784* | *0.113* | *0.845* | *0.038* | *1.000* | | | | | |
| *SMB* | *0.520* | *-0.054* | *0.601* | *0.117* | *0.372* | *1.000* | | | | |
| *HML* | *0.221* | *0.002* | *0.229* | *0.154* | *0.171* | *0.331* | *1.000* | | | |
| *RMW* | *-0.172* | *0.037* | *-0.335* | *-0.001* | *-0.184* | *-0.384* | *-0.006* | *1.000* | | |
| *CMA* | *-0.091* | *-0.056* | *-0.088* | *-0.075* | *-0.127* | *0.060* | *0.609* | *0.117* | *1.000* | |
| *RF* | *-0.200* | *-0.050* | *-0.090* | *-0.049* | *-0.088* | *-0.102* | *-0.088* | *0.024* | *-0.132* | *1.000* |

*Panel B: Correlations ESG scores and related variables*

| | ESG_adj | ESG_weight | HIGH-LOW (adj) | HIGH-LOW (weight) |
|---|---|---|---|---|
| ESG_adj | 1.000 | | | |
| ESG_weight | 0.38530460 | 1.000 | | |
| HIGH-LOW (adj) | 0.06855979 | -0.04946382 | 1.000 | |
| HIGH-LOW (weight) | 0.06980710 | -0.00493185 | 0.73294599 | 1.000 |

***Table 5***
*Panel A presents the correlation matrix for the variables used in the first regressions estimating the sin premium, including all portfolio returns and the Fama–French factors.*
*Panel B shows the correlation matrix for the ESG-related metrics such as ESG scores and portfolio returns, which can be used to assess the differences between using the two types of ESG scores."*

## 4.3 Regression Results

### 4.3.1 Hypothesis 1

For the first hypothesis three regression were carried out each with a different control group. Table 6 presents the results.

## *Table 6: Regression results Hypothesis 1*

*Panel A: Control Group Fama and French 48 Industry group 2 (food) group 3(soda), group 7 (entertainment) and group 43 (hotels)*

| Variable | Expected Sign | $R_{SIN} - R_{COMP}$ | | |
|---|---|---|---|---|
| | | **CAPM** | **FF3** | **FF5** |
| Intercept | + | 0.0020837 | 0.0023023 | 0.0016442 |
| Mkt-Rf | + | 0.2283685*** | 0.1991975*** | 0.184551*** |
| SMB | + | | 0.1235960 | 0.184014 |
| HML | + | | 0.017451 | 0.088833 |
| RMW | + | | | 0.257916 |
| CMA | - | | | -0.23347 |
| Industry FE | | No | No | No |
| $R^2$ | | 0.07193 | 0.07839 | 0.09738 |
| $R^2_{adj.}$ | | 0.06715 | 0.06399 | 0.07363 |
| N | | 196 | 196 | 196 |

*Panel B: Control Group Propensity Score Matching (PSM)*

| Variable | Expected Sign | $R_{SIN} - R_{COMP}$ | | |
|---|---|---|---|---|
| | | **CAPM** | **FF3** | **FF5** |
| Intercept | + | 0.003596 | 0.0036775 | 0.0017439 |
| Mkt-Rf | + | 0.1735138* | 0.1739782** | 0.1704073** |
| SMB | + | | -0.0324220 | 0.1278040 |
| HML | + | | 0.0513012 | 0.0795949 |
| RMW | + | | | 0.5724487*** |
| CMA | - | | | -0.1845856 |
| Industry FE | | No | No | No |
| $R^2$ | | 0.02836 | 0.02951 | 0.07407 |
| $R^2_{adj.}$ | | 0.02343 | 0.01458 | 0.05008 |
| N | | 196 | 196 | 196 |

*Panel C: Control Group same 2 Digit SIC Code*

| Variable | Expected Sign | $R_{SIN} - R_{COMP}$ | | |
|---|---|---|---|---|
| | | **CAPM** | **FF3** | **FF5** |
| Intercept | + | -0.0060466 | -0.005308 | -0.006449 |
| Mkt-Rf | + | 0.3608513*** | 0.260345** | 0.258018** |
| SMB | + | | 0.426360** | 0.525881** |
| HML | + | | 0.071612 | 0.088461 |
| RMW | + | | | 0.344337 |
| CMA | - | | | -0.105148 |
| Industry FE | | No | No | No |
| $R^2$ | | 0.07153 | 0.1021 | 0.1115 |
| $R^2_{adj.}$ | | 0.06675 | 0.08811 | 0.08811 |
| N | | 196 | 196 | 196 |

*Table 6 presents the results from regressions estimating the sin premium. Panel A uses the Fama–French 48-industry groups as the control group, Panel B reports results for the matched sample, and Panel C is based on the control group of firms with the same 2-digit SIC code.N represents the number of monthly observations.*
*Significance levels given as *** p<0.01, ** p<0.05, * p<0.1*

These regressions all passed the tests and statistical considerations mentioned in the method part of this thesis. The correlation matrices flagged for potential multicollinearity, but all the scores for the VIF test were below two. Furthermore, the Newey-West procedure was always used to obtain robust t-statistics.

The sign of the intercept varies with the control group. In one of the cases it is negative which would indicate that sin firms have lower returns than comparable firms. However, the intercept is not significant in either case which means it is not possible to draw that conclusion either. The intercept being insignificant in all cases means that there is no support for a sin premium. The only factors that are significant for these three factors is the market factor or in some cases SMB or RMW. Furthermore, the adjusted R squared is rather low for all the groups indicating that this model and Fama and French factors do not fully explain a stocks' return. But generally, the explanatory power increases when more variables are added.

### 4.3.1 Hypothesis 2

This study also aimed to assess if ESG affects the financial returns for sin stocks. The results are presented in Table 7.

Once again, all statistical considerations accounted for. This regression showed non-normality for the errors but that was addressed by using Newey-West estimates.

The intercept has a different sign depending on what ESG data is being used but is insignificant in both cases. These results do not show that ESG would significantly affect the financial performance of sin firms even though the average HIGH-LOW was negative.

*Table 7: Regression results ESG-sorted portfolio*

| *Variable* | *Expect. Sign* | *HIGH-LOW (adj)* | | | *HIGH-LOW (weight)* | | |
|---|---|---|---|---|---|---|---|
| | | **CAPM** | **FF3** | **FF5** | **CAPM** | **FF3** | **FF5** |
| Intercept | - | -0.00196 | -0.00289 | -0.00432 | 0.00490 | 0.00319 | 0.00213 |
| MKT -RF | | -0.520*** | -0.475*** | -0.423*** | -0.683* | -0.621** | -0.610** |
| SMB | | | 0.0040 | 0.00705 | | 0.0630 | 0.130 |
| HML | | | -0.318* | -0.547* | | -0.641** | -0.694 |
| RMW | | | | 0.0129 | | | 0.206 |
| CMA | | | | 0.586 | | | 0.0960 |
| Industry FE | | No | No | No | No | No | No |
| $R^2$ | | 0.067378 | 0.0804373 3 | 0.0888063 | 0.0625667 | 0.08850701 | 0.08944908 |
| $R^2_{adj.}$ | | 0.062521 | 0.0625209 | 0.0645724 | 0.05770953 | 0.07419037 | 0.06536043 |

*Table 7: Regression results for the difference in high ESG Portfolio les s low ESG portfolio against the Fama and French Factor. The ESG variable is lagged as standard in academic literature.*
*Significance levels given as *** p<0.01, ** p<0.05, * p<0.1*

The robustness check depicts a slightly different picture than the main model. In both cases SINDUM is negative and significant meaning that sin firms have lower returns than non-sin firms keeping all else constant. This contradicts the theory of a sin premium. However, this sample is relatively limited and as mentioned all sin firms have an ESG score. The only conclusion we can draw is that in this of sample sin firms where all of them have an ESG score, they earn lower returns than non-sin firms. That could either indicate the absence of a sin premium or that ESG decreases the financial returns for sin stocks. Another observation is that in one of the cases the interaction variable is positive and significant. However, the variable was only significant when using industry-adjusted scores and the very basic model. It lost its significance when more variables were introduced and hence we will not further consider that result.

Overall industry adjusted scores and weighted scores produce similar results when it comes to which variables are significant and their signs.

## *Table 8: Regression results Fama-Macbeth robustness check*

*Panel A: Using Industry Adjusted ESG Scores*

| | Expected Sign | | (7) | |
|---|---|---|---|---|
| SINDUM | + | -0.034923*** | -0.026405** | -0.03241992* |
| LOGSIZE | | 0.001450 *** | 0.000092 | 0.00064512 |
| MB | | 0.002905 | 0.000101 | 0.00571286* |
| ESG | | -0.000442 | -0.000173 | -0.00025830 |
| ESG×SINDUM | - | 0.006136* | 0.004218 | 0.00617437 |
| RET | | | 0.255745*** | 0.24744697*** |
| GDUM | | | -0.000014 | 0.00023543 |
| BETA | | | | 0.00000266 |
| TURN | | | | 0.00023829 |
| Leverage | | | | -0.00653913 |
| Industry FE | | Yes | Yes | Yes |
| Time FE | | Yes | Yes | Yes |
| $R^2_{adj.}$ | | 0.038392 | 0.102808 | 0.095804 |

*Panel B: Using Weighted ESG scores*

| | Expected Sign | | (7) | |
|---|---|---|---|---|
| SINDUM | + | -0.042252 ** | -0.029903 | -0.04092379* |
| LOGSIZE | | 0.001408** | -0.000075 | 0.00057171 |
| MB | | 0.003408 | 0.000723 | 0.00554985* |
| ESG | | -0.000177 | 0.000199 | 0.00019412 |
| ESG×SINDUM | - | 0.007854 | 0.005002 | 0.00822508 |
| RET | | | 0.263276*** | 0.24781813*** |
| GDUM | | | 0.002964 | 0.00047306 |
| BETA | | | | 0.00000273 |
| TURN | | | | 0.00027134 |
| Leverage | | | | -0.00631970 |
| Industry FE | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes |
| $R^2_{adj.}$ | | 0.035011 | 0.102611 | 0.095741 |

*Table 8 shows the regression results for the Fama-MacBeth robustness check. Panel A shows results using industry adjusted ESG scores and Panel B uses weighted ESG scores.*
*Significance levels given as *** p<0.01, ** p<0.05, * p<0.1*

# 5. Discussion

Sin stocks have always been surrounded by criticism because the industries they belong to, such as tobacco, gambling, and alcohol, are often viewed as harmful or unethical. However, it is worth noting that these industries are usually highly regulated, which limits competition and can create steady profits for the companies that operate within them. Earlier research argues that sin stocks earn higher returns because certain investors avoid them, creating a pricing discount that results in a sin premium (Hong & Kacperczyk, 2009). More recent findings question this interpretation and suggest that the apparent outperformance of sin stocks disappears once additional risk factors are considered, meaning the returns can be explained by conventional asset-pricing variables rather than by stigma-driven mispricing (Blitz & Fabozzi, 2017). In contrast, research examining ESG practices shows that sin firms often score higher on specific ESG dimensions, particularly governance, which suggests that these firms may use ESG strategically to manage reputation rather than to enhance financial returns (Du & Sun, 2023). By relating the results of this thesis to these three studies, the discussion considers whether the arguments for a sin premium still apply in today's market.

## 5.1 Interpretation of the Main Findings – Part I

Our first hypothesis proposed that sin stocks should outperform comparable firms, implying that a sin premium continues to exist in the modern U.S. market. However, the regressions in Table 6, Panels A–C do not support this claim. Across all three model specifications, whether using industry-based control firms (Panel A), propensity score matched firms (Panel B), or firms identified through similar SIC codes (Panel C), the intercepts representing abnormal returns are statistically insignificant and close to zero.

The descriptive statistics in Table 3 help to contextualize this outcome. At first glance, sin sectors appear to generate attractive raw returns. Gambling firms, for example, exhibit the highest average monthly return at 0.0113, followed by alcohol (0.00942) and tobacco (0.00801). Yet these returns are accompanied by substantial volatility, gambling's standard deviation is 0.168, noticeably higher than tobacco (0.112) and alcohol (0.137). At the same time the median is also much lower than the mean. Overall this suggests that higher average returns may simply reflect greater exposure to risk rather than any systematic mispricing. Once returns are evaluated in a risk-adjusted framework, there is no evidence of any return advantage to begin with, as the regressions show no significant abnormal performance for sin firms.

Across all specifications in Table 6, the market factor (Mkt–Rf) is the only consistently significant variable. Its coefficients are large and highly significant, reaching 0.2284 in Panel A and 0.3609 in Panel C, indicating that sin stocks largely move with the overall market. In contrast, the other Fama–French factors show limited explanatory power. The size factor (SMB) and value factor (HML) alternate in sign and significance, while the profitability (RMW) and investment (CMA) factors introduced in the five-factor model rarely reach significance. This suggests that sin firms do not exhibit distinctive pricing characteristics that would justify a return premium. Instead, their performance is explained by broad market exposure rather than industry-specific neglect or investor bias. The low explanatory power of the models reinforces this interpretation. The adjusted $R^2$ values across all regressions are quite modest, ranging only from 0.01458 to 0.08811. This does not indicate hidden abnormal performance but rather that sin stocks behave like other firms whose returns are primarily driven by market-wide forces rather than idiosyncratic risk related to their controversial status.

A plausible explanation for the absence of a sin premium in this study is that the market conditions that once enabled such excess returns have changed. Previous papers utilize periods starting in the 1950s and extending to the early 2000s, often finding a sin premium. Our study covers a much shorter timeframe: 2007–2023. It is likely that market conditions and social norms have shifted over the longer period. For instance, it was in the 1950s–1960s that the harmful effects of smoking became widely known to the public, and tobacco stocks were first classified as sin stocks (Hong & Kacperczyk, 2009). This would have affected investors differently than today, when the harmful effects of smoking are well-known. To fully understand whether this factor plays a role, one would need to analyze the sin premium across different time periods separately to observe any differences. However, it is also possible that our time frame simply is too short to obtain any significant results.

Another reason why the current investment landscape looks different from the one in which those early findings emerged is that sustainable investing has become far more structured. As a result, sin firms are increasingly being excluded because of negative screening practices, but they do also have the possibility to attract investors by investing in sustainable practices and improving their ESG scores. How this affects sin stock, their returns and the sin premium is still not well researched. However, it is likely that this development will affect older market conditions that once enabled systematic neglect.

All in all, Sin firms may continue to operate in controversial sectors and carry reputational baggage, but this no longer translates into superior financial performance. Their returns reflect market trends rather than a compensatory risk premium tied to moral stigma. In short, the data provides no support for the existence of a sin premium during the 2007–2023 period examined in this study.

## 5.1 Interpretation of the Main Findings – Part II

Our second hypothesis was to analyze whether ESG performance affects the returns of sin stocks. We expected to find that sin firms with higher ESG scores would earn lower returns, based on the idea that better sustainability practices reduce perceived risk and stigma, making them more attractive to investors (Du & Sun, 2023). If this was the case, portfolios consisting of sin firms with higher ESG scores would reveal lower returns than portfolios with low-ESG sin firms. Our results, presented in Table 7, reject this hypothesis as well.

As shown in Table 7, the intercepts for the HIGH-LOW portfolios are consistently close to zero and statistically insignificant across all model specifications, regardless of whether we use industry-adjusted ESG scores or value-weighted ESG scores. This means that sin firms with better ESG scores do not earn meaningfully lower (or higher) returns than those with weaker ESG scores. Firms that score well on ESG dimensions are not rewarded, nor are those with poorer ESG records punished, at least in terms of abnormal returns. Also, the adjusted $R^2$ values remain low throughout, suggesting that the inclusion of ESG does little to explain cross-sectional variation in returns.

The descriptive statistics in Table 4 can be used to explain this outcome. While some sin industries do show variation in sustainability profiles, gambling firms have the highest industry-adjusted scores (4.15) and alcohol firms lead under the value-weighted measure (4.55). These distinctions do not translate into financial consequences. The HIGH-LOW spreads in Table 4 are effectively zero for both ESG measures, already hinting that the differences in ESG scores do not result in meaningful differences in returns. This observation fits well with what previous literature has suggested about the nature of ESG activities in stigmatized industries. Studies show that when sin firms engage in ESG, they rarely do so to transform their business model or distance themselves from the products that define their controversial identity. Rather, they tend to use ESG as a reputational buffer, an attempt to soften public criticism without changing the core activity that attracts that criticism in the first place (Kotchen & Moon, 2012; Paradis & Schiehll, 2021). In that light, the lack of observable

return effects in our data becomes more understandable: if ESG initiatives are primarily symbolic or defensive, financial markets may not treat them as value-relevant signals.

Including both industry-adjusted and value-weighted ESG scores further strengthens this interpretation. These two measures capture slightly different aspects of ESG performance and ensures that our analysis does not overlook meaningful variation. Yet, despite this careful distinction, neither measure produces a performance differential. This reinforces the idea that, within sin industries, ESG is not shaping investor expectations in a way that translates into excess returns.

One interesting note on our results is the sign and strength of the market factor in Table 7. It's negative and highly significant across all specifications. This indicates that, all else equal, high-ESG sin firms are more resilient during market downturns and outperform low-ESG sin firms when the market goes down. This supports the usual story that ESG provides resilience or protection. The same mechanisms that apply to normal firms seem to apply to sin firms as well when it comes to the protective properties of ESG.

Another interesting observation can be found in the robustness check. While there are no significant coefficients for ESG-related variables, the SINDUM variable has a negative and significant coefficient across all regressions. This means that on average sin stocks earn lower returns than non-sin stocks which would once again reject the first hypothesis. It shows that sin firms do not outperform other stocks and indicates that it might be the other way around. As mentioned, all sin stocks in the model did however have an ESG score and this relationship might not hold for sin firms lacking the sustainability rating. It does not provide as strong evidence as the first model that tested all sin stocks available.

To sum up, despite theoretical arguments that ESG should influence expected returns, our evidence shows that ESG engagement does not materially affect how sin stocks perform. The market seems to treat these firms similarly regardless of their sustainability profile, suggesting either that ESG does not change investor perceptions in vice-related industries, or that such perceptions are rooted in values rather than risk. Therefore, hypothesis 2 is rejected. However, an unexpected finding is encountered: if a sin firm has a high ESG score that can be risk mitigating during market downturns.

# 6. Conclusion

This thesis set out to re-examine the existence of the sin premium and to explore whether ESG considerations influence the financial behavior of sin stocks in the modern market environment. By analyzing U.S. sin firms over the period 2007–2023 and applying the Fama and French five-factor model, the study contributes to the ongoing discussion on whether earlier findings about abnormal returns in controversial industries still hold. The results show that sin stocks do not generate significant abnormal returns, providing evidence that the traditional sin premium documented in earlier research no longer appears in contemporary data. This finding adds to a growing body of literature suggesting that the sin premium may have weakened or disappeared as investment practices have changed and as risk factors have become more thoroughly accounted for.

A second key contribution lies in examining how ESG scores relate to the performance of sin firms. While ESG does not affect the financial returns within these industries, the data in this study reveals that loadings reveal that high-ESG sin firms behave differently from low-ESG firms, especially in their sensitivity to market movements and value–growth dynamics. A higher ESG score can serve as protection when markets decline These findings suggest that ESG influences how returns are formed, even if it does not affect the magnitude of financial performance.

Together, these contributions help clarify the role of ESG in sin industries and offer updated empirical evidence on the relevance of the sin premium in a market where sustainability considerations have become more widespread.

## 6.1 Limitations of the study

Despite its contributions, the study has several limitations that should be considered when interpreting the results. First, as mentioned the sample period covers 2007–2023, which is substantially shorter than the multi-decade horizons used in many foundational studies on sin stocks such as Hong & Kacperczyk (2009). If the sin premium gradually declined over a longer period, this study may only capture the later phase, thereby missing historical patterns that contributed to earlier findings.

Another limitation is the relatively low number of sin firms. Many observations were removed when extracting return data from CRSP, since, as mentioned, the database only includes firms traded on NASDAQ, NYSE, or AMEX. Limited data was also an issue for the

second part of the study concerning ESG. Only 38 sin firms in total had ESG scores in MSCI's database, but in the early years there were far fewer observations. In the first year, 2007, only seven sin firms had an ESG score. Such small samples may not provide a fully representative picture.

Finally, the analysis focuses solely on U.S. firms. Cultural attitudes toward sin products vary significantly across countries, and investor behavior in Europe, Asia, or emerging markets may produce very different return dynamics. As such, the findings cannot be generalized globally without further cross-country analysis.

## 6.2 Implications and Future Research

The findings of this study suggest that sin stocks no longer behave in the way traditionally assumed. Contrary to earlier studies, sin firms in the observed period did not outperform comparable companies, indicating that the pricing mechanisms historically linked to moral stigma and investor exclusion may have changed. This challenges the long-held belief that controversial industries inherently offer superior returns and suggests that modern investment practices and broader availability of information have weakened the market inefficiencies that once drove such outcomes.

The results also show that ESG considerations influence how sin firms are positioned within financial models, even though they do not translate into higher or lower returns. High-ESG sin firms display different factor sensitivities than their low-ESG counterparts, indicating that ESG plays a role in shaping how investors perceive these firms and how their returns behave over time. This implies that ESG engagement is now part of the identity and risk profile of sin firms, not a mechanism for creating financial outperformance. In this way, ESG may provide reputational benefits or signal credibility, yet these actions are not sufficient to alter return levels within such industries.

These findings open several opportunities for future research. Extending the time period could help determine whether the disappearance of abnormal returns is a recent development or part of a longer structural shift. Investigating other markets with different cultural attitudes toward sin products may reveal whether these patterns are unique to the U.S. context. Further work could also examine whether specific components of ESG, environmental, social, or governance, carry more informational value than aggregate scores, or whether sentiment-based indicators such as media controversies better explain how investors respond to firms in

stigmatized industries. Such studies would deepen understanding of how modern financial markets evaluate companies whose core activities continue to spark ethical debate.

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# Appendix

## Appendix A: Methodology for Propensity Score Matching and the Procedure's Effectivness

The methodology for the propensity score matching was inspired by the approach outlined in earlier research (Du & Sun, 2023). The matching was performed using 1:1 nearest-neighbour matching without replacement, with the caliper set to 0.01 to ensure that matched firms were sufficiently similar. To generate the propensity scores used in the matching process, a logistic regression model was estimated, following the specification applied in a previous study (Du & Sun, 2023).

$$(7)\quad SINDUM_{i,t} = \beta_0 + \beta_1 Size_{i,t} + \beta_2 Leverage_{i,t} + \beta_3 ROA_{i,t} + \beta_4 MB_{i,t} + \beta_5 KZscore_{i,t} + \beta_6 HHI_{i,t} + \varepsilon_{i,t}$$

*Table 9: Overview variables used in propensity score matching*

| *Variable* | *Definition* |
|---|---|
| $SINDUM_{i,t}$ | Indicator variable. Equal to 1 if the firm is classified as a sin firm and 0 otherwise.<br>Source: Compustat |
| $Size_{i,t}$ | Book value of total assets at the end of year t.<br>Source: Compustat |
| $Leverage_{i,t}$ | Debt-to-asset ratio at the end of year t.<br>Source: Compustat |
| $ROA_{i,t}$ | Operating income before depreciation divided by the book value of total assets at year-end t.<br>Source: Compustat |
| $MB_{i,t}$ | Total book value of assets plus market value of equity minus the difference between book value of equity and deferred tax, divided by total assets.<br>Source:Compustat |
| $KZscore_{i,t}$ | Kaplan-Zingales index (1997).<br>Source:Compustat |
| $HHI_{i,t}$ | Herfindahl-Hirschman index based on sales and 2-digit SIC industry codes, measuring industry concentration,<br>Source: Compustat |

*Table 9 provides an overview and definitions for all variables used in the propensity score matching*

The matching was performed separately for each year using annual data, ensuring that the matched sample was updated annually to reflect changes in firm characteristics and improve match quality. For each year, the resulting matched sample was then linked to monthly returns within that year. Consequently, the composition of the PSM sample varied across years, with firms entering or exiting the matched sets depending on how their characteristics changed from year to year. If any firm did not have data for all of these variables, both sin and non-sin, it was excluded from the matching process and from this sample.

To show the effectiveness of the propensity score matching, Table 9 provides a balance table.

*Table 10: Balance diagnostics test after matching*

| *Variable* | *Sin* | *Non-sin* | *p value* |
|---|---|---|---|
| *Leverage* | 0.425 | 0.343 | 0.313 |
| *Size* | 7.23 | 7.52 | 0.613 |
| *ROA* | 0.107 | 0.191 | 0.287 |
| *MB* | 1.56 | 2.69 | 0.537 |
| *KZ* | 1.72 | 3.05 | 0.406 |
| *HHI* | 0.00715 | 0.00650 | 0.628 |

## Appendix B: Description of AI use within the Thesis

1. **Name and Version:** We used ChatGPT-5, the version released on August 2025, which was the main model available during this thesis period.
2. **Developer:** OpenAI
3. **Link:** https://chat.openai.com/
4. **Date of use:** Continuous from October 2025 through December 2025.

ChatGPT was used as a supportive tool in this thesis. It helped us summarize and understand peer-reviewed articles, assisted with troubleshooting and structuring code in R-Studio, and provided suggestions to improve the grammar and clarity of our writing. Through this work, we were fully responsible for checking and validating any information provided by the tool.