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Has Sinning Stopped Winning? A Revised Look at Sin Stock Performance and Recent Trends

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Abstract

This thesis investigates the performance of sin stocks between 2000 and 2021. With the historically strong performance of the sector, it is interesting to observe whether investors are turning down abnormal returns as capital is now being pressured towards more sustainable investing. We study the risk-adjusted returns to draw a conclusion on abnormal returns of owning sin stocks and the cost of neglecting the sin stocks in a portfolio. We classify alcohol, tobacco, and gambling as the traditional sin industries, in line with well-known researchers such as Hong and Kacperzcyck (2009). We furthermore argue that the focus on reduced carbon footprint has led to the emergence of a modern sin stock industry, consisting of oil and gas companies, as suggested by researchers such as Sainsbury (2020).

Looking at various well-known asset pricing models, we conclude that traditional sin stocks have positive abnormal returns, whereas modern sin stocks do not. However, we do find an absence of abnormal returns in the traditional sin portfolio for the last five years. By studying the difference portfolio, a portfolio that goes long sin stocks and short their comparables, we find no abnormal returns. Indeed, from 2017 to 2021, the difference portfolio yielded negative abnormal returns. This is mainly driven by the equivalent strong performance of comparable companies. We find evidence that sin stocks performed well during the dot-com bubble and financial crisis, although showing no resilience during the Covid-19 crisis. Interestingly, we find a variety of conclusions different to those of Hong and Kacperzcyck (2009) regarding traditional sin stock's analyst coverage and outside equity financing, amongst others.

The main result learned from the thesis is that sin stocks have abnormal returns but with a negative trend the last years.

Keywords: Sin stocks, Abnormal returns, Responsible Investing, Alcohol, Tobacco, Gambling, Oil and Gas

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1 Introduction

In this thesis, we examine sin stocks from 2000 to 2021 to answer the following research question:

Are sin stocks performing better than non-sinful stocks, and what are the recent sin stock developments?

Our research has practical importance for investors and researchers in their quest to maximize risk-adjusted returns. We have seen strong demand for socially responsible investments and strict investment criteria forcing asset managers to exclude companies with morally unacceptable exposure. In this context, we study the relationship between this stigma toward sinful stocks and abnormal returns. We define a sin stock as the traded equity of a company with exposure to the sinful industries of alcohol, tobacco, and gambling. The definition and selection of industries are in line with those of the well-known sin stock researchers Hong and Kacperczyk (2009), who did find sin stocks to have positive abnormal returns. They highlight that sin stocks have greater litigation risk heightened by social norms, yielding higher returns. We further present research on the development of a modern group of sin stocks related to the emission-heavy oil and gas industry.

Whereas Hong and Kacperczyk (2009) concluded that sin stocks have positive abnormal returns, Blitz and Fabozzi (2017) suggested the opposite. They claimed investors could expect equal returns by owning stocks with similar exposures to the investment and profitability factors. With large amounts of capital relocating from sinful equities and towards more sustainable companies, the demand for responsible companies has undoubtedly lifted the valuations of these companies. The interesting question then becomes that of whether sinful companies experience headwinds due to the ongoing change in investor preferences. Time periods of previous research become crucial as the perception of what is considered both sinful and sustainable is continuously changing, as highlighted by Blitz and Fabozzi (2017).

Traditional sin stock industries comprise large alcohol companies such as Heineken, gambling companies such as DraftKings, and tobacco companies such as Philip Morris International. Common to all these industries are the often large, well-established corporations operating with monopolistic features (Tromp, 2019). As mentioned, the increased focus on sustainability, global warming, and carbon emissions has led to the rise of a potential modern sin industry. Whereas the traditional sin industry receives criticism for its addictive and destructive nature, modern sin stocks are criticized for their environmental impact. We find oil and gas companies such as Exxon Mobile, Chevron, and Shell at the forefront of this.

Our thesis aims to provide insights into sin stock performance and the potential indirect cost of excluding these investment alternatives. We start the analysis focusing on a sin portfolio and studying whether there are abnormal returns, in line with most sin stock studies, e.g., Hong and Kacperzyk (2009). We further move on to make period-divided portfolios to investigate the development of abnormal returns across different time periods.

We perform a study of resilience during distressing periods, a geographic extension, and research on the cost of raising capital for sin stocks. Additionally, our thesis focuses on companies that meet some minimum requirements regarding market capitalization, turnover, and operational history to capture the universe of stocks available for large investment managers. All this works as an expansion of previous sin stock research.

In line with Hong and Kacperczyk (2009), we find that sin stocks have abnormal returns, but not against the comparable group of companies. We thereby expect risk-adjusted returns also by investing in similar non-sinful companies. The comparable group of companies is extracted in a similar fashion to the work of Hong and Kacperczyk (2009), except for some added criteria on liquidity, market capitalization, etc. We use soft drinks and bottled waters as comparables to alcohol, food manufacturing as comparable to tobacco, and hotels and cruises without casinos as gambling comparables. Due to the strong performance of the peer companies, going long sin stocks and short comparables would yield negative

abnormal returns in 2017-21. This suggests a negative trend for sin stocks and a positive trend for a comparable group of companies over the last five years.

All of this suggests that an investor can build a non-sin stock portfolio consisting of comparable stocks and still expect positive abnormal returns. This goes against the work of Hong and Kacperczyk (2009), who argued that lower demand for sin stocks drove the abnormal returns, whereas we find that similar companies without sinful traits also have abnormal returns. However, the sin portfolio has a higher and more statistically significant abnormal return. This may suggest that the lower demand for sin stocks, in fact, is driving some of the abnormal returns. This weakens the critique of Hong and Kacperczyk's (2009) paper, as we have mitigated any potential excess returns of illiquid stocks by having stock inclusion criteria on size and liquidity. Thus, excluding sinful companies has proved to be a costly strategy historically, albeit this strategy has been positive for investors over the last five years.

We extend our research by investigating the development of a new group of modern sin stocks consisting of high carbon footprint companies within the oil and gas industry. However, we do not find evidence that the modern sin portfolio yields any abnormal returns, neither on a general basis nor against the comparable group of companies.

Some researchers claim that sin stocks' fundamental characteristics include steady cash flows (Tromp, 2019). This could give some resilience during market turmoil. To investigate this, we carry out an analysis of returns during the three most significant economic downturns. We find it interesting to see whether there is any resilience in such periods and how the sin stocks developed during the Covid-19 market turmoil. Our understanding is that there is no previous research on sin stock returns during market turmoils. The results suggest excellent nominal and risk-adjusted returns for the sin stock portfolios during the dot-com bubble and financial crisis. More interesting are the returns during the Covid-19 crash. This time, sin stocks yielded the worst risk-adjusted returns, despite nominal returns above the market. Indeed, the travel restrictions led to high volatility in the gambling and

alcohol market as the leisure sector experienced strong headwinds. Common to all the crisis periods is the absence of abnormal returns.

To investigate sin stock valuation developments, we look at the CAPE ratio. This metric shows a downward sloping trend over the last few years, with an end-of-year (2021) CAPE ratio below the 2000-21 average. On the other hand, the comparable portfolio has had a positive CAPE development, suggesting the opposite trend. This is interesting, as there seems to be a multiple contraction the recent years for the sin stock portfolio, which can be seen in the light of the lower returns in the period.

Furthermore, we see that sin stocks, to a higher degree, pay out dividends and implement share buybacks versus the comparable portfolio. However, we see a negative trend in margins, return metrics, and dividend payments, suggesting that sin stocks have become less profitable in recent years. Our data suggest more analyst coverage for sin stocks and less of an outside equity finance disadvantage than comparable companies. We find the opposite conclusion to Hong and Kacperczyk (2009) on analyst coverage and outside equity financing.

Our thesis contributes to today's literature in several ways. We capture a broader geographic view than traditional research, focusing on the countries Fama French defines as developed markets. In comparison, much of the literature up to this point has been heavily focused on the American and European markets. Furthermore, we provide new evidence using old methods to examine the sin stock valuation discount, but perhaps more importantly, the development of a modern sin sector comprising “new” sin companies. Furthermore, we focus on the development of abnormal returns, with a tilt towards discussing the 2017-21 period. With limited new sin stock research, our research captures the trends following the higher amount of socially responsible investments. The study of the sin industry as more resilient stocks during market turmoil also offers an extension to traditional literature.

The rest of the thesis is structured in the following way. Section two gives a theoretical introduction and a literature review studying previous researchers’

conclusions regarding abnormal returns and a potential sin valuation discount (sin premium). Section three presents our research question and methodology, while section four gives a detailed overview of our data and portfolio constructions. In the fifth section, we present our results before wrapping up the thesis with a conclusion and discussion in the sixth and final section.

2 Literature review and theory

2.1 The evolution of social norms and market behaviour

Social norms have always been around, but investor awareness is continuously rising following several scandals in the last decades. Nike's child labor accusations and BPs oil spill in the Gulf of Mexico have led to some of the world's largest and most profitable companies being perceived as sinful and unethical operators. Liu et al. (2014) show a strong interaction between social norms and financial incentives in determining the behavior of market participants. They present the vital conclusion that social norms can be crossed when motive and opportunity exist. The economist Becker (1971) was one of the early to present theories suggesting that social norms influence economic behavior and can sometimes even be prioritized over profit. In his model, he found that agents with discriminating tastes fueled by norms of the society would incur a financial cost from their selective morally motivated decisions.

Hong and Kacperczyk (2009) followed up on the same field when they presented several factors driving cost in the case of sin stock discrimination. They highlight the cost of being unable to diversify into publicly-traded companies while admitting to this being a small problem in real life due to such a broad market universe. On the other hand, they find sin stocks relatively cheaper on average, with lower P/E and P/B ratios than the comparable, not sinful companies (Hong & Kacperczyk, 2009). These lower valuation ratios suggest a return premium for sinful companies. If this holds, you can buy sin stocks at a discount and receive a return above the market. Finally, Geczy et al. (2003) found in their paper that the cost of SRI depends on the investor's views about asset pricing models. CAPM would be the least costly, whereas fund managers heavily dependent on factor models such as Fama French's five-factor model would incur the highest cost related to sinful stock discrimination. While they concluded that SRI investing is costly for investors, Hong and Kacperczyk (2009), amongst others, concluded that investors in sinful industries yield abnormal returns.

2.2 An introduction to traditional sin stocks

Sin stocks are typically classified as the traded stock of a company associated with vice or immoral company exposure. The most common sectors to be classified as sinful are alcohol, tobacco, gambling, weapons and defence, and companies associated with the adult Industry. The two latter sections are the most debatable, and we move on in this paper to focus on what is collectively known as the "Triumvirate of sin", namely alcohol, tobacco, and gambling (Hong & Kacperczyk, 2009). The common trend in the capital markets has been more stringent investor mandates with the ever-growing focus on sustainable investing. On the forefront of this is perhaps the Norwegian Sovereign Wealth Fund with their public available list of the companies they classify as unsustainable, or sinful if you may (NBIM, 2019). Please see chapter 4.4 for alternative sin industry considerations.

2.3 An introduction to modern sin stocks

On this same exclusion list as mentioned above, we find the development of a new more modern sin sector. As manifested in the Paris agreement in 2015, the urgent matters regarding sustainability, carbon footprint and co2 emissions need to be addressed. In the capital markets, this has led to also traditional oil and gas companies increasingly being classified as sinful. Alternative energy sources will serve as the lifebuoy for this significant change in energy supply. To build on traditional sin stock theory, we introduce the distinction between traditional- and modern sin stocks. We present a modern sin stock industry including companies such as oil and gas majors Exxon Mobile and Chevron, affiliated with heavy environmental footprints. See the second header of chapter 2.4 for more background on the emergence of a modern sin industry.

2.4 Literature review

Sin stocks and returns

One of the most cited articles on sin stocks is "*The price of sin: The effects of social norms on markets*" by Harrison Hong and Marcin Kacperczyk, published in 2009. Their paper provides evidence of social norms' effects on markets by studying sin stocks related to tobacco, alcohol, and gambling. The analysis concluded that sin stocks generate higher returns because investors face greater litigation risk. The

study additionally suggests that investors who avoid sin stocks pay a high financial cost, as they sacrifice a higher expected return. They also conclude that large institutional investors are less likely to own sin stocks due to the social controversy of their products (Hong & Kacperczyk, 2009).

Despite being widely cited, Hong and Kacperczyk's (2009) paper has gotten critique. Adamsson and Hoepner (2015) question their research design for having limited empirical evidence from an international sample of stocks. They also highlight the flaw of assuming cultural similarities as studies show different investor sentiments on sin stocks across markets (Adamsson & Hoepner, 2015). They further argue that "*if social norms are priced, then cross-cultural differences in sin stocks´ performance should be present*" (Adamsson & Hoepner, 2015). The practical relevance of Hong and Kacperczyk's (2009) data sample and research design is also challenged. For instance, they neglect standard investment criteria such as market capitalization, liquidity, and trading volume (Adamsson & Hoepner, 2015). Lastly, they argue that Hong and Kacperczyk's (2009) risk-adjusted performance is wrong as they use a regression on an equal-weighted portfolio against a value-weighted market benchmark. This implies that outperformance could be driven by a small-cap performance bias instead of sin stock characteristics (Adamsson & Hoepner, 2015). We take Adamsson and Hoepner's (2015) critique into account and will run several tests to improve the study, i.e., by running both value- and equally weighted portfolios, and using investment criteria.

Another study on sin stock returns is the paper published by Fabozzi et al. (2008). As opposed to Hong and Kacperczyk (2009), they used a broader geographical and categorial examination. The study expanded the research to the US, Europe, Oceania, and Asia and examined alcohol, tobacco, weapons, gaming, biotech, and adult services. They concluded that sin stocks significantly outperform the broader markets, and concluded on a sin premium because investors were unwilling to take the risk of owning sin stocks. The study also found sin industries are more likely to be profitable due to the monopolistic characteristics of their companies (Fabozzi et al., 2008).

Blitz and Fabozzi's (2017) study went on to investigate the performance of tobacco, alcohol, and weapon stocks in the US, European and Japanese markets in the 1963-2016 period. Also, this study concluded that sin stocks significantly outperformed the broader markets. However, the abnormal returns measured through the alpha decreased with more risk factors included in the asset pricing models, whereas the alphas were gone when reaching a five-factor model. Thus, Blitz and Fabozzi (2017) concluded that sin stock returns are explained by controlling for more risk factors. They further argued that investors could expect similar returns by investing in companies with similar risk factors, e.g., companies with a high load towards the robust operational profitability factor. According to the study, no abnormal returns are related to sin investing, which is the opposite conclusion of the widely cited study by Hong and Kacperczyk (2009).

The development of new sin industries

Commodity analyst and author Peter Sainsbury (2021) published an article expecting oil and gas to encounter the same obstacles as the tobacco industry faced decades ago. Sainsbury argues that fossil fuel companies are the "new" tobacco companies. With increasing pressure from both authorities and consumers due to the climate impact (Sainsbury, 2021). The author reminds the audience that the tobacco industry has outperformed the market, thereby pointing out the historically strong performance of sin stocks.

The theory about modern sin stocks can be paralleled with the article by Blitz and Fabozzi (2017). Here they specify that what is recognized as a sin stock will often change over time. Companies work aggressively towards reduced carbon footprints and improved ESG ratings, which cause the list of sinful companies to typically vary. This theory is in line with other researchers, such as Blitz and Swinkels (2019), which compare the lowest scoring sustainability companies to the traditional sin companies.

Political forces have given the oil and gas producers an everlasting headwind, with the imposed restrictions regarding emissions committed by signing the Paris Agreement. This has led to divestures within carbon intense industries and record-

high capital inflow into ESG companies (Proactive investors, 2021). The result has been a sell-off of sin stocks while lifting the valuations of ESG stocks, potentially driven by multiple expansions. The EU taxonomy works as an extension of these theories, with the motive to incentivize the responsible companies and potentially shift capital flows (European Commission, 2020).

Bolton and Kacperczyk (2021) further found that companies with high emissions yield greater returns, and point out that institutional investors implement exclusionary screening based on emission intensity. Interestingly, a paper by In et al. (2019) found the opposite results. According to their studies, long stocks with low carbon emissions and short stocks with high carbon emissions proved to yield abnormal returns. Both theories suggest abnormal returns due to investor preferences but disagree on whether high- or low-carbon-footprint yields abnormal returns. The unfavorable implications of sin stocks are further covered in the Ilhan et al. (2018) paper. They find that the cost of option-protection against downside tail risk is higher for firms with more carbon-intense business models.

Sin stocks vs. ESG litterature

ESG is, in many ways, the opposite of sin stock investing. Therefore, we highlight some key ESG research and raise the question of whether the conclusions would be opposite for sin stocks. A meta-study by Clark et al. (2014) finds that strong ESG standards lower the cost of capital, and the meta-study concluded that stock prices are positively affected by solid ESG performance. Additionally, traditional finance theory suggests that low risk leads to low return, but a study by Kumar et al. (2016) suggests that companies incorporating ESG factors show lower volatility and higher returns than the control group. On the contrary, a study by Cornell (2020) suggests that companies with high ESG scores might receive a lower cost of capital but at the cost of a lower expected return as well. Other research suggests that ESG companies receive better financing terms (Gross & Roberts, 2011; Nanday & Lodh, 2012). The latter article is interesting with our belief that sin stocks might struggle to raise capital compared to peers.

Other relevant literature

In the last section of our thesis, we look at the capital structure and capital distribution strategies involving equity issuances, share buybacks, and dividend payments. Baker and Wurgler (2004) published an article highlighting that dividend payments are driven by prevailing investor demand for dividend payers. The management typically decides to pay dividends when the financial market puts a premium on dividend payers. Baker and Wurgler (2002) also published a well-known paper on market timing and capital structure, reminding everyone about the logical fact that current capital structure is highly related to historical market values. The study highlights the importance of issuing shares at a high price and repurchasing shares at a low price. We will further examine if sin stocks can issue shares in a reasonable matter and whether sin stocks have an outside equity financing disadvantage, as Hong and Kacperczyk (2009) concluded.

See Table 2.1 in the Appendix for an overview of previous sin stock literature.

Gaps in current literature and how we add value

We expand today's sin stock research with; new periods, new markets, new types of sin stocks, and new stock criteria. We also focus on sin stock's financial development, valuation, and outside equity financing.

While most of the established research is focused on the US markets, we will include all the developed countries. We generally find a lack of well-established research on period-divided sin stock performance, which we will go in-depth on. We extend the traditional research by also focusing on fundamental factors such as valuation, financial developments, and financing disadvantages. By additionally imposing a set of data criteria, we respond to a large set of what Hong and Kacperczyk (2009) has been criticized for. We find no recent papers on sin stock trends, suggesting that this paper should add value to the already limited sin stock research. This is especially relevant in the current environment with a high focus on SRI and ESG. The research will add value to the ongoing discussion regarding sustainability, where one camp claims ESG trades at a premium while the other camp designates a sin premium, as mentioned regarding the opposing theories of

Bolton and Kacperczyk (2021) and In et al. (2019). The evolution of new sin industries is an important field to investigate further. We add value to the current literature by researching the sin stock resilience during market turmoils, being one of the first to connect the covid-19 crash to sin stock performance.

3 Hypothesis and methodology

3.1 Hypothesis

We hypothesize that sin stocks outperform relevant peers in line with traditional economic theory (Hong & Kacperczyk, 2009). We furthermore expect sin stocks to yield excess returns. Our next theory is that sin stock returns have lagged the overall market since the ESG- and SRI- focus accelerated around 2015-2016. On top of this, we would like to examine whether the sin stock avoidance becomes more relaxed in a crisis environment where the sin stocks, with their high profitability and steady cash flow, might become advantageous. We finally want to investigate the development of valuation and financial characteristics for sin stocks. We expect a lower valuation due to the sin premium, but better profitability and shareholder returns through dividends for sin stocks compared to similar non-sinful industries. The flipside of being a sinful company might be that equity issuances could need a higher issue discount following the outflow of capital from the industry. The counterargument we would like to study is whether this becomes a problem if the sin stocks raise capital less often. We generally focus on the shareholders' payoffs from owning sin stocks.

We form a set of hypotheses to address these questions:

H1A: Traditional sin stocks yield abnormal returns

We expect sin stocks to have abnormal returns compared to the market portfolio and comparable stocks. This is based upon the sin stock premium, where we expect sin stocks to be systematically underpriced due to investor avoidance. Therefore, the investors would need to earn a premium (Blitz & Fabozzi, 2017). We will create different sets of portfolios and measure the potential abnormal returns using various regression models.

H1B: Modern sin stocks have (no) abnormal returns

With the shunning of emission-heavy companies, we expect to see a sin stock trend develop within the oil and gas industry. We will here follow the same methodology as described for hypothesis 1A.

H1C: Sin stocks perform better during distressed periods

We expect that sin stocks typically have strong cashflows, cheaper pricing, and less cyclicality, in line with Tromp (2019). We predict sin stocks to outperform the market during turmoils such as the dot-com bubble, financial crisis, and Covid-19 crash. We will therefore study the resilience of sin stocks during distressed periods.

H2: Sin stock company valuations decrease over time, and they receive worse terms regarding outside equity financing than comparable companies

Due to the sin stock premium, we expect sin stocks to be cheaper than a comparable group of companies. We expect this valuation gap to increase with time as sin divestments have accelerated. Our expectation is that sin stocks have better company fundamentals than the peer group. Given that some investors are forced to exclude sin stocks, we expect it to be more difficult for sin stocks to raise capital than comparable companies in line with Hong and Kacperczyk´s (2009) findings.

3.2 Introduction to asset pricing models

We will use asset pricing models to measure returns. Our framework includes the models of CAPM, the Fama-French three-factor, five-factor, and five-factor with a momentum extension. These asset pricing models are widely used in previous sin stock studies such as Hong and Kacperczyk's (2009) and Blitz and Fabozzi (2017). The models are known for their rigorous predictions when portfolios are well-diversified (Fama & French, 1993). We will model both equally weighted- and value-weighted portfolios to get the best possible overview of the return drivers, albeit we will focus more on the value-weighted portfolio and the five-factor model. This is one of the key improvements from the study by Hong and Kacperczyk (2009).

3.2.1 Capital asset pricing model (CAPM) and Jensen's Alpha

The capital asset pricing model (CAPM) is one of the most famous asset-pricing models (Lintner, 1965; Sharpe, 1964). Jensen's alpha is also a widely used risk-adjusted performance measure that illustrates the average return on a portfolio or investment above or below the CAPM's predicted return, given the portfolio's beta,

market premium, and the risk-free rate (Jensen, 1968). We have the following equations:

Equation 1: CAPM

$$R_{it} = R_{ft} + \beta_i(R_{mt} - R_{ft})$$

Equation 2: Jensen's Alpha

$$R_{it} - R_{ft} = \alpha + \beta_i(R_{mt} - R_{ft}) + \epsilon_{it}$$

Where R_{it} is the return of the investment i in the month t, R_{ft} the return of the risk-free T-bill in month t, R_{mt} the return of the relevant equity benchmark in the month t, β_i the measure of systematic risk (relative to the relevant benchmark), and ϵ_{it} as the error term (Jensen, 1968; Bauer et al., 2005). A positive α would, for instance, imply some positive excess return that is not predicted by the CAPM. The model incorporates two key assumptions; the first is that it assumes that the market is efficient, and the second is that investors are rational. Therefore, the second assumption is potentially broken in line with the sin stock theory suggesting irrational stock discrimination. Following the model's simplicity, we shift our primary focus toward more advanced regressions, including several control variables.

3.2.2 Fama-French three-factor model

Other studies believe that a single index model might not appropriately explain investment performance (Fama & French, 1993; Fama & French, 1996). The Fama and French 3-factor model from 1993 is considered to yield better predictions on investment behavior in stocks, portfolios, and funds. This model suggests that returns in excess of the risk-free rate can be comprehensively explained by three factors (Fama & French, 1993). The first factor is the excess return on the broad portfolio ($R_M - R_f$), while the second factor is the difference between the returns on a portfolio of small stocks and the return on a portfolio of large stocks (SMB). The third factor is the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks (HML).

Thus, according to the Fama-French 3-factor model, the expected excess return of portfolio i is the following:

Equation 3:

$$E(R_{it}) - R_{ft} = b_i[E(R_{Mt}) - R_{ft}] + s_i E(SMB_t) + h_i E(HML_t)$$

Where $E(R_M) - R_f$, $E(SMB)$, and $E(HML)$ are expected premiums of bearing risk. The factor sensitives/loadings, b_i, s_i and h_i, are the slopes in the time-series regression. The model can also be written the following when testing for abnormal returns:

Equation 4:

$$R_{it} - R_{ft} = \alpha_{it} + b_i[R_{mt} - R_{ft}] + s_i SMB_t + h_i HML_t + e_{it}$$

3.2.3 Fama-French five-factor model

Fama and French have extended their mode into a five-factor model to explain variation in average returns related to profitability and investments (Fama & French, 2015). According to the study, the model captures size, value, profitability, and investment patterns in average stock returns and should capture stock return performance better than the three-factor model (Fama & French, 2015). Even though the model should perform better, Fama and French still conclude that the model fails to capture low average returns on small stocks whose returns behave like those of firms that invest a lot despite low profitability (Fama & French, 2015). The Fama-French five-factor model is written as the following:

Equation 5:

$$R_{it} - R_{ft} = \alpha_i + b_i[R_{mt} - R_{ft}] + s_i(SMB_t) + h_i(HML_t) + r_i RMW_t + c_i CMA_t + e_{it}$$

Where RMW_t is the difference between the returns on diversified portfolios of stocks with robust and weak profitability, while CMA_t is the difference between returns on a diversified portfolio of the stocks of low and high investment firms. According to Fama and French (2015), the intercept α_i will equal zero for all securities and portfolios i if the exposures to the five factors b_i, s_i, h_i, r_i and c_i

capture all variations in expected returns (Fama & French, 2015). Our studies assume that the five-factor model captures all the risk factors, meaning that a significant alpha would imply abnormal returns.

3.2.4 Fama-French five-factor model with momentum extension

The momentum factor is a widely accepted return factor for stocks. We find it relevant to extend the Fama-French five-factor model with the momentum factor. We have the following model:

Equation 6:

$$R_{it} - R_{ft} = \alpha_i + b_i[R_{mt} - R_{ft}] + s_i(SMB_t) + h_i(HML_t) + r_i RMW_t + c_i CMA_t + p_i PR1YR_t + e_{it}$$

Where $PR1YR_t$ is the difference in returns between a portfolio of past 12 months winners and losers.

3.2.5 Model testing and validity

In order to trust our regression results, we must make sure the following Gauss-Markov assumptions hold (Wooldridge, 2012).

1. $E[u_t] = 0$
2. $Var[u_t] = \sigma^2 < \infty$
3. $Cov[u_i, u_j] = 0$
4. $Cov[u_t, x_t] = 0$
5. $u_t \sim N(0, \sigma^2)$,

The first assumptions state that the standard errors must have a zero mean. As long as the regression has a constant term, the residuals will be zero on average. Assumption number two is regarding homoscedasticity, meaning that the error of the variance is constant. The third assumption covers autocorrelation, whereas the fourth covers collinearity. The fifth assumption states that the error terms are normally distributed. The Fama-French factors have proven to predict stock returns successfully. This demonstrates that assumptions 1 and 4 about linear parameters and collinearity already hold and do not need further investigation (Carhart, 1997).

Assumptions two and three regarding homoscedasticity and autocorrelation must be tested to ensure the regression is unbiased. We test this by running a Breusch-Godfrey and Breusch-Pagan test, whereas both tests suggest that the assumptions hold. Assumption 5 regarding normality is tested through a Jarque-Bera test, which implies that the normality assumption holds. Therefore, we can conclude that all the assumptions hold, and the regression results are thereby valid. Please see chapter three in the Appendix for an overview of the test results.

3.2.6 Model weaknesses

Critiques include comments on the value factor being more of a firm's characteristic rather than a risk factor determining expected returns. For instance, Daniel and Titman (1997) argued that investors prefer to hold high book-to-market stocks than low book-to-market stocks, thus reflecting the returns but not the risks. Fama and French have been critiqued for not including a momentum factor in their three- and five-factor models, as the momentum factor has been proven to capture short-term continuation of returns. However, Fama and French argue that adding a momentum factor to the five-factor model might result in faulty diversification in the portfolios used to create explanatory factors (Fama & French, 2014).

The Fama-French five-factor model has been criticized due to the riskiness of adding more explanatory variables to the model (Blitz, 2018). According to Blitz et al., adding more factors can make it more challenging to examine the cross-section of stock returns because the added factors might interact with each other. Additionally, they write that there are uncertainties about how profitability and investment fit into their old asset pricing framework, as their previous three-factor model only suggests that the relationship between risk and returns is linear and positive (Blitz et al., 2018).

3.3 Valuation methodology

The price-to-earnings ratio is a well-known and widely accepted valuation measure. Despite this, Perry et al. (1952) were one of the early movers to stress the validity of this measure. They argued that the metric was too dependent on what was happening in the economy, hence misleading a company’s long-term prospects.

Therefore, the proposed solution was to look at the profits over a five to ten-year period. Robert Shiller relayed this concept when publishing his (1996) paper on the strength of using 10-year average company earnings to correctly compute a cyclicality adjusted price-to-earnings ratio (CAPE). We can further CPI-adjust the historical CAPE ratio to arrive at the most accurate metric across different time periods.

Equation 7:

$$CAPE_t = \frac{P_t * (\frac{CPI_t}{CPI_{t-1}})}{\left[\frac{(EARN_t + EARN_{t-1} + \cdots + EARN_{t-10}) * \frac{CPI_t}{CPI_{t-1}}}{10}\right]}$$

Where P_i is the close price per share, CPI_i is the consumer price index for time t, and $EARN_i$ is the reported earnings per share. We value-weight the CAPE with the same methodology as described in chapter 4.9.

3.4 Introduction to financial characteristics and capital structure

To investigate the change in valuation and characteristics, we also compute various well-known finical metrics as found in the book "*Measuring and Managing the Value of Companies*" published by McKinsey & Company (2020).

Table 3.1: Financial metrics overview

Various Financial Metrics	
Dividend yield	= Dividend per share / Price per share
EBIT Margin	= EBIT / Revenue
Return on Equity	= Earnings / Average 12-month Equity
Return on Assets	= Earnings / Average 12-month Assets
Cash Flow to Total Assets	= CF / Average 12-month Assets
Debt to Total Capital	= Debt / Average 12-month Assets
Net Leverage Ratio	= (Debt – Cash) / Average 12-month Assets
Price- Earnings Ratio	= Price Per Share / Earnings Per Share
Price- Book Ratio	= Price Per Share / Book Value Per Share

Note: The Table gives an overview of financial characteristics we further comment on throughout our descriptive analysis in chapter 5.4. The metrics align with important financial characteristics from the well-known *Measuring and Managing the Value of Companies*, published by McKinsey & Company (2020).

3.5 Alternative methodologies

To narrow the scope, we choose to omit some inessential models. For instance, we could have used the Fama-French 3 three-factor with momentum extension, also known as the Carhart four-factor model. By running this regression, we could have introduced a factor to control for cross-sectional variations in momentum-sorted portfolios (Carhart, 1997). We also need to highlight that we prioritize the value-weighted five-factor model despite running a variety of regressions. To investigate changes in valuation, ownership, and analyst coverage, it would be possible to follow Hong and Kacperczyk's (2009) methodology using a Fama and MacBeth (1973) regression model. Here they first run a regression to determine the asset betas. After that, the asset returns are regressed against these betas. This would determine the respective risk factors for each asset. We further note that other methods could be used to measure the change in valuations for sin stocks. We use the CAPE ratio but argue that regression on a multiple against various financial metrics might be an accurate method to check if there are changes in the fundamental valuation of sin stocks.

4 Data and preliminary analysis

4.1 Data selection

As previously mentioned, we will focus on listed equities in developed countries throughout this paper. We started by creating a list of companies classified as traditional sin stocks related to alcohol, tobacco, and gambling. We obtained the necessary data using Thomson Reuters's Datastream, Bloomberg, Kenneth French and Shiller's online data libraries. All these platforms are well-established and trusted data providers. We downloaded the necessary data for our multi-factor models from French's data library (French, 2022). Most of our analysis is done by studying the total returns for different periods. We chose the 22 nations classified as "developed countries" by Fama and French and set the timeframe to the last 22 years (see sections 4.6 and 4.7 for further information). We set the following criteria for the companies to have a minimum 12 consecutive months of data, an average market capitalization above $30 million, and a turnover of at least $1 million per day. We also set a criterion of a minimum of 5% relevant industry revenue to avoid including minority shareholders within the industry. All monetary factors are retrieved in dollars. A summary of the data sources is found in Table 4.1.

Table 4.1: Data source overview

Data sources	
Datastream: Refinitiv	Company Financials: Aot. Total Returns, EPS, Market Capitalization, Price, Crude oil price WTI futures, etc.
Fama French Library	Fama-French and momentum factors
Shiller's Data Library	CAPE Ratio: CPI Development and S&P 500 CAPE ratio
Bloomberg	Shareholder Yields: Dividend, Equity Issuance, Stock Buybacks, etc.

Note: The Table illustrates our data sources for various data. We have used Refinitiv for most of our data.

4.2 Selection of sin stocks

4.2.1 Selection of Alcohol companies

We extract all alcohol company tickers for the relevant industry codes, as seen in Table 4.2. We wanted to capture companies primarily involved in producing and distributing alcohol, especially the large producers of beer and beverages, wineries, and spirits producers. We excluded alternative parts of the alcohol industry, such as

bars or nightclubs, as these companies are less industrialized. We exclude retailers such as Walmart as we do not see them as a part of the alcohol industry despite their significant turnover from alcoholic products. As mentioned, we focus on companies like Heineken, Budweiser, and American beverage producer Constellation brands. These stocks are highly liquid and available to the public markets. See Table 4.2 for an overview of all industry categories included.

4.2.2 Selection of Tobacco companies

We include a variety of tobacco companies found by Refinitiv Datastream. The primary industry is cigarette manufacturers such as Philip Morris and British American Tobacco. However, we also included companies related to the upstream industry, such as American company Greenrose Holding focusing on crop production. Moreover, we also chose to have the most industrialized cannabis companies, such as Columbia Care, famous for distributing cannabis products.

4.2.3 Selection of Gambling companies

The largest decision in terms of gambling companies is whether to include the hotels or not. We chose to do this as many hotels have an aggressive strategy toward gambling revenues. We believe many investors would classify a majority of Las Vegas hotels as sinful companies. The largest company within our gambling portfolio is Las Vegas Sands Corp, with MGM and Caesars Entertainment also ranking amongst the top companies in market capitalization. Digital gambling companies like DraftKings Inc and Lottery companies like La Française des Jeux are also included.

4.2.4 Selection of modern sin stocks

As previously mentioned, we believe a new modern sin stock industry is developing. We use Datastream to find companies within the oil and gas industry by screening on behalf of the industry codes, as seen in Table 4.2. Some of the largest companies represented are oil majors Exxon Mobile and Chevron.

Table 4.2: Sin stock categories

Industry	SIC	NAICS
Alcohol	2082, 5812	312120, 312140, 312130, 325193, 453920, 424820, 722410
Tobacco	2834, 2111, 8742, 5141, 5099	311423, 311411, 311999, 311930, 311942, 311412, 311615, 311711, 311119, 311919
Gambling	7011, 7372, 7948, 7373	721120, 713290, 713210, 713120
Oil and Gas	1311, 1381, 1382, 1389, 2911, 3272, 4731	446120, 211112, 211111, 424720, 324110, 424510, 221210, 213112, 333415, 212210,

Note: The table gives a complete overview of the various SIC and NAICS industry codes we have used to extract relevant companies in various sin industries from Refinitiv Datastream.

4.3 Selection of comparable companies

We find comparable stocks in the same way as Hong and Kacperczyk (2009). The alcohol industry is benchmarked against soft drinks and bottled waters, represented by companies such as Pepsi and Coca-Cola. The tobacco segment is compared to the food manufacturing sector, heavily dominated by producers of canned or sealed grocery products such as Kraft Heinz. Since most gambling companies are casino hotels, the gambling peers mainly comprise hotels without casino revenues, albeit we also include cruise stocks in the comparable gambling portfolio.

The main difference of the comparable portfolio compared to Hong and Kacperczyk (2009) is that we have not included some Fama French (n.d.) industry groups related to fun entertainment, e.g., video rental, motion picture theaters, and professional sports. This is because we see these industries as less relevant since the gambling portfolio has moved towards being more exposed to online gambling since the Hong and Kacperczyk (2009) study. In addition, we also add cruises without casinos, which Hong and Kacperczyk (2009) did not include. For the modern sin stocks, we choose renewable companies as their comparable. This group is comprised of a variety of alternative energy producers like for Ørsted, one of the world's largest offshore wind producers. Like for Ørsted, many of the renewable companies originate from previous exploration and production (E&P) companies.

We use the same geography, timeframe, and way of construction of the comparable portfolios as for the sin portfolio, which is further commented on later in chapter four. An overview of the comparable stock industries is shown in Table 4.3.

Table 4.3: Comparable stock industries

Industry	SIC	NAICS
Alcohol Peers	2086, 2082	312111, 311511, 312112
Tobacco Peers	5961, 5812, 6794, 7011, 2052, 2033, 2015	311919, 311941, 311920, 722310, 311991, 311421, 311712, 446191, 311111, 311422, 311911
Gambling Peers	7011, 6513, 6552, 6531	721110, 483114, 487210
Renewables	4931, 4911, 1311, 4941, 3272, 4932	312221 ,111998, 453991, 424590, 424940, 453998, 312229, 111419, 111910, 312210

Note: The table gives a complete overview of the various SIC and NAICS industry codes we have used to extract relevant companies in various comparable industries from Refinitiv Datastream.

4.4 Alternative sin considerations

Our exclusions are in line with previous researchers such as Hong and Kacperczyk (2009). The **weapon and defense** industry includes everything from gun producers to large fighter jet manufacturers. The cutoff between engineering and sinful companies can also be tough to determine. Another alternative conflict that could be deemed sinful is the GEO Group, Avalon, and Corrections Corporation of America, which all are **for-profit prison companies**. The reason we choose not to include the weapon industry is that we follow the traditional literature focusing on the "Triumvirate of Sin" in line with Hong and Kacperczyk (2009) and Adamsson and Hoepner (2015). We note that the well-known research from Blitz and Fabozzi (2017) includes the weapon industry.

A**dult entertainment** is often recognized as part of the traditional sin industry. Playboy, founded by Hugh Hefner, is perhaps the most well-known company in this area, albeit the company has a limited history as a publicly traded company. Well-known sin industries are characterized by strict regulations, social stigma, and habitual elements. Researchers such as Lobe and Walkshäusl (2014), and Fabozzi, Ma, and Oliphant (2008) have published sin stock research with adult entertainment industry data. While there is some capital market activity within this segment, it is minimal, and we therefore choose to exclude this segment.

The Healthcare industry is also widely affected by strict regulation, addictive and habitual elements as well as social stigma. The producers and researchers of necessary medical treatments are obviously omitted. Companies involved in

producing addictive medication for profit could be categorized as sin stocks, along with producers of sex-related drugs, toys, and protection. Researchers such as Fabozzi et al. (2008) and Cai et al. (2012) did include this in their sin stock research. Despite being sinful, we choose to exclude this type of companies from our study, as we argue there are several difficulties in determining which healthcare companies are sinful. Our research further focuses on the original Hong and Kacperczyk (2009) study, which did not include the healthcare industry.

4.5 Geography selection

While looking at stock returns is quite generic in terms of data, there can be geographic limitations in terms of investor sentiment across countries. We know that sin stocks are often linked to the US, Singapore, and Hong Kong but are also represented in the EU and the Nordics (Fabozzi et al., 2008). The traditional study by Hong and Kacperczyk (2009) highlighted the joint perspective toward sin stocks shared by the U.S, Canada, and several European markets. A study by Liston (2016) highlights the strong relationship between investor sentiment and sin stock returns. For instance, the Netherlands has legalized cannabis, which might put its investors in another mindset than Norwegian investors with no legal access to these products. Baker et al. (2012) further found that global and local investor sentiment influences various non-American stock markets. Schmeling (2009) also found that investor sentiment impacts stock returns when studying the 18 most industrialized countries.

We chose the Fama French country classification of "developed countries" as our geographic selection, consisting of 22 of the most well-established economies. We hereby provide an extension to a large amount of American-focused sin stock literature. An overview of countries and industry composition is illustrated in Appendix Tables 4.2 and 4.3.

4.6 Selection of timeframe

We choose the time frame 1.1.2000-31.12.2021. We believe using a relatively recent timeframe is essential, with the focus on SRI accelerating. As highlighted, the perception of what is a sin stock can develop over time (Blitz and Fabozzi, 2017). To investigate structural changes in returns, we also define four sub-periods:

2000-05, 2006-11, 2012-16, and 2017-21. Our 22-year timeframe allows us to investigate the burst of the dot-com bubble, the financial crisis, and the recent Covid crash. To investigate our hypothesis about the resilience of sin stocks during distressing periods, we look at the respective timeframes listed in Table 4.4.

Table 4.4: Crisis periods

	Dot-com-crash	Financial Crisis	Covid-19 crash
From	March 2000	March 2007	1.Feb 2020
To	June 2002	March 2009	31. March 2020

Note: The table provides an overview of the various crisis periods within the 2000-21 periods. We define each crisis period based on when the bear market starts and ends, i.e., when market portfolios start declining until they provide positive returns.

4.7 Fama-French factors and CAPE-ratio

The Fama-French factors are retrieved from the Kenneth French Data Library. French has specific factors for the developed countries, exclusively matching our data on developed countries. The Fama-French factors are constructed using six value-weighted portfolios formed on size and book-to-market, size and operating profitability, and size and investment (French, 2020). All the returns are in United States Dollars (French, 2020). The risk-free rates are based on returns for a 1-month Treasury Bill (French, 2020). We use the same methodology in our regressions and base our research on Fama French factors retrieved from Kenneth French's data library. We refer to a market proxy in some parts of our research. The market proxy is also extracted from the Kenneth French data library for the developed countries.

We base our CAPE-ratio calculations on the Robert Shiller online data library. We use the same CPI adjustment as Robert Shiller but use Refinitiv's data for nominal earnings and close prices. We include the S&P 500 CAPE ratio in our CAPE illustrations extracted from the Shiller online database. Our portfolio CAPE ratios are calculated similarly to the original Shiller P/E ratio, with a value-weighted portfolio, albeit we do not adjust for minor differences in inflation across countries (Shiller, 2022). Note that our data set has a high representation of US companies, suggesting that this should be fine. Also, we see limited variations in inflation across countries, meaning that the outputs would not have other outcomes if adjusting for the country- and value-weighted inflation.

4.8 Portfolio construction

We construct various portfolios to study the differences across both industries and periods. We compute the total portfolio returns on an equal- and value-weighted basis. However, the main focus is on the latter. We use monthly total returns from a US investor's perspective isolating the effects of FX variations.

4.8.1 Total return data

To answer the hypothesis about abnormal returns, we study the total data downloaded from Datastream monthly. This total return is computed as the change in stock price, adjusted for stock splits, assuming that all dividends are reinvested (Reuters, 2022). Thus, the total return of a stock is calculated as the following:

$$Total\ Stock\ Return = \frac{(P1-P0)+D}{P0}$$

P_0 is the initial Stock Price. P_1 is the ending stock price and D is paid-out dividends.

4.8.2 Industry-divided portfolio returns

The first step in our modeling is to create a value-weighted portfolio for the indexed return per industry. We form an individual portfolio for alcohol, tobacco, and gambling companies and then compute the indexed total return for each industry. By doing this, we can also study which industries earn abnormal returns on an individual basis. The asset weight per industry is found by dividing the asset's market cap by the total market cap of that respective industry. The sum of the weights of each portfolio thereby equals one.

The weighted total return per industry portfolio is given by:

$$r_{p,t} = \sum_{i=0}^{N} (w_{i,t} * r_{i,t})$$

$$w_{i,t} = \frac{mv_{i,t}}{\sum_{i=1}^{N} mv_{i,t}}$$

Where $r_{p,t}$ is the market-cap-weighted return of the total industry portfolio *p* at time *t*. $r_{i,t}$ is the total return of stock *i* at time *t*. The $w_{i,t}$, is the weight of stock *i* at time *t*. And $mv_{i,t}$ is the market cap of stock *i* at time *t*.

4.8.3 Value-weighted sin portfolio

We follow the same procedure to create the sin stock portfolio. The weighted return of the sin stock portfolio is computed by applying the weight of each of the tree sin industries to the already indexed value-weighted returns of each sin industry.

$$r_{p,t} = \sum_{i=0}^{N} (w_{i,t} * r_{i,t})$$

$$w_{i,t} = \frac{mv_{i,t}}{\sum_{i=1}^{N} mv_{i,t}}$$

$r_{p,t}$ is the market-cap-weighted return of the total sin stock industry portfolio *p* at time *t*. $r_{i,t}$ is the total return of each subindustry *i* at time *t*. $w_{i,t}$, is the weight of the subindustry *i* at time *t*. And $mv_{i,t}$ is the market cap of the subindustry *i* at time *t*.

We follow the same methodology to form sets of portfolios for traditional sin, modern sin, and their respective comparable portfolios. An overview of all portfolios is illustrated in Table 4.5.

Table 4.5: Overview of portfolios

Portfolio overview	
Portfolio 1	Traditional Sin stock
Portfolio 1.1	Alcohol Stocks
Portfolio 1.2	Gambling Stocks
Portfolio 1.3	Tobacco Stocks
Portfolio 2	Traditional Sin Peers
Portfolio 2.1	Alcohol Peeer Stocks
Portfolio 2.2	Gambling Peer Stocks
Portfolio 2.3	Tobacco Peer Stocks
Portfolio 3	Modern Sin Stocks
Portfolio 3.1	Oil and Gas Stocks
Portfolio 4	Modern Sin Peers
Portfolio 4.1	Renewable energy Stocks

Note: The table gives an overview of portfolio constructions. Note that we also have a difference portfolio going long the sin portfolio and short the comparable portfolio. See chapters 4.2 and 4.3 for an overview of industry composition in the sin and comparable portfolios.

4.8.4 The difference portfolio

We construct a difference portfolio going long sin stocks and short the comparables. By doing so, one is effectively applying a strategy requiring zero net investments as the proceeds from shorting will fund the long portfolio. In the case of positive abnormal returns for such a strategy, we can conclude that there are abnormal returns for the sin portfolio against the comparable portfolio. The long-short study is in line with the methodology applied by, among others, Hong and Kacperczyk (2009).

4.8 Data concerns

Data set

As seen in Appendix Figure 4.4, the total number of companies represented steadily increases each year. This leads to the issue that a few large companies drive most of the return in early periods. A cross-check between the returns for the value- and equally weighted portfolio could, for the early years, help us further understand this impact. The next issue building on the same matter is that these aged companies are often market leaders with massive growth and profitability for a long time. This could lead to a problem of survivorship bias. To prevent this, we have included companies that have gone bankrupt or delisted within the same period. We focus heavily on the CAPE ratio to evaluate the change in valuations. An essential element in this calculation is the historical CPI. Here we have used the American CPI for all nations and thereby recognize the potential error in the case of high inflation periods for some countries. The errors should be limited since we only focus on developed economies with typically more stable economies.

Timeframe

Our timeframe is, as mentioned, 1.1.2000- 31.12.2021. Our dataset's starting period is turbulent, with the dot.com market turmoil being present at the beginning of our data set. We perform a robustness test by studying the abnormal returns, excluding the first two years (2000-2002). This would exclude the volatility of the dot-com bubble and thereby represent a more neutral market environment.

Geography

Our geographical limitations are broader than much of the previous research, which focuses mainly on the US. However, we still exclude many countries as our geography choice is set to developed countries. By setting the geography to only developed countries, we cannot conclude on a potential varying sin premium in developed countries against other less developed countries. The main question regarding geographic flaws is whether our study can be classified as "International" when we do not include any of the five emerging markets known as the BRICS, consisting of Brazil, Russia, India, China, and South Africa. We note that companies in the BRICS are likely to have shorter time series and higher volatility. We cover Hong Kong, and an argument could be that the large international companies from these economies are often listed on one of the American stock exchanges and thereby included in our data set.

Industry concerns

The industry composition's main problem could be the underrepresentation of gambling stocks, which are less than 10% of the sin stock portfolio during the first years. The gambling segment is also heavily related to the large casino hotels. We also note that the comparable gambling group of companies does not have a counterweight to online gambling. However, as the gambling sin portfolio has only a small proportion of online gambling, we do not find this a problem.

Company concerns

While getting most of our company data through Datastream, we use Bloomberg to retrieve data on equity issuances, issue discounts, and first-day performance. This study is done with the Bloomberg industry categories, as summarized in table 4.6. The source and companies were used due to a lack of data in Datastream.

Table 4.6: Industry and portfolio overview

Segment overview			
Traditional Sin	**Modern Sin**	**Traditional Peers**	**Modern Peers**
Tobacco	Oil and Gas	Food-Misc/Diversified	Energy-Alternate Sources
Beverages Wine & Spirits		Non-Alcoholic Beverages	
Breweries		Entertainment Software	
Casino Services Gamgling Non Hotels			
Internet Gambling Lottery Services			

Note: The table provides an overview of industries used in the capital raise study in chapter 5.4.3. The data are aligned with the industries used in the overall portfolio study, but the companies included are not necessarily identical. Note that we had to use Blomberg for the capital raise study as Refinitiv did not have useful equity issuance data.

4.9 Data summary

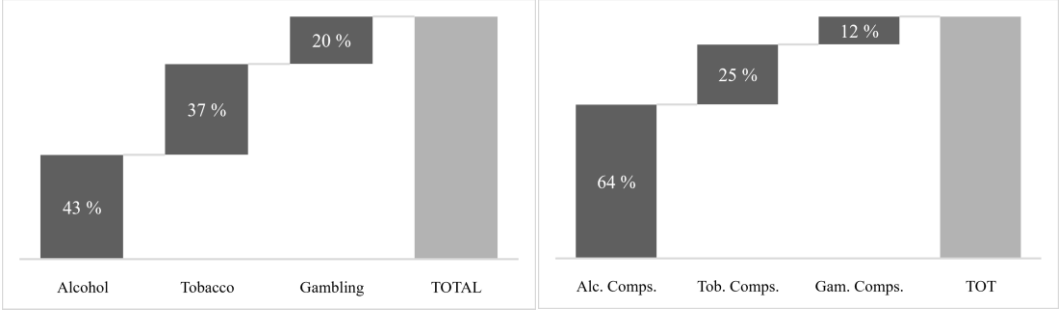
Data summaries are illustrated in Table 4.7 and Figure 4.1.

Table 4.7: Data summary

	2005		2010		2015		2021	
	Sin	Comp.	Sin	Comp.	Sin	Comp.	Sin	Comp.
No. Of Companies								
Alcohol	40	27	49	34	55	39	66	45
Tobacco	14	96	15	111	20	121	29	145
Gambling	25	37	39	42	46	49	58	59
Oil and Gas	119		181		233		287	
Renewables		62		77		89		104
Avg. Market cap								
Alcohol	2 520	11 201	3 985	11 996	6 316	15 048	9 079	19 520
Tobacco	4 800	885	12 398	1 251	18 535	1 552	16 926	2 790
Gambling	834	976	2 138	1 673	4 149	2 005	4 617	3 068
Oil and Gas	9 484		13 585		12 030		9 651	
Renewables		5 721		11 230		9 446		11 660

Note: The table gives a periodic-divided summary of the traditional- and modern sin stocks and their comparable industries. The number of companies refers to the number of companies in our data set in the respective period. Average market cap refers to the average market cap of each industry portfolio in the respective period. The data is retrieved from Refinitiv using industry codes, as illustrated in chapters 4.2 and 4.3.

Figure 4.1: Percentage share of total industry for traditional sin stocks and comps.



Note: The figures illustrate the value-weighted percentage industry composition in traditional and comparable portfolios.

5 Results and Main analysis

In this chapter, we will present and discuss our results. The goal is to answer our research question and hypotheses, as presented in chapter 3.1. We will also provide a discussion and conclude on implications throughout this chapter. We start with our primary analysis of traditional sin stocks before continuing on modern sin stocks. After that, we address trends in valuation, financial characteristics, capital allocation, and outside equity financing.

5.1 Hypothesis 1A: Traditional sin stocks yield abnormal returns

We hypothesize that traditional sin stocks have abnormal returns in general and compared to a comparable group of companies that are non-sinful. We also believe that the returns are somewhat skewed towards the earlier periods in our time regressions. Our results are studied through various time-series regressions.

5.1.1 Descriptive statistics over traditional sin stocks

We start our analysis with descriptive statistics of the total cumulative return, industry-divided, and period-divided portfolios.

5.1.1.1 Cumulative return portfolios

Table 5.1 shows a descriptive summary of the various portfolios in the 2000-2021 period. We focus on the value-weighted portfolios, albeit we have included the equally weighted total period and compounded annual returns in Table 5.1. An important observation is that the sin portfolio has significantly higher nominal returns than the peer portfolio, whereas the sin portfolio has delivered a total compounded return of 3124% in the period, the equivalent of a 17% compounded annual return. The comparable portfolio has given 1060% in the same period, equivalent to a 12% annual compounded return. However, the sin portfolio has higher volatility than the comparable portfolio, measured by the monthly standard deviation of nominal returns. We see that the sin portfolio has delivered an annual Sharpe ratio of 1.12, better than the comparable portfolio of 0.91.

The equally weighted portfolios also have delivered good nominal returns. However, the equally weighted sin portfolio has delivered a lower total return than the comparable portfolio. This suggests that large companies have driven the returns for sin stocks, while the opposite is true for the comparable industry. Hong and Kacperczyk's (2009) results illustrate the opposite, with sin stocks having better equally weighted returns than the comparable portfolio. Sin stocks have some companies that have produced high returns for many consecutive years, for instance Phillip Morris. Due to the monopolistic characteristics of sin industries, we are not surprised that large sin companies have high returns, in line with Blitz and Fabozzi (2017). Differences between the equally and value-weighted portfolios can be seen as i) sin stocks have skewed returns towards the companies with the highest market caps, while ii) the comparable portfolio's returns are skewed towards the companies with lower market caps, on average.

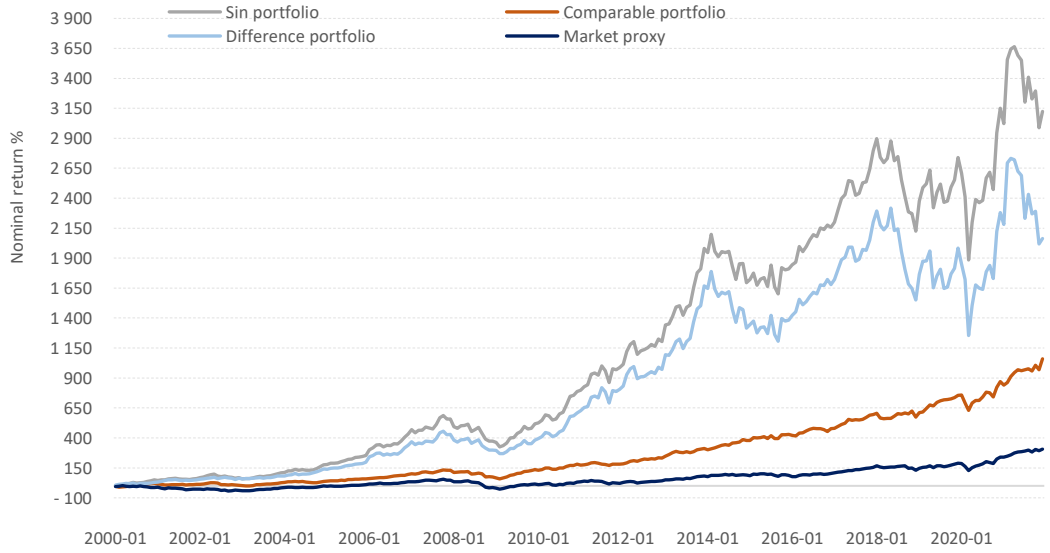
Figure 5.1 shows the portfolio returns for the period, while Figure 5.2 illustrates the sin and comparable portfolio returns, including industry-divided portfolios. As presented, the sin portfolio has high nominal returns, meaning that the difference portfolio has also delivered good returns. On a nominal and non-risk-adjusted basis, the portfolios have performed better than the market proxy. We expect this nominal outperformance to be partially explained by higher exposure to various risk factors.

Table 5.1: Total period portfolio statistics

	Value-weighted							Equally-weighted	
Statistic	**Annualized Sharpe Ratio**	**Nominal mean monthly return**	**Nominal Std.Dev of monthly returns**	**Min monthly portfolio return**	**Max monthly portfolio return**	**Total period return**	**Compounded annual return**	**Total period return**	**Compounded annual return**
Total period (2000-21)									
Sin portfolio	1.12	1.4 %	4.1 %	-13.5 %	15.5 %	3124 %	17 %	1182 %	12 %
Alcohol portfolio	0.89	1.2 %	4.1 %	-14.6 %	16.4 %	1702 %	14 %	744 %	10 %
Tobacco portfolio	0.90	1.4 %	4.9 %	-12.9 %	14.1 %	2514 %	16 %	1198 %	12 %
Gambling portfolio	0.75	2.0 %	8.8 %	-28.5 %	60.5 %	7170 %	22 %	1610 %	14 %
Comparable portfolio	0.91	0.7 %	3.3 %	-9.4 %	9.4 %	1060 %	12 %	1243 %	13 %
Alcohol peer portfolio	0.73	0.5 %	3.6 %	-9.9 %	10.0 %	765 %	10 %	2235 %	15 %
Tobacco peer portfolio	1.08	1.1 %	3.4 %	-7.5 %	9.8 %	1705 %	14 %	1402 %	13 %
Gambling peer portfolio	0.63	1.4 %	5.9 %	-23.7 %	14.7 %	1212 %	12 %	498 %	8 %

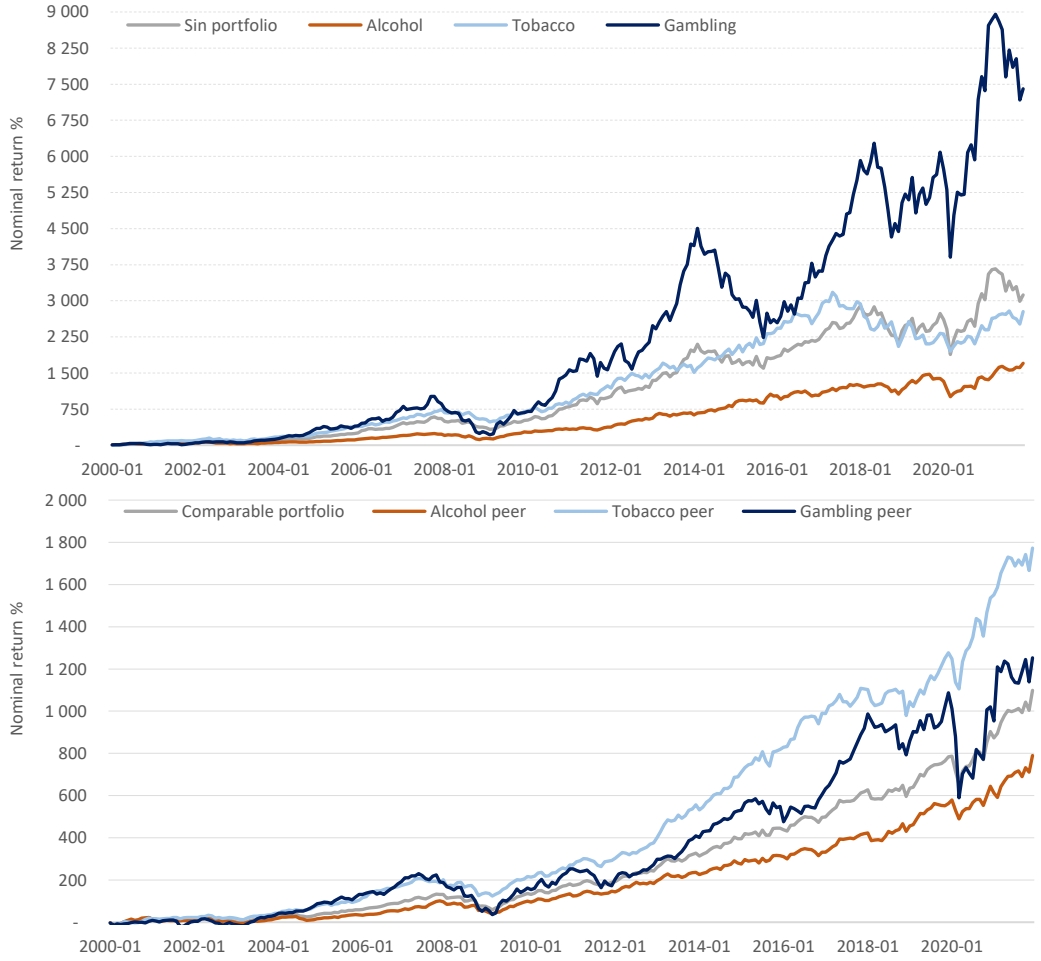
Note: Mean return is the average weighted return of all stocks in the relevant portfolio. The min/max is the smallest/highest return observed in a period in the applicable period. We used nominal returns for this statistic, meaning that the returns are not netted against the risk-free rate for the Sharpe Ratio calculation. The Sharpe Ratio is calculated as the monthly mean excess return, netted against the risk-free rate in the respective period, divided by the respective period's monthly standard deviation. We further annualized the Sharpe Ratio by multiplying the monthly Sharpe Ratio with the square root of twelve. The Table shows total returns in their respective periods adjusted for dividends. The difference between the total period return and the sum of the respective returns comes from the compounding effect, which is only considered for a specific period. The portfolio returns are monthly value-weighted and adjusted for dividends. The Table shows total returns in their respective periods adjusted for dividends. The portfolio returns are monthly value-weighted and adjusted for dividends. We used nominal returns for this statistic, meaning that the returns are not netted against the risk-free rate except for the annualized Sharpe ratio.

Figure 5.1: Portfolio returns



Note: The figure shows the total period nominal returns of various value-weighted portfolios. The sin portfolio is the value-weighted portfolio of sin stocks and consists of alcohol-, tobacco- and gambling stocks. The comparable portfolio comprises various comparable industries to the sin industries that are not sinful. The difference portfolio is a portfolio going long the sin portfolio and shorts the comparable portfolio. The market proxy is the Fama French market portfolio for developed countries.

Figure 5.2: Sin and comparable portfolio returns



Note: The figure shows the total period nominal returns of various value-weighted portfolios. The upper figure illustrates the sin portfolio and its various industry portfolios. The latter figure shows the comparable portfolio and its respective industry portfolios. The sin portfolio is the value-weighted portfolio of sin stocks and consists of alcohol-, tobacco- and gambling stocks. The comparable portfolio consists of various comparable industries to the sin industries that are not sinful.

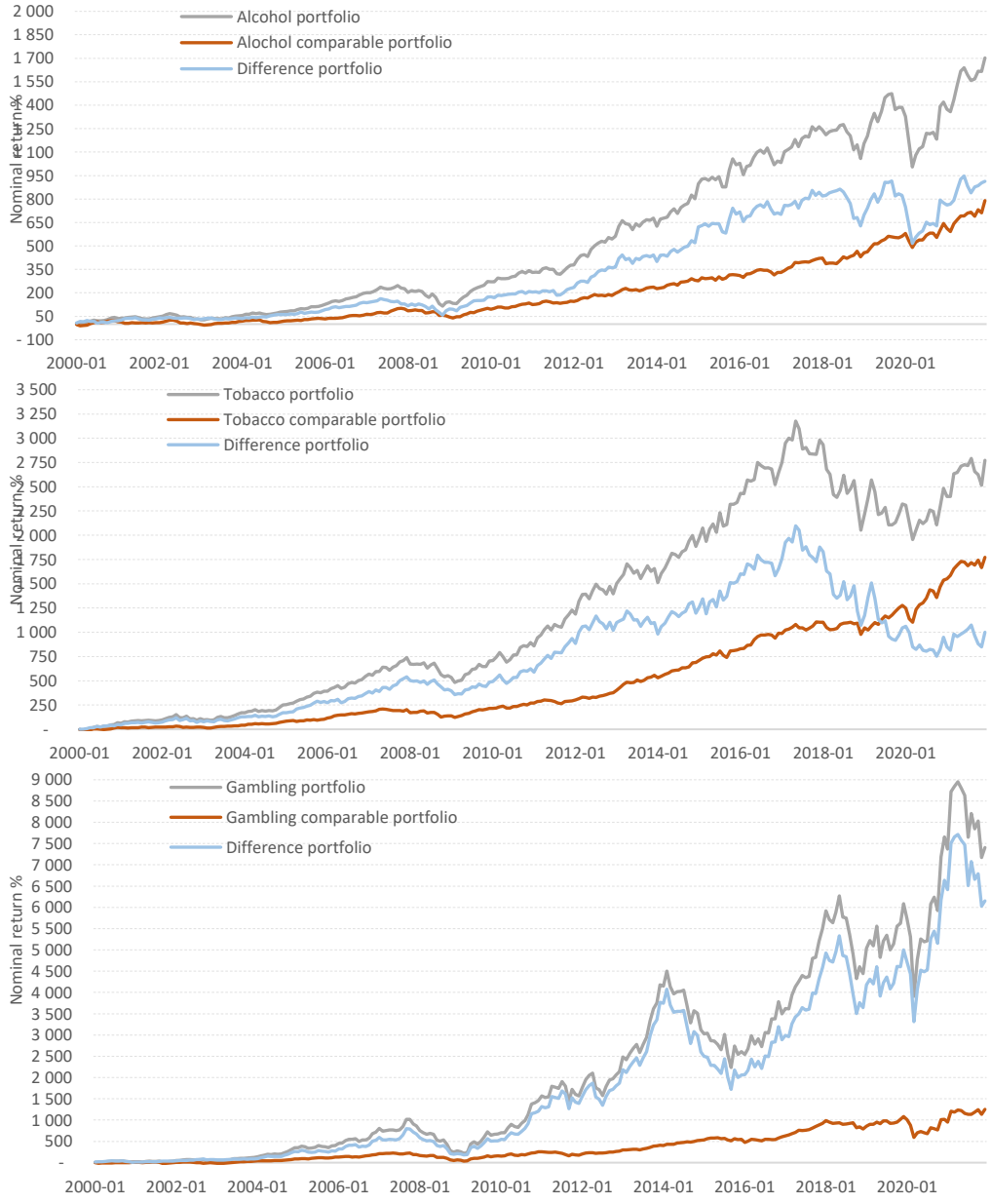
5.1.1.2 Industry divided portfolios

We continue our analysis with more details on the industry-divided portfolios. The sin and comparable industry portfolios are explained in chapter 4 and are in line with Hong and Kacperczyk (2009). An overview of cumulative returns for the various industries and their comparable portfolios is illustrated in Table 5.1. We present the value-weighted nominal performance for each industry portfolio, their comparable portfolios, and the respective difference portfolio in Figure 5.3. We see that the sin industry portfolios have outperformed their comparable portfolios on a nominal basis when not adjusting for risk. The alcohol portfolio and its comparable are correlated, but the alcohol portfolio is more volatile. We see alcohol peers start to perform better in recent years and find similar results for the tobacco portfolio. This is supported by the difference portfolio having diminishing returns from 2017.

The gambling portfolio is more volatile than the peer portfolio and significantly outperformed the comparables during the entire period.

The gambling portfolio has delivered the best nominal returns over the period, although with significantly higher volatility than both the other sin industries and comparables. The gambling portfolio consequently has a lower Sharpe ratio than the remaining sin industries. The comparable gambling portfolio has the highest standard deviation amongst the comparable industries, which is expected as the peer industry has the same risk exposure and company characteristics. We also believe that gambling and its comparable portfolio's higher standard deviation may be explained by having a smaller, less diversified portfolio within a younger industry with potentially higher growth opportunities, e.g., online gambling. In comparison, the alcohol and tobacco industries are more mature than the gambling industry.

Figure 5.3: Industry-divided portfolios



Note: The figure shows the total period nominal returns of various value-weighted portfolios. The upper figure illustrates the alcohol portfolio, comparable and difference portfolios. The middle figure shows the tobacco-, comparable- and difference portfolio. The latter figure illustrates the gambling portfolio, its comparable portfolio, and the difference portfolio. The portfolios are value-weighted with nominal returns adjusted for compounding and dividends.

5.1.1.3 Period-divided portfolios

We continue our descriptive analysis focusing on period-divided portfolios. The various charts show that returns are skewed towards the beginning of the total period. We divide the 2000-21 period into four sub-periods; 2000-05, 2006-11, 2012-16, and 2017-21, to capture sin stock sentiments and the development of returns throughout five to six years. All periods include various market turmoils,

which we will study later in the thesis. We expect the returns to be diminishing as a consequence of a recent sell-off due to various sentiments towards exclusion criteria and ESG-focus, implying that investors need a higher expected return to be invested in sinful stocks. Potentially, there might have developed an increasing sin premium. However, if the sin premium has increased, one might argue for a higher expected return in the coming period. A comprehensive overview of the period-divided portfolios is shown in Table 5.2. A further description of timeframes is in chapter 4.6.

We see that the sin portfolio has delivered significantly better nominal returns than the comparable portfolio in 2000-05, 2006-11, and 2012-16 with a 23%. 19% and 19% compounded annual returns, respectively. The comparable portfolio has 8%, 10%, and 16% compounded annual returns in the same periods. However, in the 2017-21 period, the comparable portfolio delivered significantly better returns than the sin portfolio, with 15% compounded annual returns. On the other hand, the sin portfolio had 9% in 2017-21, which was the worst period for the sin portfolio.

We see that the sin and comparable portfolios have an opposite development of returns, with the sin portfolio having a negative return trend while the comparable portfolio had a positive trend. Although we cannot conclude this, we would argue that this might indicate changed investor sentiment towards sin stocks. This can suggest that investors have sold sin stocks and bought companies with similar characteristics that are not sinful. This goes hand-in-hand with a study showing gradually increased exclusion criteria of sinful stocks over the last years (OECD, 2020).

We also see a negative development of sin stock risk-adjusted returns, measured with the Sharpe ratio of the respective portfolios. The sin portfolio had a Sharpe ratio of 1.66 from 2000 to 2005, while the comparable portfolio had 0.49 during the same period. In 2006-11, the sin portfolio had a somewhat lower Sharpe ratio but higher than the comparable portfolio. However, in 2012-16 and 2017-21, the comparable companies had a better risk-adjusted performance, with 2017-21 as the worst period for the sin stocks with a Sharpe ratio of 0.57. The comparable portfolio

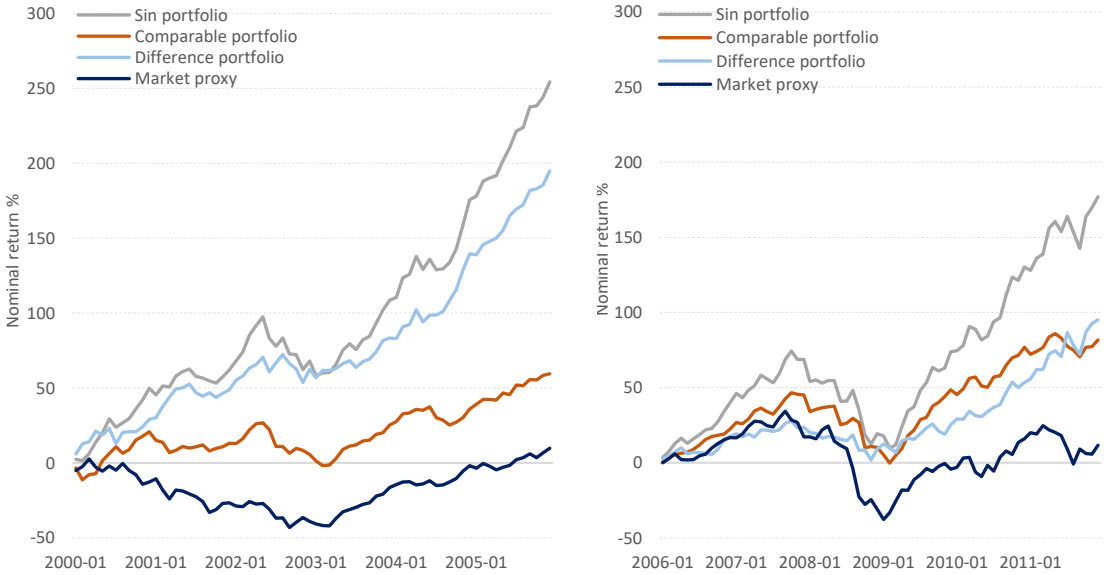
had a 2017-21 Sharpe ratio of 1.17 in the same period. The negative trend is explained by lower nominal returns for all the sin industries while having a somewhat higher standard deviation than in previous periods.

Table 5.2: Period-divided portfolio statistics

	Annualized Sharpe Ratio	Nominal monthly mean return	Nominal Std.Dev of monthly returns	Min monthly portfolio return	Max monthly portfolio return	Total period return	Compounded annual return
Panel B: 2000-2005							
Sin portfolio	1.66	1.8 %	3.4 %	-7 %	8 %	254 %	23 %
Alcohol portfolio	0.99	1.2 %	3.2 %	-7 %	8 %	120 %	14 %
Tobacco portfolio	1.37	2.4 %	5.4 %	-13 %	14 %	392 %	30 %
Gambling portfolio	1.33	2.4 %	5.7 %	-15 %	12 %	401 %	31 %
Comparable portfolio	0.49	0.9 %	3.4 %	-13 %	8 %	58 %	8 %
Alcohol peer portfolio	0.26	0.9 %	3.4 %	-13 %	8 %	36 %	5 %
Tobacco peer portfolio	0.78	1.0 %	3.7 %	-12 %	7 %	99 %	12 %
Gambling peer portfolio	0.55	0.5 %	7.2 %	-19 %	29 %	119 %	14 %
Panel C: 2006-2011							
Sin portfolio	1.06	1.5 %	4.5 %	-12 %	11 %	177 %	19 %
Alcohol portfolio	0.80	1.2 %	4.4 %	-15 %	11 %	117 %	14 %
Tobacco portfolio	1.07	1.5 %	4.3 %	-8 %	10 %	170 %	18 %
Gambling portfolio	0.64	2.3 %	11.8 %	-29 %	61 %	233 %	22 %
Comparable portfolio	1.03	1.2 %	2.5 %	-5 %	6 %	77 %	10 %
Alcohol peer portfolio	0.93	1.0 %	2.8 %	-4 %	6 %	77 %	10 %
Tobacco peer portfolio	1.12	1.7 %	2.6 %	-5 %	8 %	91 %	11 %
Gambling peer portfolio	0.3	1.7 %	3.8 %	-11 %	12 %	21 %	3 %
Panel D: 2012-2016							
Sin portfolio	1.39	1.5 %	3.7 %	-8 %	12 %	135 %	19 %
Alcohol portfolio	1.33	1.5 %	4.0 %	-7 %	11 %	140 %	19 %
Tobacco portfolio	1.06	1.3 %	4.3 %	-8 %	10 %	106 %	16 %
Gambling portfolio	0.70	1.6 %	8.0 %	-16 %	22 %	116 %	17 %
Comparable portfolio	1.73	1.2 %	2.5 %	-5 %	6 %	106 %	16 %
Alcohol peer portfolio	0.95	1.0 %	2.8 %	-4 %	6 %	74 %	12 %
Tobacco peer portfolio	0.76	1.7 %	2.6 %	-5 %	8 %	177 %	23 %
Gambling peer portfolio	0.72	1.7 %	3.8 %	-11 %	12 %	158 %	21 %
Panel E: 2017-2021							
Sin portfolio	0.57	0.8 %	4.6 %	-14 %	16 %	56 %	9 %
Alcohol portfolio	0.58	0.9 %	4.7 %	-13 %	16 %	58 %	10 %
Tobacco portfolio	0.08	0.2 %	5.2 %	-11 %	10 %	5 %	1 %
Gambling portfolio	0.62	1.6 %	8.3 %	-26 %	22 %	109 %	16 %
Comparable portfolio	1.15	1.2 %	3.5 %	-8 %	10 %	101 %	15 %
Alcohol peer portfolio	1.17	1.3 %	3.5 %	-7 %	10 %	106 %	16 %
Tobacco peer portfolio	0.38	1.4 %	8.0 %	-30 %	27 %	72 %	11 %
Gambling peer portfolio	0.58	1.4 %	8.0 %	-30 %	27 %	92 %	14 %

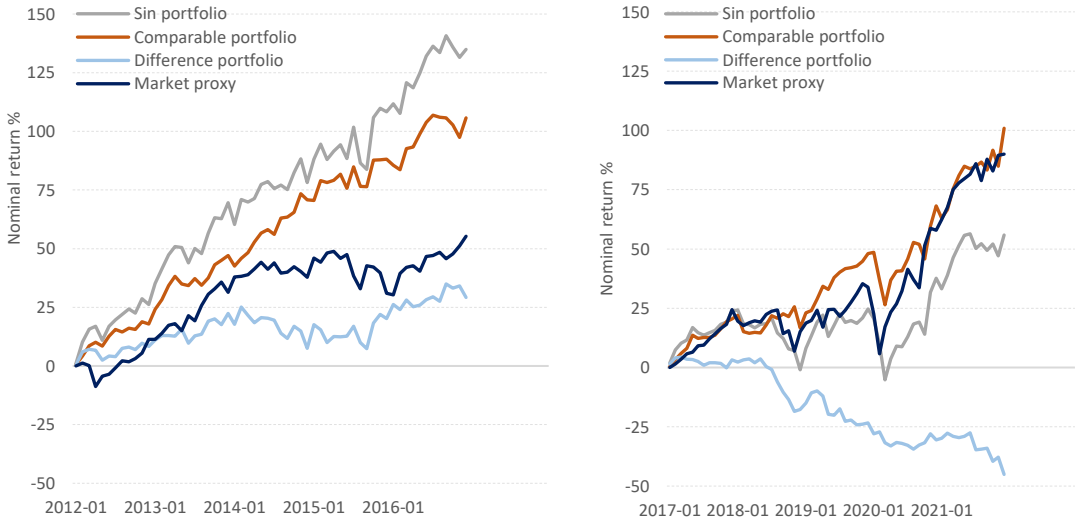
Note: The figure shows various key statistics in multiple periods. Mean return is the average weighted return of all stocks in the relevant portfolio. The min/max is the smallest/highest return observed in a period in the applicable period. We used nominal returns for this statistic, meaning that the returns are not netted against the risk-free rate for the Sharpe Ratio calculation. The Sharpe Ratio is calculated as the monthly mean excess return, netted against the risk-free rate in the respective period, divided by the respective period's monthly standard deviation. We further annualized the Sharpe Ratio by multiplying the monthly Sharpe Ratio with the square root of twelve. The Table shows total returns in their respective periods adjusted for dividends. The difference between the total period return and the sum of the respective returns comes from the compounding effect, which is only considered for a specific period. The portfolio returns are monthly value-weighted and adjusted for dividends. The Table shows total returns in their respective periods adjusted for dividends. The portfolio returns are monthly value-weighted and adjusted for dividends. We used nominal returns for this statistic, meaning that the returns are not netted against the risk-free rate except for the annualized Sharpe ratio.

Figure 5.4: Return overview, 2000-2005 and 2006-2011



Note: The figures shows various portfolios' total period nominal value-weighted returns. The left figure illustrates the portfolios' returns in 2000-2005. The right figure shows the return in the 2006-2011 period. The portfolios are value-weighted with nominal returns adjusted for compounding and dividends.

Figure 5.5: Return overview, 2012-2016 and 2017-2021



Note: The figures show various portfolios' total period nominal value-weighted returns. The left figure illustrates the portfolios' returns in 2012-2016. The right figure shows the return in the 2017-2021 period. The portfolios are value-weighted with nominal returns adjusted for compounding and dividends.

Figures 5.4-5.5 illustrates the period returns. The sin portfolio did remarkably well when not adjusting for risk from 2000 to 2017. The first period, 2000-05, is probably the most exciting, as there seems to be little relationship between the sin returns and the market proxy. Indeed, the market proxy had marginally positive returns, while the sin portfolio delivered more than 250% in accumulated returns. The 2006-11 period seems to align with the market and the sin portfolio, albeit

moving towards higher levels. From the figures, we can see that the financial crisis also affected the sin stocks. We also see a high nominal return performance. The 2012-16 period had lower differences between the sin and comparable portfolios, illustrated by the difference portfolio having its worst performance. The 2017-21 period was the worst period for the sin portfolio, with worse performance than the comparable portfolio and the market proxy. This is illustrated by the difference portfolio yielding negative performance in the period. As previously mentioned, we expect the lower nominal performance in the period to be from a sell-off in sin stocks.

5.1.2 Regression results

We have already established that the sin portfolio outperforms the market proxy and comparable portfolio when not adjusting for risk factors. However, we cannot conclude any abnormal returns based on a descriptive analysis. Thus, our goal in this section is to evaluate our hypothesis on whether sin stocks outperform the market proxy and comparable portfolios when adjusting for risk factors. We measure this potential outperformance by estimating abnormal returns using CAPM, the Fama-French three-factor model, the Fama-French five-factor model, and the Fama-French five-factor model with a momentum extension. We will focus mostly on the Fama-French five-factor model as it takes most risk factors into account and focuses on value-weighted portfolios, although we will also include the results of the equally weighted portfolio in our main text and the appendix.

Further, we apply a different portfolio strategy to explore the potential sin stock outperformance versus the comparable portfolio. The dependent variable in our regressions is the respective portfolio's monthly returns net of the risk-free ratio, which is in line with other studies, e.g., Hong and Kacperczyk (2009), while the independent variables are the different Fama-French risk factors. For the difference portfolio, the dependent variable is the sin portfolio's monthly return net of the comparable portfolio's monthly return. We carry out the same analysis throughout this paper.

5.1.2.1 The total sin portfolio

Our regression results for the sin and comparable portfolio are illustrated in Table 5.3. From the table, we can see that the sin portfolio yields abnormal returns. The CAPM regression implies a monthly abnormal return of approximately 0.995%, with the intercept and market risk factor being positive and statistically significant at a 1% significance level. The excess return is significantly higher than the 0.44% and 0.33% found by Blitz and Fabozzi (2017) and Salaber (2007). We still have abnormal returns when adding the SMB and HML factors to a three-factor regression, although the intercept has decreased marginally and now implies an abnormal return of 0.914% at a 1% significance level. The SMB factor is insignificant, suggesting no tilt toward either small- or large-cap stocks. HML is positive and significant at a 1% significance level, implying a tilt towards high book-to-market companies, i.e., the value premium.

When adding RMW and CMA, the sin portfolio still has abnormal returns at a 2.5% significance level, implying approximately 0.501% monthly excess returns. When using the five-factor model, SMB becomes significant and positive, suggesting a tilt toward small market cap stocks. Further, HML becomes insignificant, suggesting that the companies might not be exposed to the value factor, which goes against Tromp's (2019) arguments that sin stocks are mature companies with mature businesses. However, the RMW factor is correlated with the HML factor, implying that the HML factor only becomes insignificant by adding the RMW factor.

RMW is significant and positive, indicating a tilt towards stocks with robust operating profitability. The RMW is a vital return driver with a high factor load. This is highly expected, as sin stocks generally have good profitability, which is further examined in chapter 5.3. Sin stocks are profitable with high and steady cash flows (Tromp, 2019) due to, amongst others, monopolistic tendencies. The positive RMW, a crucial return driver, is in line with Blitz and Fabozzi’s (2017) results, as they concluded that RMW is a substantial driver of the sin stock returns. Further, the CMA factor is positive and statistically significant, suggesting a tilt towards companies with conservative investments.

Our statistically significant abnormal returns go against Blitz and Fabozzi's (2017) results, which implied no abnormal returns for sin stocks in the five-factor model. They argued that the investors are not compensated for owning sinful stocks but rather getting high nominal returns through stocks with tilts towards the profitability and investment factors. The difference might be explained by a discrepancy in the industries and companies included, as well as different geographic selections. They argued that investors could expect the same returns when investing in non-sinful stocks with the same factor exposure as sinful companies. We also have positive return drivers from the investment and profitability factors. However, our regressions imply that some returns are still not captured by the model, suggesting abnormal returns.

The abnormal returns are still statistically significant and positive when adding the momentum factor to the five-factor model, although the alpha marginally decreases. However, the momentum factor is insignificant. We see only minor deviations in the coefficients after adding the momentum factor, which is expected to result from the momentum factor being somewhat correlated with the other elements. Other papers have found this a problem, as the momentum factor can be correlated with different coefficients (Fama & French, 2014).

Because of the very high nominal returns compared to the market proxy during the dot-com crisis, we find it reasonable to do the same regressions when excluding the 2000-02 period – as a robustness test. We find similar results with statistically significant abnormal returns, although the abnormal returns are somewhat lower. This is as expected, in our view, as the period showed a significant nominal outperformance versus the overall market and the comparable portfolio. Our regression results are illustrated in Appendix Table 5.1.

As illustrated in Table 5.3, we did the same regressions for the comparable portfolio. Our regression results also imply that the comparable portfolio has abnormal returns, albeit lower and only statistically significant in the five-factor model at a 10% significance level. As expected, the comparable companies have factor loads in the same direction, with a positive and significant tilt towards the

profitability and investment factors. This was expected because of similar company characteristics to those of the sinful companies, which is discussed further in chapter 5.4.

We further see that the comparable portfolio has a lower tilt towards the profitability factor than the sin portfolio, although it is still a vital return driver. This is in line with Trump (2019), suggesting that the sin companies have monopolistic tendencies and thus should have somewhat higher profitability, all else being equal. The positive tilt is expected, as the peer group can also have monopolistic tendencies, as stated by Lall and Siddenharthan (1982). We also see that the comparable portfolio has a higher factor load towards the investment factor.

Table 5.3: Regression results for sin- and comparable portfolios

	Value-weighted Sin Portfolio				Value-weighted Comparable Portfolio			
	CAPM	3 factor	5 factor	5 factor + mom	CAPM	3 factor	5 factor	5 factor + mom
Intercept	0.99503****	0.91351****	0.50139***	0.49683***	0.61650****	0.58054****	0.23155*	0.24540*
Mkt-RF	0.64623****	0.66257****	0.79070****	0.79440****	0.50230****	0.52508****	0.65375****	0.64251****
SMB		-0.0498	0.18471**	0.17135*		-0.31109****	-0.11994*	-0.07936
HML		0.28294****	0.09727	0.11505		0.16244***	-0.07271	0.56717****
RMW			0.74014****	0.73254****			0.54410****	0.54898****
CMA			0.29549**	0.27911*			0.49925****	-0.06107*
MOM				0.02011				-0.02558
R^2	0.509	0.545	0.615	0.615	0.494	0.557	0.636	0.640
Adjusted R^2	0.507	0.539	0.608	0.606	0.492	0.552	0.629	0.632

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total value-weighted sin portfolio 2000-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d).

We do the same regressions for the equally weighted sin and comparable portfolios, suggesting abnormal returns, as illustrated in Table 5.4. We see that the load towards small market cap stocks is much higher and statistically significant, which is expected as the smaller market cap companies have a higher return contribution when equally weighing the portfolio. In addition, we see that the profitability factor has decreased, suggesting a lower but still positive tilt towards companies with robust operational profitability. We argue that lower profitability when equally

weighting the portfolio is expected, as smaller market cap companies tend to be less mature and thus have lower profitability. We also see a negative tilt toward the investment factor, which is also aligned with our expectations as lower market cap companies might have more aggressive investment styles to grow as they are typically less mature companies. The essential takeaway is that the equally weighted sin and comparable portfolios also have abnormal returns.

Table 5.4: Equally weighted regression results for sin and comparable portfolios

	Equally-weighted Sin Portfolio				Equally-weighted Comparable Portfolio			
	CAPM	3 factor	5 factor	5 factor + mom	CAPM	3 factor	5 factor	5 factor + mom
Intercept (alpha)	0.61891****	0.50159****	0.40612***	0.41960***	0.61891****	0.52357****	0.40072****	0.42438****
Mkt-RF	0.58711****	0.59296****	0.58941****	0.57848****	0.58711****	0.57711****	0.59001****	0.57081****
SMB		0.53272****	0.60850****	0.64797****		0.48232****	0.57118****	0.64050****
HML		0.27453****	0.33936****	0.28685****		0.26061****	0.27260****	0.18042***
RMW			0.28703***	0.30947****			0.29526****	0.33466****
CMA			-0.33186***	-0.28349**			-0.21269**	-0.12776
MOM				-0.0594				-0.10430****
R^2	0.640	0.668	0.696	0.699	0.640	0.742	0.770	0.782
Adjusted R^2	0.638	0.664	0.690	0.692	0.638	0.739	0.766	0.777

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total equally-weighted sin portfolio 2000-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d).

5.1.2.2 The difference portfolio

We continue our analysis with regressions on the difference portfolio to test whether the sin portfolio outperforms its non-sinful peer companies when adjusting for risk exposures. The constant still represents the monthly abnormal returns in percentage, while the coefficients are explanatory variables that capture differences in the exposure for the difference portfolio. Our results are illustrated in Table 5.5.

The CAPM and three-factor model suggests a positive and statistically significant abnormal return of approximately 0.38% and 0.33%, respectively, at a 5% significance level. We see a positive tilt towards the market risk beta at a 1% significance level in the CAPM regression, implying a higher market risk tilt for the sin portfolio than for the comparable portfolio. This is in line with our regression

results for the respective portfolios from chapter 5.1.2.1. However, the market risk premium is insignificant when using the three-factor model. The regression further suggests a positive tilt towards small market cap and high book-to-market companies.

When extending the regression with the profitability and investment factors, we do not find abnormal returns, suggesting that the sin portfolio does not have better risk-adjusted performance than the comparable portfolio. We find, however, a positive tilt towards the profitability factor and a negative tilt towards the investment factor. Thus, the regression suggests that the sin industry has higher profitability, as expected, but a more aggressive investment style, which is somewhat surprising as the sin industry is mature and has monopolistic tendencies.

We further note that R^2 is significantly lower for the difference portfolio regression results compared to testing only for the sin and comparable portfolios alone. Thus, the regression models might be less trustworthy than the individual sin and comparable portfolio regressions. We have done similar regressions for the equally weighted difference portfolios that show no abnormal returns, as illustrated in Appendix Table 5.5.

Table 5.5: Difference portfolio regression results

	Value-weighted Difference Portfolio			
	CAPM	3 factor	5 factor	5 factor + mom
Intercept	0.37852**	0.33297**	0.24248	0.25143
	(0.15781)	(0.15572)	(-0.16456)	(0.16511)
Mkt-RF	0.14393****	0.13749	0.14426****	0.15189****
	(0.03481)	(0.03439)	(0.04065)	(0.04151)
SMB		0.26129***	0.27336***	0.25071***
		(0.08011)	(0.08625)	(0.09048)
HML		0.12051**	0.18711**	0.24173**
		(0.05896)	(0.08929)	(0.09757)
RMW			0.21321*	0.16537
			(0.10884)	(0.11031)
CMA			-0.22232*	-0.26986*
			(0.13455)	(0.13961)
MOM				0.08118
				(0.04433)
R^2	0.061	0.105	0.129	0.136
Adjusted R^2	0.058	0.095	0.112	0.116

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total value-weighted difference portfolio 2000-2021. Dependent variables are the sin portfolio monthly portfolio return net of the comparable portfolio monthly return, $r_{sin,t} - r_{comparable,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d).

5.1.2.3 Industry-divided portfolios

We continue our analysis with industry-divided portfolios to check whether there are differences between the sin industries. Some investors might view different sin industries as separate entities with different characteristics and risk profiles, making these regression results relevant and interesting. The value-weighted regression results are illustrated in Table 5.6, while the equally weighted regressions are presented in Appendix Tables 5.3 and 5.4.

According to the three-factor model, all three sin industries have abnormal returns at a 1% or 2.5% significance level. The market beta is positive and statistically significant at a 1% level. We observe that both the alcohol and tobacco portfolios have market betas lower than one, while the gambling portfolios have a higher than one and thus a significantly higher market beta load. This is in line with Hong and Kacperczyk (2009). We believe the gambling's higher load towards the market risk

premium can be explained by the gambling portfolio being more exposed to companies in earlier phases compared to the alcohol- and tobacco portfolios, which are more established industries following high regulations (Brand et al., 2007; Savell et al., 2015; Jacobson et al., 2010).

When we add the profitability and investment factors, we see that the abnormal returns are still positive but become only significant at a 10% significance level for the alcohol and gambling portfolios, while the tobacco portfolio becomes insignificant. We see that the profitability factor is high, positive, and statistically significant for all three industries, which is highly expected, as the sin industries tend to be highly profitable, which is further explained later in this paper.

The investment factor is insignificant for the alcohol portfolio, suggesting that the alcohol companies have neither an aggressive nor conservative investment strategy. The investment factor is positive and statistically significant at the 2.5% level for the tobacco portfolio, which suggests that the tobacco companies are typically conservative in their investment strategy, which is in line with our overall thesis that the tobacco companies are more developed companies with monopolistic tendencies. Furthermore, we see that the gambling portfolio has a negative factor load on the investment factor, suggesting it is more aggressive in its investment strategy. This aligns with our previous comments on the gambling portfolio consisting of companies in the early stages of their investment cycle and investing more aggressively to take market shares.

Table 5.6: Industry-divided regression results

	3 factor		3 factor		3 factor	
	Alcohol	Comparable	Tobacco	Comparable	Gambling	Comparable
Intercept	0.743189****	0.58054****	0.9243****	0.73289****	1.04657***	0.30669
Mkt-RF	0.53674****	0.52508****	0.55804****	0.52766****	1.34399****	1.18090****
SMB	-0.002376	-0.31109****	-0.44593****	-0.19333**	0.72476****	0.19092*
HML	0.165612**	0.16244***	0.34904****	0.21219****	0.42850***	0.57703****
R^2	0.345	0.557	0.311	0.518	0.521	0.709
Adjusted R^2	0.338	0.552	0.303	0.512	0.516	0.706
	5 factor		**5 factor**		**5 factor**	
	Alcohol	Comparable	Tobacco	Comparable	Gambling	Comparable
Intercept	0.3518*	0.15969	0.41736	0.23155*	0.84426**	0.31588
Mkt-RF	0.64758****	0.58063****	0.74280****	0.65375****	1.33423****	1.15538****
SMB	0.22593**	-0.22910***	-0.18193	-0.11994*	0.90773****	0.21807*
HML	0.04694	-0.21546**	0.02543	-0.07271	0.63733***	0.67730****
RMW	0.76004****	0.59278****	0.81255****	0.54410****	0.66242**	0.07484
CMA	0.14599	0.63822****	0.686614***	0.49925****	-0.72225**	-0.26852
R^2	0.414	0.453	0.385	0.636	0.545	0.712
Adjusted R^2	0.402	0.443	0.373	0.629	0.536	0.707

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on value-weighted industry portfolios for both the sin- and comparable portfolios in 2000-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{portfolio,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d).

5.1.2.4 Period-divided portfolios

In chapter 5.1.1.3, we commented that the nominal performance for the sin portfolio and its respective industry portfolios had a negative trend in performance, both on a nominal basis and when adjusting for risk through the Sharpe ratio. We also commented that the comparable sin portfolio had the opposite trend, with increasing returns. Thus, we found it relevant and interesting to research this further.

We argue that some of the negative return trends probably result from smaller companies growing into larger companies, thus having a lower tilt towards the small market cap factor in the latter part of the period. However, one could argue that the investment factor should be increasingly tilted towards a conservative style throughout the period. Given the poor nominal return development illustrated in chapter 5.1.1.3, we expect potential excess returns to be declining over the period and no abnormal returns in the latter period. We focus on the five-factor model

throughout this chapter. Our sin industry value-weighted results are presented in Table 5.7, while the industry- and period-divided portfolios are illustrated in Appendix Tables 5.6-5.8.

Our regressions suggest monthly abnormal returns of approximately 0.08%, 1.31%, and 0.480% in 2000-05, 2006-11, and 2012-16 at a 10%, 1%, and 10% significance level, respectively. However, there are no abnormal returns for the sin portfolio in the 2017-21 period, which aligns with our expectations. On the other hand, the comparable portfolio has only abnormal returns in the 2012-16 period at a 2.5% significance level. We find the results as expected in broad terms, although we are somewhat surprised by the low amount of statistically significant factor loads throughout the periods. Except for the intercept and the market risk premium, the 2000-05 period only has the positive profitability factor load as significant for the sin portfolio, albeit only at the 10% level. The 2006-11 and 2017-21 periods have no statistical factors loads, except for the market risk premium and the intercept. However, the 2012-16 period has statistically significant factors loads for every factor in the five-factor model. We see a similar trend for the comparable portfolio.

We are somewhat surprised that the 2006-11 period shows better abnormal returns than the 2000-05 period, as the 2000-05 period had higher nominal- and risk-adjusted returns measured through the Sharpe ratio. However, it might make sense given that 2006-11 was particularly bad for financial stocks, which is a large part of the market portfolio. In addition, the 2006-11 period showed a significant multiple expansion, illustrated by the CAPE P/E ratio in chapter 5.4.1. We further see that the 2012-16 period has negative SMB and HML factor loads, which is somewhat surprising, as the sin portfolio for the entire 2000-21 period showed an insignificant SMB factor and a positive tilt towards the HML factor. This might suggest that the portfolio had a higher contribution towards large market caps in the 2012-16 period on a monthly basis than for the entire period.

The negative load towards the HML factor is also surprising and might suggest that the portfolio had positive exposure to the value factor in the entire period but not in 2012-16. We further see that the investment factor is significantly more positive in

2012-16 than for the whole period, suggesting a conservative investment style compared to the total period.

We see similar results for the comparable portfolio. We find the negative SMB and HML coefficients somewhat surprising in the 2012-16 period, while the very positive CMA factor in 2017-21 is in line with the low capex figures for the comparable portfolio we illustrate in chapter 5.4.2.

Table 5.7: Period regression results for sin and comparable portfolios

	Sin Portfolio				Comparable Portfolio			
	2000-2005	2006-2011	2012-2016	2017-2021	2000-2005	2006-2011	2012-2016	2017-2021
Intercept	0.0767*	1.30852****	0.47973*	-0.22549	-0.3989	0.44515	0.55389***	0.23506
Mkt-RF	0.57979****	0.69480****	1.03172****	0.91367****	0.6733****	0.58030****	0.66237****	0.74473****
SMB	0.21029	0.05257	-0.62412***	0.17829	0.025	-0.07075	-0.50412****	-0.217
HML	0.28063	-0.18393	-0.71516***	0.12343	0.2999	-0.16244	-0.41226***	-0.21838
RMW	0.46966*	-0.05338	0.75293**	0.25804	0.3702*	0.29504	0.51085**	0.30603
CMA	0.09847	-0.10222	0.73511**	0.18272	0.251	0.21338	0.60228**	0.86782****
R^2	0.328	0.766	0.788	0.786	0.494	0.705	0.766	0.812
Adjusted R^2	0.277	0.748	0.769	0.766	0.456	0.678	0.744	0.794

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on value-weighted sin- and comparable portfolios in 2000-05, 2006-11, 2012-16, and 2017-21 when using the Fama French five-factor model. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$ for the sin portfolio and $r_{comparable,t} - r_{rf,t}$. For the comparable portfolio. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, captures conservative investment strategy exposure (Fama & French, n.d.).

Due to abnormal returns in the 2000-05, 2006-11, and 2012-16 periods, we find it relevant to check for potential abnormal returns for a period-divided value-weighted difference portfolio, i.e., long the sin portfolio and sell the comparable portfolio. Our results are illustrated in Table 5.8.

Table 5.8: Period regression results for difference portfolio (value-weighted)

	Difference Portfolio, Three-Factor				Difference Portfolio, Five-Factor			
	2000-2005	2006-2011	2012-2016	2017-2021	2000-2005	2006-2011	2012-2016	2017-2021
Intercept	1.13032***	0.61056**	0.01693	-0.44083	1.12396**	0.76649**	-0.07416	-0.46055*
	(0.41824)	(0.26845)	(0.27305)	(0.27376)	(0.42799)	(0.32245)	(0.29984)	(0.26599)
Mkt-RF	-0.11126	0.19705****	0.32540****	0.21336****	-0.09349	0.13503*	0.36935****	0.16893***
	(0.09566)	(0.05104)	(0.08167)	(0.05984)	(0.11678)	(0.07142)	(0.09948)	(0.06309)
SMB	0.16598	0.28338	-0.22105	0.49015***	0.18529	0.23432	-0.12000	0.39529**
	(0.13871)	(0.17332)	(0.19041)	(0.17080)	(0.15371)	(0.18019)	(0.23417)	(0.18506)
HML	-0.05510	-0.08571	-0.35456	0.11586	-0.01924	-0.04452	-0.30289	0.34181**
	(0.13237)	(0.16181)	(0.16135)	(0.08782)	(0.24267)	(0.20056)	(0.24765)	(0.16121)
RMW					0.09941	0.24446	0.24208	-0.04798
					(0.25239)	(0.34344)	(0.36464)	(0.22367)
CMA					-0.15257	-0.28846	0.13283	-0.68510**
					(0.28644)	(0.23223)	(0.38856)	(0.27528)
R^2	0.048	0.235	0.263	0.359	0.053	0.252	0.273	0.428
Adj. R^2	0.006	0.201	0.224	0.325	-0.019	0.195	0.205	0.375

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on value-weighted difference portfolios in the periods 2000-05, 2006-11, 2012-16, and 2017-21 when using the Fama French three- and the five-factor model. Dependent variables are the monthly sin portfolio return net of the comparable portfolio monthly return, $r_{sin,t} - r_{comparable,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy (Fama & French, n.d.).

Firstly, the three-factor regression suggests monthly abnormal returns of approximately 1.13% and 0.61% in 2000-05 and 2006-11, while the regressions imply no abnormal returns in 2012-16 and 2017-21. Furthermore, when including the profitability- and investment factors, the regressions indicated positive abnormal returns in 2000-05 and 2006-11. However, the regression indicated a negative intercept in the 2017-21 period, albeit only statistically significant at the 10% significance level.

These results are expected, as 2000-05 and 2006-11 were the periods with the best returns versus the comparable portfolio, while the difference portfolio significantly outperformed the sin portfolio in 2017-21 when not adjusting for risk. However,

our regression results imply this is also the case when adjusting for risk factors through the five-factor model. We do not find any abnormal returns using the five-factor model for the difference portfolio for the 2000-21 period. Thus, there are abnormal returns in the earlier periods but not later years.

5.1.3 Final discussion and partial conclusion

As several other studies have concluded, we also find sin stocks to have abnormal returns. However, on a more interesting note, sin stocks have a negative trend in abnormal returns, without any abnormal returns in the last years. We find a broad change in sin stock abnormal returns, whereas most abnormal returns in the total period can be explained by the 2000-2011 period. With sin stock research not being frequently published, we find the development of sin stock returns in the last few years to be significant as no studies have researched this.

We find no abnormal returns for the sin portfolio against the comparable group of companies. Indeed, we find negative abnormal returns for the long sin and short comparables portfolio in the last years, also amplifying the negative trend and skewed sin stock returns. The same portfolio had positive abnormal returns in previous periods (2000-05 and 2006-11), suggesting that comparables have taken over some of the sin stock abnormal return sentiment. However, on a general basis, there are abnormal returns for both the sin and comparable portfolios in the 2000-21 period, suggesting that both have returns that our regression models cannot explain. In other words, in that period, an investor could have expected abnormal returns by investing in sin stocks but similar abnormal returns by investing in similar but non-sinful companies. In addition, we find abnormal returns for the comparable portfolio.

All of this suggests that an investor can build a non-sin stock portfolio with similar risk-return characteristics and still expect abnormal returns, given that the historical trend continues. This goes against Hong and Kacperczyk's (2009) argument that lower demand for sin stocks impacts the returns due to their sinful characteristics, as similar companies without sinful traits also have abnormal returns. However, on a general basis, the sin portfolio has a higher and more statistically significant

abnormal return, illustrated in Table 5.3, which may suggest that the lower demand for sin stocks, in fact, is driving some of the abnormal returns, in line with Hong and Kacperczyk's (2009) arguments.

This defies the critique of Hong and Kacperczyk's (2009) paper, as we have mitigated any potential excess returns of illiquid stocks through stock inclusion criteria that include size and liquidity. Thus, excluding sinful companies has proved to be a costly strategy historically, albeit this strategy has been positive over the last five years.

5.2 Hypothesis 1B: Modern sin stocks

There has been a recent divestment of sinful stocks due to Socially Responsible Investing (SRI) (Fischel, 2017). As Trinks et al. (2018) imply, this has been the case also for fossil fuel companies. We find it interesting to study whether the fossil fuel companies are starting to follow the same trend as the traditional sin stocks (Revelli & Viviani, 2015; Trinks et al., 2018). To investigate this, we will check whether there are any abnormal returns for these *modern sin stocks* and compare this against a portfolio of low-carbon companies. Although the divestment movement of fossil fuel companies formally started in 2011, we do not expect any abnormal returns as it still seems to be a relatively small proportion of investors and fund managers with exclusion criteria of high fossil fuel companies (Trinks et al., 2018). However, as Hong and Kacperczyk (2009) suggested, high fossil fuel companies may have additional returns because of high reputational, litigation, and environmental risks.

As factor loads and explanations of implications of them are explained in depth in chapter 5.1, we will focus less on the meaning of factor loads in this section. However, tilts in the same direction as before would imply the same exposure and vice versa.

5.2.1 Descriptive statistics

5.2.1.1 Cumulative returns

A summary of the descriptive analysis for the fossil fuel /modern sin stock portfolio and its comparable portfolio, the renewable energy production portfolio, is illustrated in Table 5.9. The Table illustrates that the modern sin stock portfolio has a lower Sharpe ratio than the renewable energy portfolio and the traditional sin portfolio over the 2000-21 period. The nominal returns are somewhat in line, with the fossil fuel portfolio having a 10.8% CAGR, while the renewable and traditional sin stock portfolios have 11.6% and 15.5% return CAGR over the total period. The fossil fuel portfolio has a higher standard deviation than its comparable portfolio (renewable energy portfolio) and the traditional sin portfolio. We do not see any notable trend in the returns or the Sharpe ratio, which we might have seen if the fossil fuel industry was developing into a new type of sin industry. A comprehensive overview is illustrated in Table 5.9.

5.2.1.2 Period-divided returns

Compared to the traditional sin portfolio, the modern sin portfolio seems to have more stable return statistics throughout the periods with a Sharpe ratio and compounded annual return ranging from 0.47-0.73 and 9.1%-13.2%. However, the 2000-05 period shows better performance when looking at the Sharpe ratio and compounded annual return, which is in line with the traditional sin portfolio. The comparable modern group, consisting of renewable energy companies, has better overall performance measured by the Sharpe ratio and the compounded annual return throughout the periods. The portfolio has a Sharpe ratio and compounded annual returns ranging from 0.25 to 1.15 and 4.6%-15.5%.

Table 5.9: Modern sin stock and comparable portfolios descriptive analysis

Statistic	Annualized Sharpe Ratio	Nominal mean return	Nominal Std.Dev of returns	Min portfolio return	Max portfolio return	Total period return	CAGR
Panel A: Total period							
Fossil Fuel Portfolio	0.59	1.0 %	5.1 %	-20.4 %	23.7 %	861 %	10.8 %
Renewable Energy Portfolio	0.82	1.0 %	3.7 %	-12.0 %	9.2 %	1026 %	11.6 %
Panel B: 2000-2005							
Fossil Fuel Portfolio	0.73	1.1 %	4.3 %	-10.9 %	12.8 %	111 %	13.2 %
Renewable Energy Portfolio	1.11	1.3 %	3.2 %	-10.4 %	8.4 %	138 %	15.5 %
Panel C: 2006-2011							
Fossil Fuel Portfolio	0.47	0.7 %	5.7 %	-11.0 %	13.7 %	71 %	9.3 %
Renewable Energy Portfolio	0.25	0.0 %	4.4 %	-11.6 %	8.4 %	31 %	4.6 %
Panel D: 2012-2016							
Fossil Fuel Portfolio	0.68	0.8 %	4.1 %	-9.4 %	10.2 %	54 %	9.1 %
Renewable Energy Portfolio	1.02	0.9 %	3.1 %	-6.2 %	7.1 %	54 %	9.0 %
Panel E: 2017-2021							
Fossil Fuel Portfolio	0.56	1.1 %	6.3 %	-20.4 %	23.7 %	73 %	11.6 %
Renewable Energy Portfolio	1.15	1.4 %	3.8 %	-12.0 %	9.2 %	74 %	11.7 %

Note: Mean return is the average weighted return of all stocks in the relevant portfolio. The min/max is the smallest/highest return observed in a period in the relevant period. We use nominal returns for this statistic, meaning that the returns are not netted against the risk-free rate expected for the Sharpe Ratio calculation. The Sharpe Ratio is calculated as the monthly mean excess return, netted against the risk-free rate in the respective period, divided by the respective period's monthly standard deviation. We further annualized the Sharpe Ratio by multiplying the monthly Sharpe Ratio with the square root of twelve. The Table shows total returns in their respective periods adjusted for dividends. The difference between the total period return and the sum of the returns in the respective periods comes from the compounding effect, which is only considered for a specific period. The portfolio returns are monthly value-weighted and adjusted for dividends.

5.2.2 Regression results

We continue this analysis with various regressions to establish whether there are abnormal returns for fossil fuel companies in the modern sin portfolio. Our results for both the value-weighted current sin portfolio and its comparable portfolio are illustrated in Table 5.10.

The regression results suggest no abnormal return for the fossil fuel portfolio when applying more factor loads than the market risk premium. The CAPM regression suggests abnormal returns. However, when adjusting for other risk factors, the intercept becomes insignificant. The fossil fuel portfolio has a positive and statistically significant HML coefficient for all regression models, suggesting a tilt towards high book-to-market companies. This is expected, given that oil companies tend to have high amounts of assets on their book, e.g., oil fields etc.

Further, a positive tilt towards the RMW coefficient suggests a tilt towards robust operating profitability companies. A negative tilt towards the CMA suggests an aggressive investment style. We see that the market beta for the fossil fuel portfolio is close to one, thus being reasonably close to the market index. Therefore, one might argue that the modern sin portfolio might be considered a substitute for the market index, albeit above the market index on nominal returns. Thus, the absence of diversification costs from divestment can be explained by the modern sin portfolio not outperforming other stocks when accounting for risk and thus only providing marginal diversification benefits. This is in line with Trinks et al.'s (2018) study on fossil fuel companies.

On the other hand, the comparable portfolio shows abnormal returns when using the five-factor model, albeit only on the 10% significance level. The five-factor regression implies a positive load toward robust operating profitability. This is expected as our renewable portfolio primarily consists of more mature renewable companies with positive cash flow and good historical margins. Our period-divided regressions also suggest the same and are illustrated in Table 5.11.

Table 5.10: Regression results for modern sin and comparable portfolios

	Fossil Fuel Portfolio				Renewable Energy Production Portfolio			
	CAPM	3 factor	5 factor	5 factor + mom	CAPM	3 factor	5 factor	5 factor + mom
Intercept	0.42924**	0.267907	0.2046	0.194733	0.60408****	0.54727***	0.31168*	0.28993
Mkt-RF	0.85676****	0.883996****	0.8800****	0.888003****	0.51179****	0.53466****	0.61250****	0.63015****
SMB		-0.003665	0.0377	0.008856		-0.24776***	-0.12051	-0.18423*
HML		0.547645****	0.6634****	0.701788****		0.22490****	0.12916	0.21391**
RMW			0.2565*	0.240092*			0.42982****	0.39360***
CMA			-0.2565	-0.291817*			0.21804	0.13996
MOM				0.043399				0.09589**
R^2	0.569	0.650	0.658	0.659	0.396	0.448	0.477	0.485
Adjusted R^2	0.568	0.646	0.651	0.651	0.394	0.442	0.467	0.473

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total value-weighted modern sin portfolio and its comparable portfolio in the period 2000-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{portfolio,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d.).

We further find no abnormal returns in either of the 2000-05, 2006-11, 2012-16, and 2017-21 periods for the modern sin portfolio, which aligns with our expectations. Thus, we cannot conclude on any specific developments of a modern sin portfolio as we did for the traditional sin portfolio. Thus, we do not see any evidence of developing a new modern sin group of companies. The period-divided regressions are illustrated in Table 5.11.

Table 5.11: Regression results for modern sin and comparable portfolios (value-weighted)

	Fossil Fuel Portfolio				Renewable Energy Portfolio			
	2000-2005	2006-2011	2012-2016	2017-2021	2000-2005	2006-2011	2012-2016	2017-2021
Intercept	0.25098	0.28015	-0.27497	0.56466	0.31777	0.09144	0.02956	0.4381
Mkt-RF	0.91673****	0.86628****	0.97174****	1.11427****	0.58509****	0.58794****	0.72528****	0.5410****
SMB	0.01452	-0.21228	0.06515	0.22893	0.038	-0.31219	-0.12808	-0.3751
HML	0.33788	0.02598	1.14499****	0.68534***	0.39967*	0.46296**	-0.29299	0.1245
RMW	0.66355**	0.02598	0.41339	-0.64358*	0.12402	0.37158	0.71680*	0.5853
CMA	-0.14789	0.78746*	-0.13627	-0.10656	0.05029	-0.14647	1.21978***	0.2496
R^2	0.509	0.715	0.773	0.833	0.415	0.662	0.460	0.428
Adjusted R^2	0.471	0.693	0.752	0.818	0.371	0.636	0.410	0.375

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total value-weighted modern sin portfolio and its comparable portfolio in the periods 2000-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{portfolio,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d.).

5.2.3 Final discussion and partial conclusion

We conclude that our results do not imply any abnormal returns for the modern sin portfolio, which aligns with Trinks et al. (2018) results. Hence, the results suggest that the fossil fuel industry is different from the traditional sin industries that show significant outperformance in our regressions and others, including Fabozzi (2017) and Hong and Kacperczyk (2009). In our view, the divestment might be more prevalent in order to have any significant pricing impacts resulting in outperformance of the stocks, as more divestment might lead to lower prices and,

thus, higher expected return, holding all else equal. Also, from our results, we cannot conclude that there is any new modern sin industry development, as we do not see any developments equal to the traditional sin portfolio. We find similar results for the equally weighted portfolios, as illustrated in Appendix Table 5.11.

5.3 Hypothesis 1C: Sin stocks outperform during stressed periods

We expect sin stocks to perform better both nominally- and risk-adjusted in distressed periods, as we expect the demand for sin stocks to increase in uncertain periods with market turmoil. This is because sin stocks typically have more predictive and safe cash flows than other companies (Tromp, 2019). In distressing periods, the market prefers companies with better near-term cash flow opportunities with a safer cash flow. For instance, Demers (2021) concluded that ESG did not immunize stocks during the Covid-19 crisis, while investments in intangible assets did. Further, Smales (2017) concluded that high market capitalization and value stocks tend to be less responsive to investor sentiment changes, typically measured through the VIX index (Smales, 2017). A higher VIX index typically means higher investor fear, suggesting higher risk premiums.

Further, Mazur et al. (2020) suggested that natural gas, food, healthcare, and software stocks performed the best during the Covid-19 crisis, while entertainment, real estate, hospitality, and petroleum performed the worst in the same period. Since sin stocks have some traits that investors seek during high market volatility, we expect the sin portfolio to do well during market downturns compared to the market portfolio. However, gambling and alcohol might do poorly in the Covid-19 period, according to Mazur et al. (2020)’s findings. This is because of the loss of business and revenue streams following the global lockdowns, which naturally affect gambling and alcohol businesses due to their businesses' dependence on physical attendance. We do not expect extreme variations between the sin and comparable portfolios in the periods, as the comparable portfolio should have approximately the same company fundamentals and exposure towards the same business segments as the sin portfolio. The level of cyclicality is approximately the same for the sin portfolio as for the comparable portfolio.

5.3.1 Descriptive statistics

We start this analysis with some descriptive statistics illustrated in Table 5.12. The sin portfolio had a compounded annual return and Sharpe ratio of 31% and 2.0 in the dot.com market turmoil. This is significantly higher than the comparable portfolio and market proxy with a compounded annual return of 20% and -14% and a Sharpe ratio of 1.1 and -1.3.

The sin portfolio had the lowest daily standard deviation and the highest return in the period, which suggests that investors enjoyed the company characteristics sin stocks offer during uncertain periods. Also, the modern sin portfolio delivered positive returns and Sharpe ratio, although they were in line with the comparable portfolio. The dot-com crisis affected tech stocks the most, suggesting that the outperformance against the market proxy might be related to the market proxy consisting of tech stocks, while the various sin portfolios did not.

The sin portfolio had a compounded annual return and Sharpe ratio of -3% and -0.2 in the financial crisis. The market proxy had -23% annual compounded returns and a Sharpe ratio of -1.3, while the comparable portfolio had -4% annual compounded return and -0.3 in the Sharpe ratio. Once again, the sin portfolio delivered better in nominal terms and adjusted for risk, measured through the Sharpe ratio. To our surprise, the fossil fuel portfolio had positive returns, with a 4% CAGR and 0.3 in Sharpe ratio. We find this somewhat surprising as crude oil prices declined to less than USD40 per barrel from more than USD140 per barrel during the period (Bloomberg, 2022).

The sin portfolio performed poorly during the short bear market during the Covid-19 market turmoil. The sin portfolio delivered -22% return during our defined period and -4.2 in Sharpe ratio, while the market proxy and comparable portfolio had returns of -24% and -16% and .3,9 and -3.2 in Sharpe ratio. The industry sin portfolios show that the alcohol and gambling portfolios performed the worst, which is highly expected as these industries were most operationally affected by lockdowns due to their natural business activity. We further see that the fossil fuel

portfolio and its comparable portfolio delivered a Sharpe ratio of -3.4 and-2.4 and -32% and -18% return in the period, which is expected as the fossil fuel industry was heavily affected by a steep decline in energy prices.

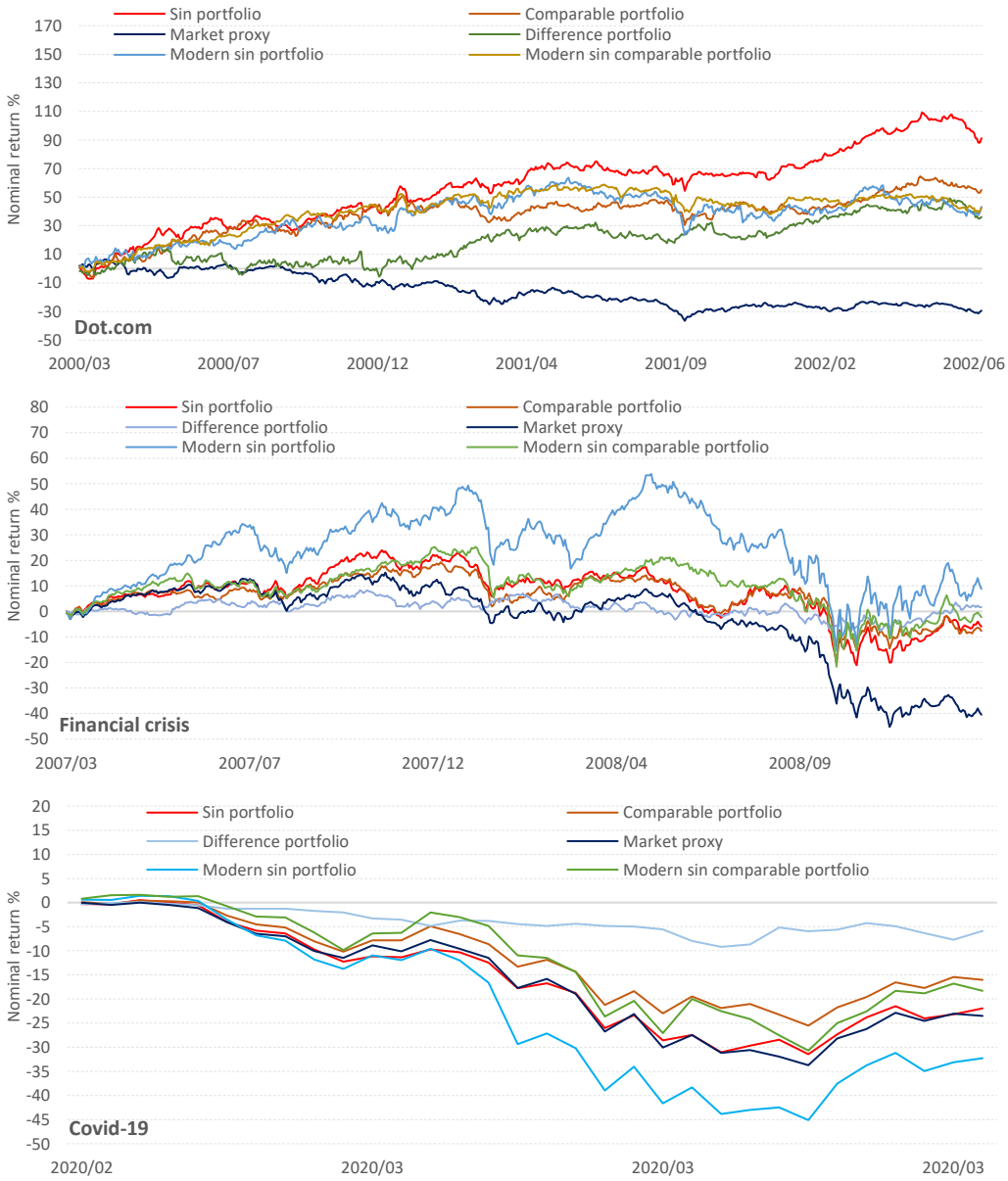
We further provide some illustrations of the daily portfolio performance during the various defined periods, illustrated in Figure 5.6. Generally, we see that the sin portfolio did well compared to the market and comparable portfolio during the dot.com and financial crises, but worse in the Covid-19 crisis.

Table 5.12: Crisis periods summary statistics

Statistic	Annualized Sharpe Ratio	Monthly mean return*	Daily standard deviation	Min daily return	Max daily return	Total return	CAGR**
Panel A: Dot.com turmoil							
Traditional sin stocks							
Sin portfolio	2.0	3.4 %	0.9 %	-4.7 %	5.2 %	91 %	31 %
Alcohol portfolio	1.2	2.6 %	1.1 %	-4.3 %	6.9 %	57 %	21 %
Tobacco portfolio	1.9	4.8 %	1.4 %	-6.4 %	6.3 %	140 %	44 %
Gambling portfolio	1.1	3.3 %	1.6 %	-9.1 %	10.2 %	75 %	26 %
Comparable portfolio	1.1	2.3 %	1.1 %	-3.6 %	6.3 %	55 %	20 %
Modern sin stocks							
Fossil fuel portfolio	0.8	2.0 %	1.3 %	-6.6 %	5.4 %	43 %	16 %
Renewable energy portfolio	1.1	1.9 %	0.8 %	-4.2 %	3.5 %	43 %	16 %
Market (for comparison)							
Market proxy	-1.3	-1.6 %	1.0 %	-3.8 %	3.4 %	-29 %	-14 %
Panel B: Financial crisis							
Traditional sin stocks							
Sin portfolio	-0.2	-0.1 %	1.3 %	-6.3 %	9.2 %	-6 %	-3 %
Alcohol portfolio	-0.2	-0.2 %	1.5 %	-6.7 %	7.2 %	-9 %	-4 %
Tobacco portfolio	0.1	0.6 %	1.5 %	-6.7 %	11.5 %	5 %	2 %
Gambling portfolio	-1.0	-3.3 %	2.4 %	-7.5 %	16.2 %	-51 %	-30 %
Comparable portfolio	-0.3	-0.3 %	1.2 %	-4.7 %	8.8 %	-8 %	-4 %
Modern sin stocks							
Fossil fuel portfolio	0.3	1.3 %	2.2 %	-10.3 %	15.4 %	9 %	4 %
Renewable energy portfolio	0.0	0.2 %	1.6 %	-6.7 %	15.2 %	-2 %	-1 %
Market (for comparison)							
Market proxy	-1.3	-2.7 %	1.5 %	-6.7 %	9.2 %	-40 %	-23 %
Panel C: Covid-19 turmoil							
Traditional sin stocks							
Sin portfolio	-4.2	-19.4 %	3.3 %	-9.0 %	6.0 %	-22 %	-86 %
Alcohol portfolio	-4.6	-20.7 %	3.2 %	-9.5 %	4.7 %	-23 %	-88 %
Tobacco portfolio	-2.2	-11.5 %	3.6 %	-8.7 %	6.2 %	-14 %	-70 %
Gambling portfolio	-4.9	-29.4 %	4.5 %	-12.4 %	9.7 %	-33 %	-96 %
Comparable portfolio	-3.2	-13.9 %	3.0 %	-8.0 %	5.1 %	-16 %	-75 %
Modern sin stocks							
Fossil fuel portfolio	-3.4	-26.8 %	5.9 %	-15.3 %	13.8 %	-32 %	-95 %
Renewable energy portfolio	-2.4	-16.1 %	4.3 %	-10.8 %	9.7 %	-18 %	-80 %
Market (for comparison)							
Market proxy	-3.9	-20.5 %	3.8 %	-9.6 %	8.3 %	-24 %	-88 %

*Monthly mean return based on daily data. **Using trading days in each respective period and assuming 253 trading days each year. Mean return is the average weighted return of all stocks in the relevant portfolio. The min/max is the smallest/highest return observed in a period in the relevant period. We use nominal returns for this statistic, meaning that the returns are not netted against the risk-free rate expected for the Sharpe Ratio calculation. The Sharpe Ratio is calculated as the daily mean excess return, netted against the risk-free rate in the respective period, divided by the respective period's daily standard deviation. We further annualized the Sharpe Ratio. The Table shows total returns in their respective periods adjusted for dividends. The difference between the total period return and the sum of the respective returns comes from the compounding effect, which is only considered for a specific period. The portfolio returns are monthly value-weighted and adjusted for dividends.

Figure 5.6: Crisis portfolios' performance



Note: The figure illustrates the nominal daily returns during the dot-com, financial, and Covid-19 crises. We define the period to be from January 2000-July 2002. We define the financial crisis to be from March 2007 until 2009. We define the Covid-19 crisis to be from 15/02/2020 until April 2020. The sin portfolio is the traditional sin portfolio. The comparable portfolio is the sin industry peer portfolio. The difference portfolio is long the sin portfolio and selling the comparable portfolio. The modern sin portfolio the portfolio consisting of fossil fuel companies. The modern sin comparable portfolio consists of renewable energy production companies. The Market proxy is the Fama French market proxy for developed countries.

5.3.2 Regression results

We further apply the five-factor model on the daily returns in each defined crisis period for the sin portfolio, the comparable portfolio, and the difference portfolio and do the same for the modern sin, comparable and difference portfolios. Our regression results are illustrated in Table 5.13. Our crisis regressions are done with daily Fama-French data compared to when we used monthly data. From Table 5.13,

our regressions imply no abnormal returns for the sin portfolio or a difference portfolio for the traditional sin portfolio. The previously described nominal outperformance versus the market proxy is the sin portfolio exposed to various factors instead of abnormal returns for sin stocks. Thus, good nominal returns can be explained by the fundamentals of the sin stock exposure and not by any abnormal returns.

We see similar results for the modern sin portfolio, whereas our regressions imply no abnormal returns in either of the crisis periods. However, the difference portfolio regression indicates daily abnormal returns in the financial crisis of 0.087% at a 5% significance level. Thus, our regression suggests abnormal returns, as the returns cannot be explained by loads towards any Fama French five-factor model factors. We cannot conclude that there are abnormal returns in crisis periods for traditional sin stock. In comparison, we can conclude that there are abnormal returns for the modern difference portfolio in the financial crisis, implying that modern sin stocks had abnormal returns against the comparable companies in the period. The modern sin portfolio returns might be explained by oil prices being still relatively high compared to the cost levels in 2007-08, suggesting positive operating margins in the period.

Table 5.13: Regression results for crisis periods on traditional sin stocks

	Traditional Sin Portfolio			Traditional Difference Portfolio		
	Dot.com	Financial crisis	Covid-19 crisis	Dot.com	Financial crisis	Covid-19 crisis
Intercept	0.01365	0.03921	0.09462	0.04224	0.01713	0.04224
Mkt-RF	0.60604****	0.80042****	0.83776****	0.04156	0.03163	0.04156
SMB	-0.26628****	-0.16850**	0.30277	0.32186***	-0.01737	0.32186***
HML	0.37548****	-0.16527	0.52067	0.24290**	0.31998***	0.24290**
RMW	-0.18475*	-0.08059	-0.04995	-0.58063****	0.01436	-0.58063****
CMA	0.66753****	0.59966****	-0.83654	-0.07321	-0.22958*	-0.07321
R^2	0.287	0.726	0.911	0.074	0.055	0.074
Adjusted R^2	0.281	0.714	0.894	0.067	0.046	0.067

	Modern Sin Portfolio			Modern Difference Portfolio		
	Dot.com	Financial crisis	Covid-19 crisis	Dot.com	Financial crisis	Covid-19 crisis
Intercept	0.01365	0.03921	0.09462	-0.0271	0.08680**	0.2958
Mkt-RF	0.60604****	0.80042****	0.83776****	0.36394****	0.17724****	0.0934
SMB	-0.26628****	-0.16850**	0.30277	0.08603	-0.11338	-0.1298
HML	0.37548****	-0.16527	0.52067	0.33125***	0.24534*	3.1791****
RMW	-0.18475*	-0.08059	-0.04995	0.1785	0.49560***	1.7691*
CMA	0.66753****	0.59966****	-0.83654	-0.07428	-1.22389****	-5.2128****
R^2	0.287	0.726	0.911	0.041	0.413	0.788
Adjusted R^2	0.281	0.714	0.894	0.033	0.407	0.747

Significance levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total value-weighted traditional sin portfolio and its comparable portfolio for our defined crisis periods. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{portfolio,t} - r_{rf,t}$. For the modern sin portfolio and the comparable portfolio. Dependent variables for the difference portfolio are the monthly portfolio return for the respective sin portfolio minus the portfolio's respective comparable portfolio, $r_{portfolio,t} - r_{comparable,t}$. For the modern sin portfolio and the comparable portfolio. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d.).

5.3.3 Final discussion and partial conclusion

The descriptive analysis shows that the sin portfolios performed outstandingly on a nominal basis for the various crisis periods. Also, when adjusting for volatility through the Sharpe Ratio, the sin portfolios performed well compared to the market proxy. However, when we perform regressions to adjust for risk, we find no results

that imply any abnormal returns for either of the traditional and modern sin portfolios.

However, we find an abnormal return for the modern sin stock difference portfolio for the financial crisis. We conclude that, on an overall basis, sin stocks perform well on a nominal basis but are not adjusted for risk factors. Thus, we see some resilience for the sin portfolios in crisis periods that are explained by various load factors. We do note that the sin stock portfolio did not provide much resilience during the Covid-19 crisis, due to the negative impacts following the travel restrictions. Thus, investors can expect some resilience in crisis periods but no abnormal returns from sin stocks during crisis periods, as resilience is a product of various risk factors.

5.4 Hypothesis 2: Sin stock fundamental development

The next part of our thesis relates to sin stock fundamentals, focusing on valuation, financial characteristics, and outside equity financing. We expect a decrease in sin stock valuations, which leads to higher expected returns and, thereby, an elevated sin stock return premium. We also expect the sin stocks to have better financial characteristics than the comparable companies, due to monopolistic tendencies, as Tromp (2019) explained but lower analyst coverage, as Hong and Kacperczyk (2009) concluded. We further expect disadvantages in getting outside equity financing, both in general terms and against the comparable portfolio, as Hong and Kacperczyk (2009) argued, because of a higher amount of debt financing for sin stocks than other companies. The Shiller PE, also known as the CAPE ratio, is central in our valuation discussion. Please see chapter 3.3 for further details on this methodology.

5.4.1 Valuation development

We will use descriptive analysis to determine whether sin stocks have had a downward trend in their valuation, in general, and versus the comparable portfolio. The CAPE ratio for traditional, modern and comparable sin stocks is illustrated in Figure 5.7, while the 5-year CAPE ratio is illustrated in Appendix Figure 5.9. The sin portfolio has the lowest average CAPE ratio in the 2005-2021 period, with an

average of approximately 25x. On the other hand, the comparable portfolio has an average CAPE ratio of 28.5x, while the modern sin portfolio has approximately 34x. The sin portfolio started the period with a high CAPE ratio but quickly became during the financial crisis, compared to the comparison group and the S&P 500. However, it has had an upward trend after the crisis, although it seems there has been a downward trend in the valuation since 2017.

The downward trending valuations align with previous comments on potential multiple contractions for the industry in recent years, although it can result from better earnings. However, from chapter 5.4.2, we see that the margin development has been negative in the same period, suggesting a multiple contraction for the industry. The multiple contraction can be due to lower expectations for the sin industry's earnings growth, possibly due to its negative margin trend. However, it can also be due to a sell-off due to sinful exclusion criteria. One can also argue that the multiple contraction might result from increasing sin premiums, i.e., investors need a higher expected return now than previously to hold sinful companies in their portfolios.

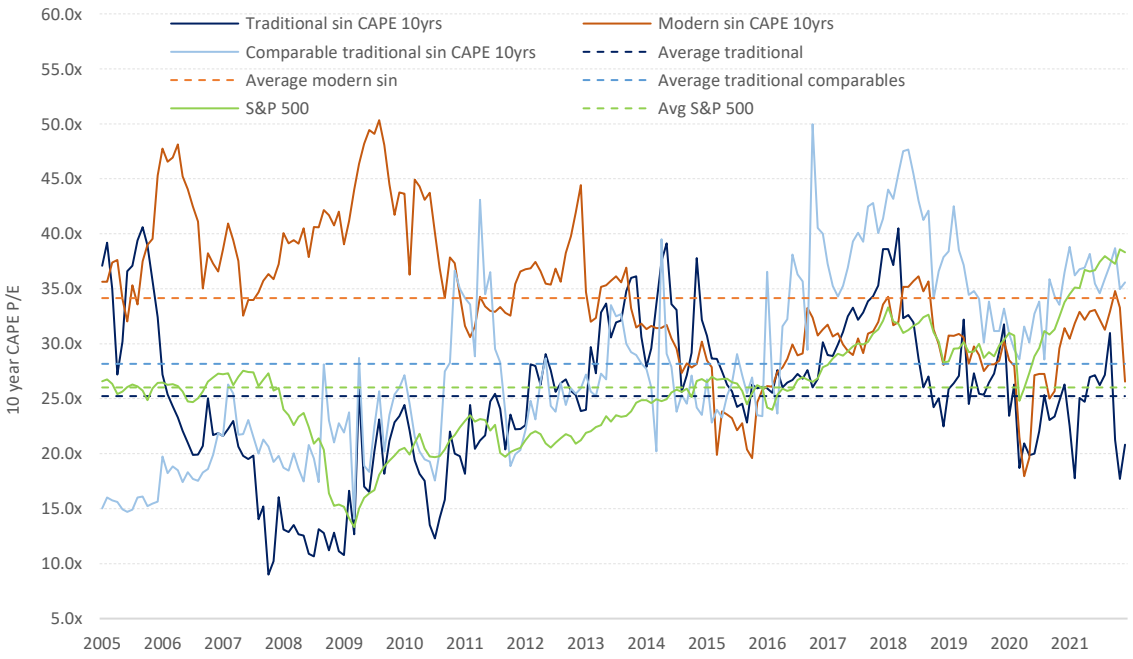
We further see that the comparable portfolio has had an increase in CAPE over the last two years and an upward trending valuation throughout the entire period. This can suggest that investors are willing to pay higher prices for comparable companies, due to higher cash flow expectations in the future. However, in light of the downward trend for the sin stocks, one can argue that investors have sold sinful stocks, possibly due to exclusion criteria, and bought similar companies that do not have sinful company traits.

We note that the comparable portfolio has close to the same factor exposure, as illustrated in the Fama French regressions in chapter 5.1.2, and very similar financial characteristics, as illustrated in chapter 5.4.2. Thus, it makes sense for investors to buy comparable companies if they want close to identical exposure to sinful companies but without sinful traits. The 2017-21 period was the only period without abnormal returns for the sin portfolio. This aligns with the downward valuation development measured by the CAPE ratio.

We see a downward trend for the modern sin portfolio throughout the period. However, we find it hard to conclude that there is any development of a valuation discount due to the fossil fuel companies potentially developing into a modern sin industry. Firstly, the average CAPE is higher for the modern sin portfolio than for the S&P 500, sin stocks, and comparable sin stocks. Secondly, from Appendix 5.10, there is an evident relationship between the CAPE and the crude oil WTI futures. We find this as the most crucial factor for the companies' earnings as expected. We do not see any downward trending valuations for the modern sin portfolio when considering the oil price changes, which suggests no developing modern sin valuation discount.

In sum, we see a downward trend in recent years for traditional sin stocks, especially when taking the opposite trend for comparable stocks. However, it is hard to conclude this just by descriptive analysis. Further, we do not see any similar trend for the modern sin portfolio when considering crude oil development.

Figure 5.7: CAPE-ratio development



Note: The 10-year CAPE ratio is based on the companies' value-weighted CPI-adjusted price and earnings in the respective portfolios. We use the average 10-year earnings and the same methodology as the traditional Shiller/CAPE P/E ratio. We use Shillier's own CPI adjustment factors. Earnings are downloaded yearly for each company, while prices are downloaded on a monthly basis. The price and earnings data are downloaded from Refinitiv.

5.4.2 Key financial developments

Given that we see i) abnormal returns for sin stocks in every period except for 2017-21 and ii) a downward trending valuation, measured by the CAPE ratio, in the same period, we find it interesting to analyze the financial performance development for the sin stocks. We expect to find results implying that sin stocks have a continued good financial development and better financials than the comparable sin portfolio.

Further, we expect higher debt levels for sin companies due to Hong and Kacperczyk's (2009) findings suggesting higher use of debt financing as sin stocks have disadvantages with equity financing. Higher debt levels can also be implied due to the trade-off theory and the agency cost theory, suggesting that companies with higher profitability tend to use more debt financing (Graham & Harvey, 2001; Baskin, 1988; Tirole, 2005). Also, we expect lower analyst coverage for sin stocks, which is in line with Hong and Kacperczyk's (2009) findings. Our results are illustrated in Table 5.14, whereas a more comprehensive overview is shown in Appendix Table 5.10.

The traditional sin portfolio has had a declining dividend yield over the period but still a significantly better yield than the comparable portfolio. We also see that the traditional sin portfolio has a higher share buyback yield. However, the payout ratio is significantly higher for the sin portfolio than for the comparable portfolio. This can suggest that the higher dividend yield results from a higher payout ratio. The dividend payout ratio has increased for the sin portfolio over the years, while the dividend yield has decreased, suggesting that the companies have reduced their earnings or had multiple expansions. Based on the P/E ratio, it does not seem as though the companies have had a multiple expansion, with a lower P/E in the 2019-21 period than in the 2016-18 period. However, the EBIT margin has decreased over the period.

In addition, the return on assets- and equity have declined over the period. This suggests that the sin stocks have experienced a profitability decline. This is supported by having a declining cash flow to total assets and a reduction in market

capitalization over the period. We see a downward trending dividend yield, margins, and profitability for the comparable companies, although this decline is significantly lower than for the sin companies.

Compared to the sin portfolio, the comparable companies have increased their market capitalizations. We further see that the sin portfolio has a significantly higher proportion of the companies' payout dividends, suggesting that the sin companies might be more mature than the comparable portfolios. This is also in line with the sin companies having higher profitability. However, we see that the sin stocks have had a significant decline in the proportion of companies paying out dividends, while the comparable portfolio only has experienced a slight decrease. We expect this to result from the decrease in profitability throughout the period.

Revenue growth has been higher for the sin portfolio than the comparable portfolio. This is somewhat surprising, as we did not estimate double-digit revenue growth for the portfolio, as sin stocks are mature companies. However, due to monopolistic tendencies, one can argue that the sin companies can increase prices with higher costs. However, if they had substantial pricing power, we argue that the margins would not have experienced a considerable decline. We see, however, that the median revenue growth is significantly lower than the average growth, suggesting that some companies experience high growth. In contrast, the majority of the companies experience slow growth. We also see that there have been some significant acquisitions in the sin industry over the latest years, suggesting that some revenue growth might be a result of acquisitions rather than organic growth.

The sin companies' investment level has remained steady but relatively low. This aligns with the Fama French regression results that implied a conservative investment strategy for the sin portfolio. Also, the comparable portfolio has a steady investment level at the same level as the sin portfolio. Because of this, we believe it is somewhat surprising that the comparable portfolio does not have higher payout ratios, although low historical capex ratios do not necessarily mean low future investments. We expect that the sin companies have slightly higher monopolistic tendencies, suggesting that the comparable companies might have more cash on

their balance sheet to make more investments, all else being equal, to ensure their market position. This might be the reason for somewhat lower dividend payments.

Hong and Kacperczyk (2009) concluded that sin stocks relied more on the debt markets for financing than other firms and argued that this is consistent with their hypothesis that sin stocks face a disadvantage in the equity markets. We discuss the potential disadvantage in chapter 5.4.3. However, our descriptive analysis shows that the sin stocks do not seem to have higher debt financing than their comparison group. The sin stocks have a slightly higher debt to capital than the comparable group. However, the traditional sin stocks have lower debt to capital than the modern sin and comparable portfolios. The comparable modern group has significantly higher debt levels, which might have something to do with renewable companies tending to have a lower cost of debt than non-renewable energy firms (Kempa et al., 2021). However, the net debt to assets shows that the traditional sin portfolio has higher net debt, meaning that they have lower cash on its balance sheet when compared to the debt to capital ratio.

We further see that the sin stocks have a higher percentage of companies being covered by an analyst than the comparable portfolio, which goes against Hong and Kacperczyk's (2009) conclusion of sin stocks receiving less analyst coverage. We see a significant uptick in the last year's percentage of sin stocks covered by an analyst. This is somewhat surprising, as investor sentiment has decreased towards sin stocks. However, given that the sin stocks have a slightly higher number of equity issues than the comparable portfolio, it might be somewhat less surprising. A higher degree of analyst coverage might also be because sin stocks are mature, and it might be easier to cover more mature companies as an analyst.

Compared to Hong and Kacperczyk's (2009) sin stocks, we have used more reasonable screening criteria, e.g., turnover, size, etc. This implies that our sin stocks should have a higher percentage of analyst coverage, as analysts tend to cover companies with higher turnover and market caps. Also, there are fewer sin companies than the comparable group of companies, suggesting a lower selection choice. Also, the monopolistic tendencies for sin stocks might lean towards higher

analyst coverage. We also see a similar analyst coverage development in the traditional sin comparable portfolio, the modern sin portfolio and the comparable modern portfolio.

To summarize, we are the most surprised by the negative development in the margins and profitability of the sin companies. Thus, the somewhat negative development of the CAPE ratio, both on a level basis and versus the comparable portfolio and the market proxy, might be due to declining margins.

Table 5.14: Sin portfolio financial characteristics

		Traditional sin		Comparable		Modern sin		Comparable	
	Unit	2016-18	2019-21	2016-18	2019-21	2016-18	2019-21	2016-18	2019-21
Dividend yield									
Median	%	3.6	2.6	1.8	1.7	5.7	4.2	3.6	3.4
Average	%	3.0	1.8	2.2	1.8	3.2	3.1	4.0	3.5
Share buyback yield									
Average	%	0.9	0.9	1.6	0.6	2.0	2.7	0.4	0.4
Dividend payout ratio									
Median	%	38.2	43.2	29.5	32.5	23.2	18.6	63.4	63.1
Average	%	74.8	67.8	41.4	51.1	120.2	76.3	77.4	89.3
# of companies paying dividend	%	64.0	58.0	49.0	48.0	18.0	19.3	74.0	75.7
EBIT margin									
Average	%	14.1	12.6	9.3	7.3	0.1	12.4	19.5	18.7
ROA									
Average	%	8.9	8.0	6.5	5.1	-0.1	1.6	2.7	2.6
ROE									
Median	%	13.7	12.2	10.6	9.7	2.0	7.3	9.3	9.1
Average	%	17.5	18.0	14.6	10.5	2.4	7.8	10.1	9.5
Cash flow to total assets									
Average	%	11.3	10.2	6.1	4.4	-9.5	-1.5	5.2	5.2
Revenue growth									
Average	%	13.2	11.2	10.9	6.1	57.5	21.8	6.3	5.5
Debt to total capital									
Average	%	29.7	31.1	28.0	27.7	35.4	33.1	46.9	46.6
Net debt to total assets									
Average	%	18.4	21.0	11.2	10.3	16.9	18.0	28.8	29.0
Capex to assets									
Average	%	5.4	5.3	5.7	5.0	9.5	9.7	6.7	6.5
Capex to sales									
Median	%	5.4	5.5	4.3	4.5	31.9	25.0	19.5	22.7
Average	%	12.7	11.8	12.3	11.7	337.1	317.2	26.3	27.7
Market capitalization									
Median	USDm	736	665	596	611	293	275	5357	6690
Average	USDm	9202	7902	5436	6642	9415	8780	10485	14812
P/E									
Median	x	21.9	19.3	20.3	21.7	17.1	15.0	22.7	30.5
Average	x	24.9	21.5	59.9	48.2	69.7	43.6	43.6	42.6
P/B									
Median	x	2.1	1.9	1.8	1.6	1.3	1.2	1.8	2.2
Average	x	3.2	3.0	2.8	3.7	10.1	6.2	2.5	2.8
CAPE-ratio									
Weighted average, 10 year period	x	30.4	26.3	31.0	29.4	24.5	24.7		
Weighted average, 5year period	x	24.5	24.7	35.6	31.9	17.9	21.5		
% of companies being covered by an analyst	%	34.7	72.2	29.6	59.9	34.8	53.1	77.5	97.6
If followed, how many analysts cover on avg.	#	2.5	8.0	1.4	4.7	1.2	4.4	4.2	10.6

Note: The Table summarizes the equally weighted company characteristics of the companies' traditional and modern sin- and comparable portfolios. We use the average results for the respective periods to see the recent years' development. All the results are fetched from the Refinitiv Datastream database and are of the end of each respective year. We assume that the data provided from Refinitiv is accurate. A complete description of the metrics is explained in chapter 3.5 and the footnote in Appendix Table 5.10.

5.4.3 Analysis of sin stock issuance of outside equity financing

Up to this point, the thesis has been heavily focused on analyzing sin stock performance measured by total returns across different industries and timespans. Another interesting study looks at the practical consequence of being a sinful company. Referring to our hypothesis about sin stocks outperforming the market, we expect the sin stocks to raise capital at a more significant discount than their comparables. We also believed sin stocks to be less active in the capital markets and less frequently raise equity. The explanation for this could be the typical high free cash flow and margins. After finding a worse-than-expected development of the sin stock company characteristics, we now investigate the visible sin stock characteristics related to capital raises.

By tracking the companies after their IPOs, we find that 69% of our sin stock universe raised additional equity after being listed versus 74% of the peer universe, as seen in Table 5.25. This was in line with our expectations. However, of all the companies that raised equity, the sin stocks performed capital raises more frequently compared to the peer industries. The appetite for sin stock equity issuances is further manifested with a better than peer performance on the first trading day. However, we see the first-day performance of the modern sin stocks react worse than peers. Regarding issuance discounts, we see that traditional sin companies raise equity less often while offering a smaller discount than the comparable portfolio. Here, we see the opposite effect for the modern sin stocks, with the issuance discount being larger for the modern sin companies than for the comparable portfolio. Some of the higher modern sin discount might reflect higher discounts during the oil price shock in 2014. The lower peer issuance discount is the opposite of Hong and Kacperczyk's (2009) results.

Table 5.15: Results of stock capital raise implications

		Traditional		Modern	
	Unit	Sin	Peers	Sin	Peers
Deal size					
Average	USDm	249	102	60	70
Median	USDm	16	9	6	6
Discount					
Average	%	-7.4 %	-7.5 %	-7.9 %	-7.7 %
Median	%	-6.0 %	-6.2 %	-4.7 %	-5.1 %
Issues					
Average no. Issues	#	2.76	2.55	2.95	2.87
% share that issued stock	%	69 %	74 %	74 %	68 %
P/B					
Historical average	x	3,1x	3,3x	8.2x	2.6x
Avg. At issue date	x	3.2x	3.5x	8.6x	2.7x
First-day performance	%	-3.2 %	-4.1 %	-3.6 %	-3.0 %

Note: The Table provides a descriptive analysis of equity capital raises and their implications. Deal size refers to the capital raise equity size. Discount refers to the capital raise price compared to the closing price. Issue refers to actual equity capital issues. P/B refers to the price-to-book ratio. First-day performance refers to the stock performance the day after the capital raise. The data are from Bloomberg and explain the equity capital raise implications for sin stocks and its comparable companies.

6 Conclusion

With this thesis, we can conclude that traditional sin stocks in developed countries do have positive abnormal returns. However, we find a negative trend for the abnormal sin stock returns. There are no abnormal returns in the 2017-21 period and negative abnormal returns versus the comparable companies for the traditional sin portfolio. Despite a potential development of a modern sin stock industry, we do not find abnormal returns within this segment containing oil and gas companies. We find a sign of strong sin stock resilience by further investigating the performance during market turmoil, although this resilience is explained by risk exposures and not by any abnormal returns. Furthermore, we have studied recent trends regarding valuation, company characteristics, and outside equity financing.

Our findings suggest results both supporting and discouraging the ongoing sin stock exclusion from a financial perspective. Firstly, investors that have excluded sin stocks have had a high cost due to historical abnormal returns in the period. However, sin stock exclusion has been positive for investors in the last five years, with no abnormal returns and negative abnormal returns if going long sin stocks and shorting non-sinful comparable companies.

Unique for this paper are the findings that the comparable portfolio had positive abnormal returns, which contradicts Hong and Kacperczyk's (2009) argument that sin stocks earn abnormal returns because of lower demand for the sinful stocks, despite concluding on more positive and significant returns for the sin stock portfolio. On another note, we see a high degree of analyst coverage for sin stocks and no clear sin stock outside equity disadvantages, which are the opposite results to those of Hong and Kacperczyk (2009).

Our paper expands today's sin stock research with new periods, new markets, new types of sin stocks, and new stock criteria, with a renewed focus on sin stock developments of returns, valuation, financial characteristics, and outside equity financing.

For the traditional sin portfolio, we find abnormal returns on both a value-weighted and equally weighted basis, although skewed towards earlier periods. More specifically, we only find abnormal returns between 2000-2016. The alcohol and gambling portfolios were the strongest performers, with both yielding abnormal returns individually. We cannot conclude any abnormal returns for the 2000-21 difference portfolio, meaning there are no abnormal returns versus a comparable portfolio. This is not surprising when this group would have abnormal returns individually if allowed a 10% significance level. The similar strong peer performance might be due to both portfolios having common factors driving the returns. Our analysis suggests that investors can earn close to the same returns by investing in comparable stocks that are not sinful. This might suggest a shift in investor sentiment, and effectively a selling of sin stocks and buying of similar but not sinful companies, likely to be fuelled by SRI.

We further conclude that sin stocks have performed very well during market turmoils. This is proven by significantly better nominal- and risk-adjusted returns during the dot-com bubble, and financial crisis, although a weak performance under the Covid-19 outbreak. Despite the above-market performance, we do not find any signs of abnormal returns during crisis periods.

We also find a declining trend in valuations in the recent years, measured through the CAPE ratio. Our evidence suggests a multiple and margin contraction, as valuations, margins, and dividends have decreased steadily. This has happened simultaneously, with the comparable portfolio experiencing multiple expansions and increased valuations. We can conclude that sin stocks do not struggle more than peers with outside equity financing supported by their lower equity issuance price discount. Surprisingly, we also find that sin stocks get much attention amongst equity research analysts versus comparable companies, with significantly more companies being covered by the sell-side analysts, with a strong trend in coverage in recent years and greater sell-side analyst coverage per stock. The equity issuance and sell-side analyst coverage results are noteworthy and the opposite results of Hong and Kacperczyk (2009).

While some results are surprising, others are as expected. The investor sentiment towards sin stocks has corroded in recent years, suggesting a sin stock sell-off over the last six years. This might lead to a higher sin premium fuelled by the increasing trend of sin stock exclusion. Further research should consider the valuation perspective and further investigate whether there has been a clear breach in the sin companies' valuation against fundamental characteristics and risk factors. In that case, new research should try to explain whether an increasing sin premium has led to a sell-off in recent years and thus a higher expected return going forward.

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8 Appendix

Table A2.1: Overview of central sin research

Research	Theme
Liu et al. (2014)	Social Norms and market behavior
Hong & Kacperczyk (2009)	Price of Sin
Adamsson & Hoepner (2015)	The Price of Sin Aversion
Fabozzi, Ma, & Oliphant (2008)	Sin stock returns
Blitz & Fabozzi (2017)	Sin Stock Anomaly
Peter Sainsbury (2020)	New Sin Sector
Blitz & Swinkels (2020)	Effectiveness of Exlusion
Bolton & Kacperczyk (2021)	Carbon Risk
In et al. (2019)	
Illhan et al. (2019)	Carbon tail risk
Cicirett & Dam (2019)	The Price of Taste
Kumar et al., (2016)	
Cornell (2020)	ESG Preferences Risk & Return
Wong et al. (2021)	ESG And Firm Value

Note: The table shows various research on sin stocks.

Table A3.1 Fama-French three-factor sin portfolio correlation matrix

	Mkt.RF	SMB	HML	Sin returns
Mkt.RF	1.00			
SMB	0.11	1.00		
HML	-0.08	-0.19	1.00	
Sin returns	0.71	0.02	0.14	1.00

Note: The table provides an overview of the correlation between various factors, including the sin portfolio returns, for the value-weighted Fama-French three-factor model.

Table A3.2 Fama-French five-factor sin portfolio correlation matrix

	Mkt.RF	SMB	HML	RMW	CMA	Sin returns
Mkt.RF	1.00	0.06				
SMB	0.06	1.00				
HML	-0.08	0.03	1.00			
RMW	-0.37	-0.29	0.12	1.00		
CMA	-0.39	-0.06	0.73	0.23	1.00	
Sin returns	0.71	0.05	0.14	-0.02	-0.08	1.00

Note: The table provides an overview of the correlation between various factors, including the sin portfolio returns, for the value-weighted Fama-French five-factor model.

Table A3.3: Fama-French five-factor difference portfolio correlation matrix

	Mkt.RF	SMB	HML	RMW	CMA	Diff returns
Mkt.RF	1.00					
SMB	0.07	1.00				
HML	-0.09	0.04	1.00			
RMW	-0.38	-0.28	0.11	1.00		
CMA	-0.39	-0.07	0.74	0.23	1.00	
Sin returns	0.26	0.19	0.07	-0.04	-0.10	1.00

Note: The table provides an overview of the correlation between various factors, including the difference portfolio returns, for the value-weighted Fama-French five-factor model.

Table A3.4: Homoskedasticity test results

	BP	P-Value	Rejection?	Conclusion
Fama-French three-factor model				
Traditional sin portfolio	5.637	0.131	No	Homoscedasticity
Traditional comparble portfolio	7.029	0.071	No	Homoscedasticity
Modern sin portfolio	2.768	0.429	No	Homoscedasticity
Modern comparable portfolio	3.698	0.296	No	Homoscedasticity
Fama-French five-factor model				
Traditional sin portfolio	6.948	0.225	No	Homoscedasticity
Traditional comparble portfolio	9.326	0.097	No	Homoscedasticity
Modern sin portfolio	6.040	0.302	No	Homoscedasticity
Modern comparable portfolio	5.979	0.308	No	Homoscedasticity

Note: The table provides results, whereas we test for the second assumption explained in chapter 3.2.5. We conclude in homoscedasticity, meaning that the assumption holds. We tested for heteroscedasticity using a Breusch-Pagan test. Since the p-value is less than 0.05, we fail to reject the null hypothesis, suggesting that we do not have enough evidence that heteroscedasticity is present in the various regression models. Thus, we can conclude that the assumption holds for our data.

Table A3.5: Autocorrelation test results

	p-value	alpha	Test stat	Crit.value	Conclusion
Fama-French three-factor model					
Traditional sin portfolio	0.438	0.050	10.028	18.307	No autocorrelation
Traditional comparble portfolio	0.608	0.050	8.211	18.307	No autocorrelation
Modern sin portfolio	0.745	0.050	6.786	18.307	No autocorrelation
Modern comparable portfolio	0.269	0.050	12.238	18.308	No autocorrelation
Fama-French five-factor model					
Traditional sin portfolio	0.181	0.050	13.828	18.307	No autocorrelation
Traditional comparble portfolio	0.607	0.050	8.223	18.307	No autocorrelation
Modern sin portfolio	0.822	0.050	5.916	18.307	No autocorrelation
Modern comparable portfolio	0.181	0.050	13.828	18.307	No autocorrelation

Note: The table provides results for our autocorrelation test results, as explained in chapter 3.2.5. We conclude that no autocorrelation is present using a Breush-Godfrey test with lagged estimated residuals and an auxiliary regression. Our test concludes that no autocorrelation exists in our data, as the p-value is higher than the alpha of 0.05. Thus, assumption three for the Classical Linear Regression Model holds.

Table A3.6: Normality test results

Fama-French five-factor model	p-value	alpha	Test stat	Conclusion
Traditional sin portfolio	0.095	0.050	Do not reject	Normality
Traditional comparble portfolio	0.287	0.050	Do not reject	Normality
Modern sin portfolio	0.061	0.050	Do not reject	Normality
Modern comparable portfolio	0.055	0.050	Do not reject	Normality

Note: The table provides results for the Jarque-Bera test for normality. We cannot reject the null hypothesis that the skewness and kurtosis of the estimated residuals are jointly zero, suggesting that the normality assumption holds.

Table A4.2: Complete sin stock industry and country overview *0.8*

Country of Exchange	Alcohol	Gambling	Tobacco	Total	Alcohol	Gambling	Tobacco	Total
Australia	5	7	0	12	7 %	11 %	0 %	7 %
Austria	0	0	0	0	0 %	0 %	0 %	0 %
Belgium	1	0	0	1	1 %	0 %	0 %	1 %
Canada	3	1	6	10	4 %	2 %	16 %	6 %
Denmark	3	0	1	4	4 %	0 %	3 %	2 %
Finland	1	0	0	1	1 %	0 %	0 %	1 %
France	6	3	1	10	8 %	5 %	3 %	6 %
Germany	3	4	0	7	4 %	6 %	0 %	4 %
Greece	0	1	1	2	0 %	2 %	3 %	1 %
Hong Kong	7	16	2	25	10 %	24 %	5 %	14 %
Ireland; Republic of	0	0	1	1	0 %	0 %	3 %	1 %
Italy	3	0	0	3	4 %	0 %	0 %	2 %
Japan	9	1	3	13	13 %	2 %	8 %	7 %
Netherlands	2	0	1	3	3 %	0 %	3 %	2 %
New Zealand	1	1	0	2	1 %	2 %	0 %	1 %
Norway	0	0	0	0	0 %	0 %	0 %	0 %
Singapore	1	1	0	2	1 %	2 %	0 %	1 %
Spain	0	1	0	1	0 %	2 %	0 %	1 %
Sweden	1	1	2	4	1 %	2 %	5 %	2 %
Switzerland	0	0	0	0	0 %	0 %	0 %	0 %
United Kingdom	14	6	6	26	19 %	9 %	16 %	15 %
United States of America	12	23	14	49	17 %	35 %	37 %	28 %
TOTAL	72	66	38	176	100 %	100 %	100 %	100 %

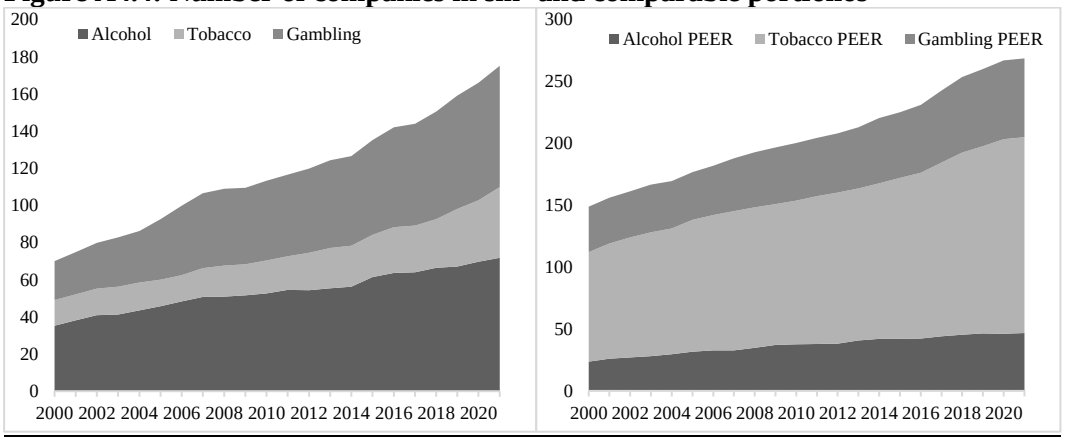
Note: The table provides a complete list of the country of exchange for traditional sin stocks in our data. To the left, we illustrate the number of sin stocks in our data listed in a specific country and the industry to which the company belongs. To the right, we provide the same results in percentage. The data is extracted from Refinitiv.

Table A4.3: Complete traditional and modern sin and comparable country overview

Country of Exchange	Sin	Comp.	Mod sin	Comp.	Sin	Comp.	Mod sin	Comp.
Australia	12	3	32	2	7 %	1 %	10 %	2 %
Austria	0	2	1	2	0 %	1 %	0 %	2 %
Belgium	1	3	1	0	1 %	1 %	0 %	0 %
Canada	10	9	66	11	6 %	3 %	21 %	10 %
Denmark	4	2	2	1	2 %	1 %	1 %	1 %
Finland	1	3	0	1	1 %	1 %	0 %	1 %
France	10	7	7	4	6 %	3 %	2 %	4 %
Germany	7	2	0	5	4 %	1 %	0 %	5 %
Greece	2	3	0	4	1 %	1 %	0 %	4 %
Hong Kong	25	32	12	4	14 %	12 %	4 %	4 %
Ireland; Republic of	1	4	2	0	1 %	1 %	1 %	0 %
Italy	3	4	3	11	2 %	1 %	1 %	10 %
Japan	13	89	10	7	7 %	32 %	3 %	6 %
Netherlands	3	3	1	0	2 %	1 %	0 %	0 %
New Zealand	2	2	1	6	1 %	1 %	0 %	5 %
Norway	0	6	13	0	0 %	2 %	4 %	0 %
Singapore	2	9	7	0	1 %	3 %	2 %	0 %
Spain	1	4	3	4	1 %	1 %	1 %	4 %
Sweden	4	7	8	1	2 %	3 %	3 %	1 %
Switzerland	0	4	0	0	0 %	1 %	0 %	0 %
United Kingdom	26	14	50	5	15 %	5 %	16 %	5 %
United States of America	49	65	100	42	28 %	23 %	31 %	38 %
Total	176	277	319	110	100 %	100 %	100 %	100 %

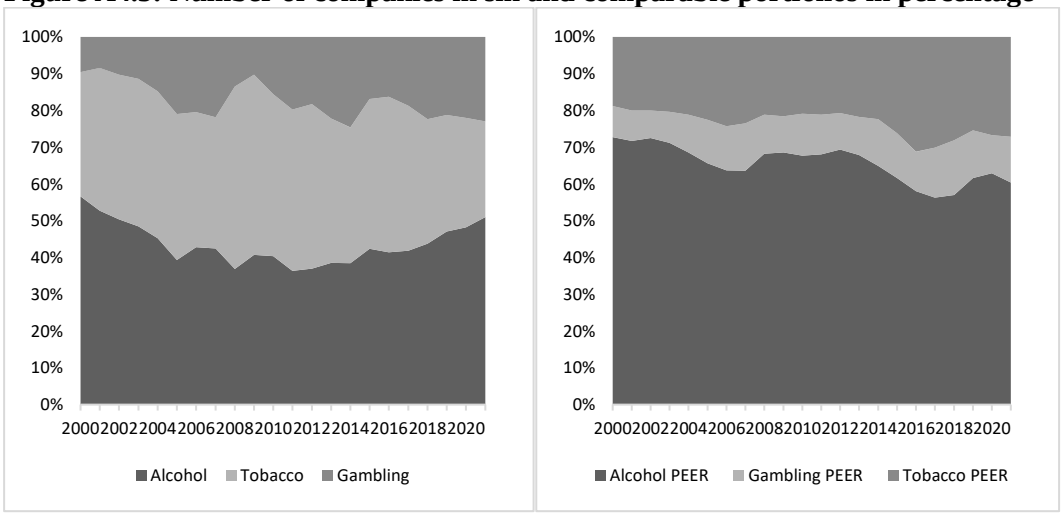
Note: The table provides a complete list of the country of exchange for traditional and modern sin stocks and their peers in our data. The data is extracted from Refinitiv.

Figure A4.4: Number of companies in sin- and comparable portfolios



Note: The figures illustrate the number of companies in the sin- and comparable portfolios throughout the period.

Figure A4.5: Number of companies in sin and comparable portfolios in percentage



Note: The figures illustrate the number of companies in the sin- and comparable portfolios in percentage and on an industry basis.

Table A5.1: 2000-03 value-weighted regression results

	CAPM	3 factor	5 factor	5 factor + mom
Intercept (alpha)	0.76426****	0.76609****	0.37601**	0.37346**
Mkt-RF	0.73107****	0.72947****	0.82320***	0.882507****
SMB		-0.03383	0.07589	0.07171
HML		0.05569	0.12395	0.13067
RMW			0.85730****	0.84971****
CMA			0.15012	0.14344
MOM				0.01095
R^2	0.605	0.606	0.670	0.671
Adjusted R^2	0.604	0.601	0.663	0.662

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total value-weighted sin portfolio from 2003-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d.).

Table A5.2: 2000-03 equally weighted regression results

	CAPM	3 factor	5 factor	5 factor + mom
Intercept (alpha)	0.56640****	0.46581***	0.39051***	0.41201***
Mkt-RF	0.62545****	0.61412****	0.60106****	0.58530****
SMB		0.64789****	0.64371****	0.67893****
HML		0.21820***	0.33045****	0.27388***
RMW			0.24738**	0.31132***
CMA			-0.36387***	-0.30765**
MOM				-0.09215**
R^2	0.681	0.678	0.701	0.706
Adjusted R^2	0.680	0.674	0.695	0.699

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total equally weighted comparable portfolio in the period 2003-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d.).

Table A5.3: Equally weighted regression results for sin industries separately

	Alcohol		Tobacco		Gambling	
	3 factor	5 factor	3 factor	5 factor	3 factor	5 factor
Intercept (alpha)	0.50159****	0.23455*	0.66861****	0.40612***	0.56532***	0.4052*
Mkt-RF	0.59296****	0.55860****	0.31097****	0.58941****	0.79755****	0.8063****
SMB	0.53272****	0.52722****	0.29094***	0.60850****	0.77613****	0.8909****
HML	0.27453****	0.36286****	0.24060***	0.33936****	0.27185****	0.3140**
RMW		0.34390****		0.28703***		0.4156***
CMA		-0.31410***		-0.33186***		-0.3800**
R^2	0.668	0.678	0.208	0.696	0.579	0.602
Adjusted R^2	0.664	0.672	0.199	0.690	0.574	0.594

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on equally weighted sin industry portfolios in the period 2000-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d.).

Table A5.4: Equally weighted regression results for comparable industries separately

	Alcohol comparable		Tobacco comparable		Gambling comparable	
	3 factor	5 factor	3 factor	5 factor	3 factor	5 factor
Intercept (alpha)	0.52357****	0.63484****	0.64126****	0.40072****	0.04521	-0.04576
Mkt-RF	0.57711****	0.57708****	0.44965****	0.59001****	0.91168***	0.88632****
SMB	0.48232****	0.33167****	0.44013****	0.57118****	0.78334****	0.87638****
HML	0.26061****	0.23184***	0.18754****	0.27260****	0.50024****	0.64452****
RMW		0.39235****		0.29526****		0.35695***
CMA		-0.20751		-0.21269**		-0.57726****
R^2	0.742	0.562	0.608	0.770	0.755	0.785
Adjusted R^2	0.739	0.553	0.603	0.766	0.752	0.781

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on equally weighted comparable industry portfolios in the period 2000-2021. Dependent variables are the monthly portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, 2022).

Table A5.5: Equally weighted difference portfolio regression results

	CAPM	3 factor	5 factor	5 factor + mom
Intercept (alpha)	-0.01595	-0.02198	0.005405	-0.004782
	(0.13138)	(0.13265)	(0.1423306)	(0.142491)
Mkt-RF	0.01755	0.01584	-0.0005984	0.007664
	(0.02898)	(0.02930)	(0.0351468)	(0.035820)
SMB		0.0504	0.0373123	0.007476
		(0.06824)	(0.0738829)	(0.078084)
HML		0.01392	0.0667529	0.106436
		(0.05023)	(0.0771684)	(0.084201)
RMW			-0.0082308	-0.025191
			(0.0941637)	(0.095199)
CMA			-0.1191732	-0.155732
			(0.1164730)	(0.120485)
MOM				0.044899
				(0.038262)
R^2	0.001	0.004	0.007	0.013
Adjusted R^2	-0.002	-0.008	-0.012	-0.010

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the total equally weighted difference portfolio in the period 2000-2021. Dependent variables are the monthly sin portfolio return net of the comparable portfolio return, $r_{sin,t} - r_{comparable,t}$. The intercept represents the monthly abnormal return in percentage. The standard error of each coefficient is illustrated in parenthesis. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure

to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.a.).

Table A5.6: Value-weighted alcohol sin and comparable portfolio period regression results

	Alcohol Portfolio				Alcohol Comparable Portfolio			
	2000-2005	2006-2011	2012-2016	2017-2021	2000-2005	2006-2011	2012-2016	2017-2021
Intercept	0.27551	0.82639*	0.83764*	-0.21839	-0.57204	0.52107	0.2944	0.25332
Mkt-RF	0.34890***	0.55159****	0.79690****	0.84736****	0.59124****	0.48941****	0.6362****	0.67224****
SMB	0.27543*	0.26758	-0.53196	-0.20994	0.01894	-0.40894*	-0.5871***	-0.51112**
HML	0.08574	0.13978	-0.69385*	0.04627	0.18449	-0.27976	-0.4188*	-0.38692**
RMW	0.35602	0.3828	0.87389*	0.24837	0.38411	0.26568	0.7124**	0.41782
CMA	0.16095	-0.3296	-0.01286	0.33045	0.36881	0.26955	0.5662*	1.23884****
R^2	0.133	0.584	0.527	0.598	0.327	0.452	0.641	0.677
Adjusted R^2	0.067	0.553	0.484	0.561	0.276	0.411	0.608	0.647

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the value-weighted industry portfolio for the alcohol industry and its comparable portfolio for 2000-05, 2006-11, 2012-16 and 2017-21. Dependent variables are the monthly sin portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The standard error of each coefficient is illustrated in parenthesis. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d.).

Table A5.7: Value-weighted tobacco and comparable portfolios period regression results

	Tobacco Portfolio				Tobacco Comparable Portfolio			
	2000-2005	2006-2011	2012-2016	2017-2021	2000-2005	2006-2011	2012-2016	2017-2021
Intercept	0.9715	1.27824***	0.2577	-0.21839	-0.1974	0.63348**	1.09608****	0.03023
Mkt-RF	0.77519****	0.61384****	0.9232****	0.84736****	0.73621****	0.57823****	0.62842****	0.70649****
SMB	-0.11103	-0.25737	-1.1415****	-0.20994	0.05449	0.17338	-0.43607**	0.07916
HML	0.73368*	-0.40174	-0.46	0.04627	0.42224**	-0.03831	-0.53186**	-0.45580***
RMW	0.48448	-0.18352	1.2597***	0.24837	0.52297***	0.17035	0.26455	0.16593
CMA	-0.02972	0.26833	1.0115**	0.33045	0.12738	0.17468	0.85289***	0.98520***
R^2	0.334	0.513	0.678	0.598	0.579	0.681	0.622	0.713
Adjusted R^2	0.284	0.476	0.648	0.561	0.547	0.657	0.587	0.687

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the value-weighted industry portfolio for the tobacco industry and its comparable portfolio for 2000-05, 2006-11, 2012-16 and 2017-21. Dependent variables are the monthly sin portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The standard error of each coefficient is illustrated in parenthesis. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d.).

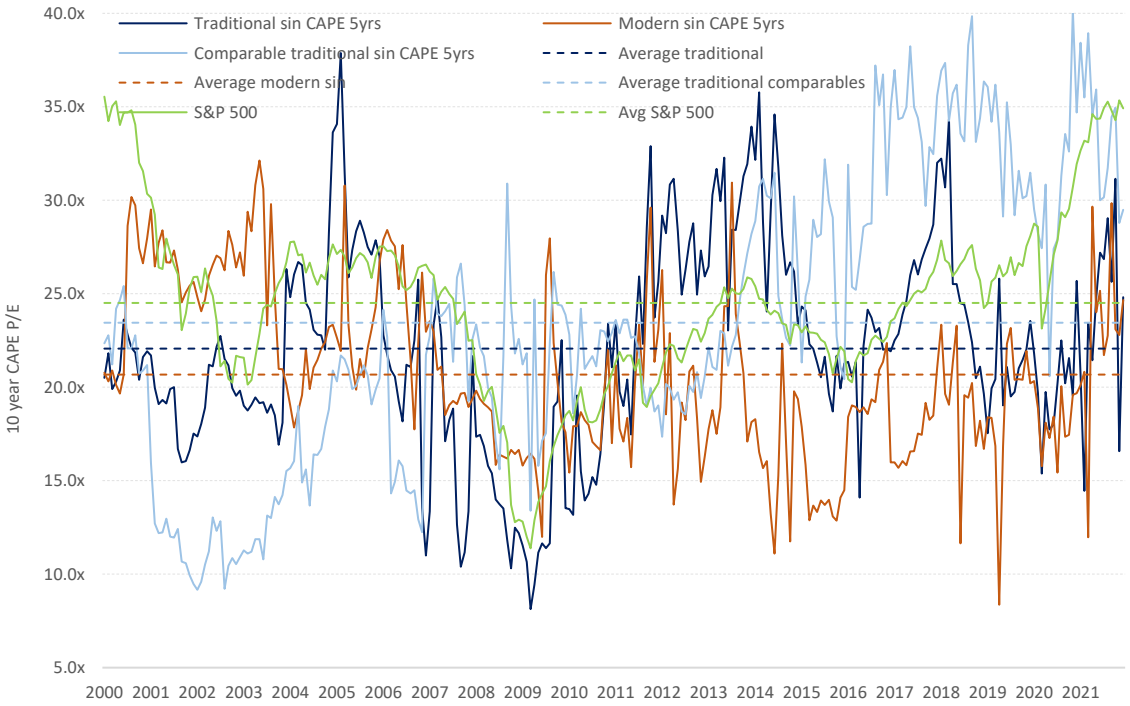
Table A5.8: Value-weighted gambling- and comparable portfolio period regression results

	Gambling Portfolio				Gambling Comparable Portfolio			
	2000-2005	2006-2011	2012-2016	2017-2021	2000-2005	2006-2011	2012-2016	2017-2021
Intercept	1.66776**	2.2605**	-0.1071	0.42978	0.1852897	0.4107	0.86701**	0.3206
Mkt-RF	0.87347****	1.3210****	1.8273****	1.28501****	1.2338248****	0.9904****	0.92545****	1.2520****
SMB	0.72012***	0.6192	0.153	1.40672***	0.0008912	0.392	-0.09903	0.7594*
HML	-0.16919	0.7157	-0.9445	0.76443**	0.9259872***	0.5320*	-0.1817	1.2763****
RMW	0.77182*	-0.1269	-0.2436	-0.07783	-0.1670176	-0.3667	-0.34397	0.3418
CMA	-0.09122	-1.4006	1.2744	-1.37771**	-0.335114	-0.3989	0.12493	-1.3309**
R^2	0.359	0.614	0.495	0.773	0.653	0.796	0.675	0.777
Adjusted R^2	0.310	0.585	0.449	0.752	0.627	0.780	0.645	0.757

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the value-weighted industry portfolio for the gambling industry and its comparable portfolio for 2000-05, 2006-11, 2012-16, and 2017-21. Dependent variables are the monthly sin portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The standard error of each coefficient is illustrated in parenthesis. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free

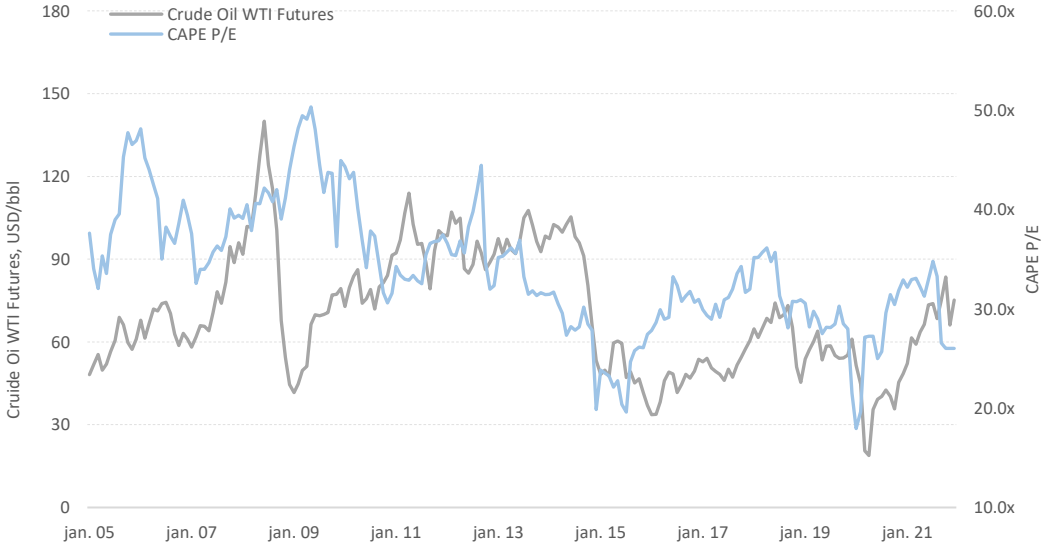
monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d).

Figure A5.9: 5-year CAPE P/E results (value-weighted)



Note: The 5-year CAPE P/E ratio is based on the value-weighted CPI-adjusted price and earnings of the companies in the respective portfolios. We use the average 5-year earnings and the same methodology as the traditional Shiller/CAPE P/E ratio. We use Shillier's own CPI adjustment factors. Earnings are downloaded yearly for each company, while prices are downloaded on a monthly basis. The price and earnings data are downloaded from Refinitiv.

Figure A5.10: Modern sin CAPE P/E vs. Crude Oil WTI Futures



Note: The 10-year CAPE P/E ratio is based on the companies' value-weighted CPI-adjusted price and earnings in the respective portfolios. We use the average 10-year earnings and the same methodology as the traditional Shiller/CAPE P/E ratio. We use Shillier's own CPI adjustment factors. Earnings are downloaded yearly for each company, while prices are downloaded on a monthly basis. The price, futures, and earnings data are downloaded from Refinitiv. We find the figure interesting as we see a clear relationship between the CAPE P/E and the crude oil futures, as the futures illustrate the market's beliefs on the future oil prices, which is the most critical input factor for the earning development of fossil fuel companies. Thus, we find it reasonable to believe that the downward trending CAPE P/E ratio mostly rather reflects the future contracts and not any sin valuation discount.

Table A5.11: Portfolio financial characteristics per period

		Sin Portfolio						Comparable Portfolio					
	Unit	2016	2017	2018	2019	2020	2021	2016	2017	2018	2019	2020	2021
Dividend yield													
Median	%			3.6	3.4	2.2	2.1			1.8	1.9	1.6	1.5
Average	%			3.0	2.6	1.4	1.3			2.2	2.1	1.8	1.7
10-year US Treasury, end of year	%	2.5	2.7	2.6	1.5	1.1	1.8	2.5	2.7	2.6	1.5	1.1	1.8
Share buyback yield													
Average	%	0.5	0.9	1.4	1.1	0.5	1.2	2.1	1.5	1.2	0.7	0.7	0.3
Dividend payout ratio													
Median	%	39.1	35.8	39.7	45.2	45.1	39.3	30.8	27.6	30.1	31.0	34.3	32.3
Average	%	96.7	55.7	71.8	62.6	88.2	52.6	47.1	34.6	42.4	46.7	50.0	56.4
# of companies paying dividend	%			64.0	65.0	62.0	47.0			49.0	48.0	47.0	49.0
EBIT margin													
Median	%	13.5	13.3	13.8	12.3	11.4	11.4	6.3	6.9	6.8	6.5	6.0	5.3
Average	%	14.0	14.3	13.9	13.2	12.0	12.6	9.4	9.3	9.4	8.9	8.2	4.7
ROA													
Median	%	8.6	8.6	7.1	7.1	6.1	5.2	4.8	5.7	6.1	5.4	5.1	4.2
Average	%	9.3	8.9	8.7	9.3	8.2	6.5	5.8	7.1	6.6	6.3	5.6	3.4
ROE													
Median	%	14.4	14.2	12.6	14.5	11.8	10.3	10.3	11.2	10.3	10.7	9.7	8.8
Average	%	19.2	17.1	16.1	19.4	16.9	17.7	13.7	16.5	13.8	13.1	11.1	7.3
Cash flow to total assets													
Median	%	10.8	10.9	9.9	10.0	8.3	8.5	7.6	7.3	7.6	7.2	7.1	6.5
Average	%	11.6	11.1	11.2	11.3	9.8	9.5	5.9	6.0	6.3	5.0	5.1	3.2
Earnings growth													
Median	%		0.2	4.7	6.9	-2.4	8.3		12.4	7.1	4.2	0.0	2.9
Average	%		176.7	54.8	91.2	19.8	145.0		44.7	29.1	130.7	23.7	69.8
Revenue growth													
Median	%		2.7	7.3	5.6	0.0	3.0		6.4	4.4	4.2	0.5	-1.1
Average	%		7.3	19.1	14.5	11.1	20.0		11.1	10.6	6.0	16.3	-4.0
Debt to total capital													
Median	%	25.2	22.7	23.6	23.2	27.3	27.0	24.1	23.1	20.9	23.0	23.1	25.2
Average	%	30.2	29.5	29.4	28.1	32.9	32.2	30.6	27.3	25.9	26.7	27.5	29.0
Cash to total assets													
Median	%	63.4	55.4	63.4	51.2	58.0	70.4	56.9	61.6	60.9	65.2	67.3	82.6
Average	%	332.0	355.9	375.3	374.9	403.5	579.6	263.9	277.4	265.2	271.7	292.6	375.3
Net debt to total assets													
Median	%	18.7	17.7	20.0	18.9	23.1	23.1	16.0	15.1	12.7	11.5	14.7	13.2
Average	%	17.5	17.7	20.1	19.8	21.8	21.4	12.6	11.0	10.0	8.8	11.6	10.6
Capex to assets													
Median	%	3.4	3.5	3.6	3.8	3.2	1.9	4.0	3.7	4.3	4.2	3.8	3.0
Average	%	5.6	5.6	5.1	6.5	6.0	3.3	5.3	5.9	5.7	5.6	5.0	4.4
Capex to sales													
Median	%	5.3	5.3	5.4	6.0	5.6	4.9	4.2	4.3	4.5	4.7	4.6	4.4
Average	%	12.7	12.7	12.8	11.5	10.9	13.0	7.2	20.4	9.1	13.0	7.6	14.4
Market capitalization													
Median	USDm	585	753	869	683	556	755	503	689	596	558	642	634
Average	USDm	8748	8716	10142	7438	8009	8260	5186	5855	5268	6085	6618	7222
P/E													
Median	x	22.4	24.8	18.6	21.5	19.2	17.2	19.9	22.6	18.5	21.4	22.6	21.0
Average	x	25.6	26.4	22.5	23.7	22.1	18.8	31.5	102.0	46.2	31.2	66.8	46.4
P/B													
Median	x	2.0	2.0	2.3	1.7	1.8	2.2	1.7	1.7	1.8	1.6	1.5	1.7
Average	x	2.8	3.2	3.5	2.9	2.9	3.2	2.7	2.7	3.1	3.2	4.2	3.8
CAPE P/E													
Weighted average, 10 year period	x	30.1	34.2	22.5	27.1	26.3	20.8	35.0	35.6	36.4	31.5	34.7	29.5
Weighted average, 5year period	x	21.9	32.0	19.6	23.5	25.7	24.8	40.0	41.4	37.9	33.2	36.5	35.6
% of companies being covered by analyst	%			34.7	65.9	75.0	75.6			29.6	53.8	63.2	62.8
If followed, how many analysts cover on avg.	#			2.5	6.7	8.5	8.7			1.4	3.8	5.1	5.2

Note: The Table summarizes the equally weighted company characteristics of the companies' sin- and comparable portfolios. The dividend yield is the dividend divided by the market capitalization. The share buyback yield refers to the repurchase of outstanding shares over a company's market capitalization. The dividend payout ratio is the dividend per share divided by the earnings per share. EBIT margin is the earnings before interest and taxes divided by the company's total revenues. ROA is the return on assets and is defined as the net income divided by the company's total assets on the balance sheet. ROE is the return on equity and is defined as the net income divided by the company's equity on the balance sheet. Cash flow to total assets is the cash flow divided by the company's total assets. Earnings growth for a respective period is the change in earnings divided by the last year's earnings. Revenue growth is the change in revenues divided by the last year's revenues. Debt to total capital is the company's debt divided by the company's total capital. Total capital is defined as interest-bearing debt plus shareholder's equity. Cash to total assets is the cash and cash equivalents divided by the total assets. Net debt is defined as interest-bearing debt minus the company's total cash and cash equivalents. Net debt to total assets is defined as net debt divided by the total assets. Capex refers to the capital expenditures of a company. Capex to assets refers to capital expenditures divided by the assets. Capex to sales refers to capex divided by the revenues of a company. P/E refers to the price of the company's equity divided by a company's earnings. P/B refers to the price of the company's equity divided by the book value of the equity on the balance sheet. CAPE P/E refers to the price divided by a company's average 10- or 5-year inflation-adjusted earnings. % of companies being followed by an analyst refers to the percentage of the companies in the respective portfolios being followed by an analyst or several analysts. If followed, how many analysts follow on average refers to the average number of analysts following the company if an analyst follows the company.

Table A5.12: Equally-weighted regression results for modern sin portfolio

	CAPM	3 factor	5 factor	5 factor + mom
Intercept	0.66707**	0.45670*	0.47593	0.45186
Mkt-RF	1.13572****	1.12392****	1.05052****	1.06671****
SMB		1.02059****	1.03257****	0.97414****
HML		0.74087****	0.98467****	1.06239****
RMW			0.21107	0.17785
CMA			-0.83101****	-0.90261****
MOM				0.08794
R^2	0.504	0.627	0.644	0.646
Adjusted R^2	0.503	0.623	0.637	0.638

Significant levels: * p<0.1; ** p<0.05; *** p<0.025; ****p<0.01. Note: The Table provides regression results on the equally-weighted modern sin portfolio. Dependent variables are the monthly sin portfolio return net of the risk-free rate, $r_{sin,t} - r_{rf,t}$. The intercept represents the monthly abnormal return in percentage. The standard error of each coefficient is illustrated in parenthesis. The Table presents the monthly returns of the Fama-French factors and the momentum factor from Kenneth R. French's Data Library. The different models capture different exposure to risk factors. Mkt-RF is the monthly market return net of the risk-free monthly rate. SMB, small minus big, captures the exposure towards small market capitalization. HML, high minus low, captures the exposure toward high book-to-market. RMW, robust minus weak, captures the exposure towards companies with robust operating profitability. CMA, conservative minus aggressive, capture the exposure to conservative investment strategy. MOM, momentum, captures the exposure to previous price movements (Fama & French, n.d).