SCHOOL OF ECONOMICS AND MANAGEMENT

LUND UNIVERSITY

To Sin, or Not to Sin?

A Study of *Traditional* and *New Sin Stocks* on the American Stock Market

by

Filip Eriksson

Herman Ljungberg

Oliver Lönegård

May 2023

Bachelor Programme in International Business

Supervisor: Christine Blomquist

Examiner: Amanda Sonnerfeldt

Abstract

This study aims to investigate the difference in stock return between *traditional sin stocks*, *new sin stocks*, and their respective peer stocks. The purpose was to expand the scarcely researched area of *new sin stocks* by being the first one to focus on *new sin stocks* on the American stock market (United States NYSE, AMEX, and NASDAQ stock exchanges), as this area has only been researched in Europe before. The study was conducted on monthly stock-return data for the period 2006-2022 by forming four portfolios of stocks and running 18 time-series regressions. The study compared several regressions using the Fama-French Three- and Five-factor models and Carhart's Four-factor model to meet the research aims, objectives, and purpose. The results suggest that *traditional sin stocks* perform better than *new sin stocks* on the American stock market. Also, it concluded that there seems to be a difference in how the American and European stock markets view sustainable investments and *new sin stocks*. The study suggested that these differences come from social norms differing between these regions. The practical implications for an investor are that there are investments, such as *traditional sin stocks,* where the view of social norms and a positive financial return oppose each other. On the contrary, in the case of *new sin stocks,* the view of social norms and financial results both suggest avoiding the industry.

Keywords: Sin Stocks, New Sin Stocks, Sustainable Investments, Social Norms, Socially Responsible Investing

Acknowledgements

We would like to express our deepest gratitude to our supervisor, Christine Blomquist, who supported us throughout the project. Her feedback and knowledge have guided us to think critically in improving our final product.

A special thanks to Garo Harwood and Academic Skills Services for your support in academic writing and sourcing, and to Victor Falini and the statistics department for your invaluable help in how to approach our method.

Lastly, we would like to acknowledge Fredrik Stenberg and the LINC Finance Lab for all the inspiration and technical guidance in our thesis. Without you, we would not have been able to finalize this project.

Table of Contents

List of Tables

List of Figures

1 Introduction

In this first section, the background of the study and the identified research gap is introduced. Secondly, the aims, objectives, research purpose, and delimitations are presented. The chapter ends with an outline of the thesis to get an overview of the structure.

1.1 Background

A term that has increased in popularity over the recent decade is that of Socially Responsible Investing (SRI). It means investing in a way that promotes ethical and socially conscious business conduct, e.g., investing in environmentally-friendly companies or avoiding industries of addictive nature, such as alcohol, casino, and tobacco (Chen, 2022). The idea of engaging in SRI is partly to make money through benefitting companies that act in accordance with the investor's perception of ethicality and partly to incentivize companies to act within the principles of Corporate Social Responsibility (CSR) (Investopedia, n.d.). While there are some differences in definitions, CSR can be summarized as corporations having a responsibility to act ethically and in the best interest of society (Carroll, 1979; Carroll, 2008; UNIDO, n.d.). As a practical example, Boyde (2023) noted that SRI has grown in the last couple of years, exemplified by the capital inflows to CSR-friendly exchange-traded funds (ETFs) in the European markets. However, she concluded that these capital inflows are significantly lower in the US.

An already established research field concerns stocks engaged in the tobacco, casino, alcohol, and weapons industries, so-called *sin stocks*, that repeatedly deliver greater returns than the stock market in general (Kim & Venkatachalam, 2011). Stock market participants generally neglect *sin stocks* due to regulatory scrutiny and their mismatch with social norms; thus, these stocks exhibit low institutional ownership and higher expected returns (Kim & Venkatachalam, 2011). Moreover, they often come with a *sin premium* awarded to the investors that put their money in *sin stocks*, stemming from institutional investors, such as banks or governmental organizations, avoiding these (Colonnello, Curatola & Gioffré, 2019). Thus, *sin-companies* are underpriced relative to *non-sin companies*, awarding the investor that is taking a risk in challenging social norms with an excess return, also called alpha (Richey, 2017). As an example, the stock of Red Rock Resorts Inc, a Nasdaq-listed casino company involved in Las Vegas casinos, has increased its price by 383% in the last three years (Avanza, n.d.). In this light, it is questionable if SRI holds real importance for investor decisions.

Furthermore, Blitz and Fabozzi (2017) mention that what is seen as *sin* will change over time, meaning that the composition of *sin stocks* should change as social norms evolve. In recent years, environmental practices have been scrutinized, and many organizations worldwide have increased their focus on combating climate change, where the Paris Agreement is a notable example (UNFCCC, n.d.a; UNFCCC, n.d.b; UNPRI, n.d.). As such, practices related to oil, coal, and mining, which negatively impact the environment, have risen as a *new* set of *sin stocks*, opposing the new norms that have risen in the market (Tronslien Sagbakken, 2021).

This thesis focuses on stocks listed on the American stock market belonging to both the *new* and *traditional sin* categories. It is positioned within a research gap as the area of *new sin stocks* has not been researched on the American stock market before, but only on the European stock markets by Tronslien Sagbakken and Zhang (2022). Listed companies in the oil, coal, and mining industries are defined as *new sin stocks*. Listed companies in the tobacco, casino, alcohol, and defense industries are called *traditional sin stocks*. These stocks will also be related to respective peer stocks (outlined in the method section), which are comparably similar industries that are not counted as *sin* in research.

1.2 Aims and Objectives

This paper aims to identify how *new sin stocks* and *traditional sin stocks* perform compared to their respective peer stocks. The main objective is to analyze if there is a significant difference between how these groups of stocks perform compared to each other and if there exists an alpha on *traditional* or *new sin stocks* on the American stock market. Based on previous research, this will differ depending on which variables are included and which asset pricing model is used. The following study aims to capture and discuss the differences between these models, highlighted through time-series regression analyses on *sin* and *non-sin* portfolios of stocks. Based on the aims and objectives, the research question is stated as follows:

What is the difference in return between new sin stocks, traditional sin stocks, and peer stocks on the American stock market?

1.3 Research Purpose

The purpose of this study is to delve deeper into a research area that has been scarcely researched before. While several studies exist on *traditional sin stocks*, this paper contributes by being the first to analyze *new sin stocks* on the American stock market, also comparing them to *traditional sin stocks*. In other words, there is a research gap as the area of *new sin stocks* has not been researched in the American setting before, but only on the European stock market. Therefore, the purpose of this research paper is to extend the research field to the American stock exchanges, inspired by the European study on *new sin stocks* done by Tronslien Sagbakken and Zhang (2022).

Furthermore, previous research on both *new* and *traditional sin stocks* has used data up until 2020 at the latest; thus, this research paper contributes with insights based on data up to the year 2022. In conclusion, this study provides additional insights into the limited research surrounding the topic. It will be of interest for expanding the knowledge of *sin stocks* in general and laying the foundation for future studies on the performance of *new sin stocks*.

1.4 Delimitations

Several delimitations have narrowed the scope of this research paper. Firstly, the term "American stock market" only includes listed companies in the United States, specifically on the NYSE, AMEX, and NASDAQ stock exchanges. This choice was made partly due to the availability of data from those exchanges and partly because previous research on *traditional sin stocks* made the same delimitation. As such, results will be more comparable if the same stock exchanges are used. Secondly, the study will only include data from the period 2006-2022. *New sin stocks* only became classified as *sin stocks* recently with more knowledge of the effects of climate change. As such, proper conclusions would not be drawn based on a longer time frame. Thirdly, the study will consider stock performance in terms of total shareholder return (adjusting for dividends being reinvested) on the stock market.

In addition to the previously mentioned parts, the authors have noted that some other papers within the study of *sin stocks* have, besides looking at performance, taken ownership of the stocks into account (Hong & Kacperczyk 2009; Tronslien Sagbakken & Zhang, 2022). However, this paper focuses on comparing the difference in return between *traditional* and *new sin stocks* and their respective peers, further what it is, and how it takes form. Therefore, the authors deemed the ownership of stocks to be out of scope for this paper even though it has relevance for the subject as a whole.

1.5 Outline of the Thesis

In the next chapter of this thesis, a review of financial models, as well as previous research on sustainable investing, and *sin stocks*, will be presented. The chapter ends with hypotheses development, where the financial models and previous research are combined to form hypotheses. In chapter three, the methodology is presented, which is directly linked to chapter four, where the results of the study are accounted for. Chapter five then analyzes how the results connect to previous research and discusses how the findings relate to the aims and objectives of the thesis. In the final chapter, conclusions and practical implications of the study are presented, together with opportunities for future research.

2 Theoretical Review

The following chapter will firstly cover the financial models of the analysis, including The Efficient Market Hypothesis, the Capital Asset Pricing Model, Jensen's Alpha, the Fama-French Three-factor model, the Carhart Four-factor model, and the Fama-French Five-factor model. Secondly, previous research on sustainable investing, as well as new and traditional sin stocks, is presented. Lastly, the hypotheses will be developed to end the chapter.

2.1 Financial Models

As this paper includes building financial portfolios and performing statistical tests based on that, understanding these models is vital in interpreting parts of the theory section, but more importantly, the method and result sections. Therefore, this section will lay out the theories surrounding these models and how they work.

2.1.1 The Efficient Market Hypothesis

The Efficient Market Hypothesis is an influential and widely used model in financial economics (Cochrane, 2014). Presented through Eugene Fama's (1970) article, it states that markets can be viewed as informationally efficient if the prices at a given moment incorporate all available public and non-public information. If, for example, there is a signal that future values will be higher, competitive investors will buy on that signal in hope of making a profit, thus bidding up the price until it reflects all the information contained in that signal (Cochrane, 2014).

Fama (1970) acknowledges that fully-available information is only theoretically possible but also argues that the market will act efficiently if a sufficient number of investors have access to enough information. As such, the hypothesis states that consistently generating alpha is impossible, but short-term periods of excess return are possible due to information asymmetries (Downey, 2022). While the Efficient Market Hypothesis is not explicitly used for analysis in this thesis, it provides a framework worth mentioning, as all the asset pricing models used originate from this theory.

2.1.2 Capital Asset Pricing Model

Fama and French (2004) presents The Capital Asset Pricing Model (CAPM) as widely used in finance, relevant since it captures the relationship between the risk of a security and its expected return. They state that at the core of the model is the notion that the higher risk an investor is willing to take, the higher the expected return should be. Berk and DeMarzo (2015) present the model with three main assumptions. First, it assumes that investors can buy and sell assets at the market price without taxes or transaction costs and borrow at the risk-free rate. Secondly, investors act rationally, only investing in effective portfolios yielding the highest expected return at a given risk level. Thirdly, investors share homogeneous expectations on a security's correlation to other securities, as well as the expected return and risk. CAPM is calculated using the following formula (Fama & French, 2004):

$$Formula\ 1\text{:}\ \ E(R_i) = rf + \beta_i[E(r_m) - rf]$$

The equation includes the risk-free rate (*rf*), which represents the return from a risk-free investment (Baldridge, 2023). It is followed by the market risk premium, which includes the expected return of the market [$E(r_m)$] minus the risk-free rate, multiplied by the beta (β) coefficient (Baldridge, 2023). Beta is a statistical measure of volatility used to describe the movements of an individual stock or portfolio compared to the market as a whole, i.e., its sensitivity to, for example, business cycles or interest rate changes (Brooks, 2015). Therefore, a higher beta translates to higher risk but also a higher expected return, and vice versa with a lower beta.

Baldridge (2023) discusses some weaknesses of the CAPM model despite its prosperity. She states that the measures used are based on estimations of historical data, making it challenging to build completely reliable measures. She exemplifies using the expected return of the market, which is speculative since it cannot be guaranteed that the market will display similar performance in the future, even if calculations are based on the historical average of a primary index. Thus, the empirical records show that using the CAPM in practice gives poor results (Fama & French, 2004). Therefore, other models have been developed as extensions to the CAPM, which will be introduced in the following sections.

2.1.3 Jensen's Alpha

Jensen's Alpha is a risk-adjusted performance measure used to see the average return of an investment compared to that which CAPM predicts. Commonly referred to as just alpha, Jensen (1968) stated that it shows the difference in return compared to the overall market. He originated from the CAPM formula, adding that an asset which systematically returns more (or less) than the market would earn alpha. In other words, alpha shows the over- or underperformance of an investment unrelated to the overall market risk. An alpha of zero indicates a portfolio return equal to that of the market portfolio. In contrast, a positive alpha indicates that the asset beats the expected market return, and a negative alpha indicates that the asset performs worse than the market (Jensen, 1968). Critics of Jensen's Alpha argue in favor of the efficient market hypothesis, saying that the excess returns come from random chance or luck since the market has already accounted for all available information in the stock price (Chen, 2020). Jensen (1968) displays the following formula to calculate alpha:

$Formula\ 2$: $a_i = r_i - [rf + \beta_i(r_m - rf)]$

Where:

a_i = portfolio alpha

r_i = realized return of the portfolio

rf = risk-free rate

β_i = portfolio beta

r_m = realized return of the market (also called Mkt in this paper)

2.1.4 Fama-French Three-factor Model

The Fama and French's (1993) Three-factor model is an extension of the CAPM model that adds two additional risk factors: size and value. In 1981, Banz published a paper suggesting that small firms had significantly larger risk-adjusted returns than large companies. Thus, he argued that the CAPM model is insufficient to measure an asset's risk-adjusted return accurately. From this, Fama and French (1993) added the variable market equity (ME). In the formula, they denote this as SMB (Small Minus Big), i.e., the return of the smallest firms minus the returns of the biggest firms in the portfolio. Furthermore, they found that the relation between a company's market value and book value had an effect on the expected return, and they, therefore, included book-to-market equity (BE/ME). Companies with a high book-to-market ratio are considered value companies as their book-value is relatively high to their market value. On the other hand, companies that have a low book-to-market ratio are considered growth stocks because of their future growth potential. They found that value stocks have a higher average return than growth companies. This is denoted as HML in the formula, which stands for high minus low. The Three-factor model is calculated using the following formula (Fama & French, 1993):

$Formula\ 3$: $r_i = rf + a_i + \beta(r_m - rf) + \beta_s SMB + \beta_v HML$

Where:

β_s = Beta for the portfolio

SMB = The difference in return between a portfolio containing small companies compared to large companies with the same average weighted value

β_v = Beta for the portfolio

HML = The difference in return between a portfolio with a high book-to-market ratio compared to one with a low book-to-market ratio

a_i = The intercept value for alpha

2.1.5 Carhart's Four-factor Model

As a further development of the Three-factor model, Mark M. Carhart (1997) developed a Four-factor model built upon the same foundation as the CAPM and the Fama-French Three-factor model but added a fourth factor, momentum (MOM). Like the Three-factor model, it posits that an asset's return is a function of four factors. The new factor, MOM, denotes the return of positive advancing firms minus the return of negative advancing firms. Carhart (1997) found this to be a determining factor of a portfolio's or security's return. More precisely, he states that going long on the top-decile mutual funds and short on the bottom-decile from last year yields a return of 8%, and market value and momentum explain 4.6% of this.

Formula for the Carhart Four-factor model is (Carhart, 1997):

$Formula\ 4$: $r_i = rf + a_i + \beta(r_m - rf) + \beta_s SMB + \beta_v HML + \beta_{mom} MOM$

Where:

β_{mom} = Beta for the portfolio

MOM = The difference in return between a portfolio containing previous year's high performing companies compared to previous year's low performing companies.

2.1.6 Fama-French Five-factor Model

The Fama-French Five-factor model does not add one factor to the previously developed Carhart model, but rather Fama and French (2015) add two new factors to their own Three-factor model. In their paper from 2015, they present empirical evidence suggesting that there were still unexplained differences in returns among securities that could not be attributed to the three factors developed earlier. The two new factors they added to the formula are profitability (RMW) and investment (CMA). Firstly, the profitability factor explains the effect of a company's operating profitability on its stock returns, as they argue that companies with higher operating profitability have a competitive advantage that yields higher returns. Secondly, the investment factor captures the effect of the level of investment on a company's return. Fama and French (2015) further argue that companies with high levels of investment experience higher returns because they generate future cash flows by investing in profitable projects. They conclude that the two additional factors are important determinants of security returns and that the model is more comprehensive when including RMW and CMA.

Formula for the Five-factor model is (French, n.d.):

$$Formula\ 5:\ r_i = rf + a_i + \beta(r_m - rf) + \beta_s SMB + \beta_v HML + \beta_r RMW + \beta_c CMA$$

Where:

β_r = Beta for the portfolio

RMW = Robust Minus Weak, is the average return on the robust operating profitability portfolios minus the average return on the weak operating profitability portfolios.

β_c = Beta for the portfolio

CMA = Conservative Minus Aggressive, is the average return on the conservative investment portfolios minus the average return on the aggressive investment portfolios.

2.2 Sustainable Investing

Since renewable energy is an important peer stock to *new sin stocks* throughout this paper, laying out the surrounding research is essential. Yue, Han, Teresiene, Merkyte, and Liu (2020) argue that sustainable investments are a relatively recent concept, entering capital markets as recently as the 21st century with large capital inflows. Regarding stock returns, early research points to SRI increasing the return on investment but with no significant difference in risk levels (Rennings, Schröder & Ziegler, 2003).

Engelhardt, Ekkenga, and Posch (2021) examined a sample of 1,452 European firms in 16 different countries. They investigated whether firms with high CSR ratings outperform firms with low CSR ratings, finding that high-ranked firms are associated with higher abnormal returns and lower volatility. Moreover, they found that these firms had better outcomes during the COVID-19 pandemic, which suggests that CSR-aligned investments are relatively stable in times of crisis. The same applies to European funds with high Morningstar Sustainability Ratings (Yue et al. 2020).

Even when expanding the scope to a more global scale, Garcia-Amate, Ramírez-Orellana, and Rojo Ramirez (2022) suggest that sustainable stocks perform well. They looked at the mean annual returns of stocks in the Dow Jones Sustainability Index, both for the world and Asia Pacific. They found that the returns are higher than conventional indexes. The same holds for the United States between 2007 and 2022, where green stocks have shown higher returns and thus proven more profitable to investors than non-green stocks (Rodionova, Skhvediani & Kudryavtseva, 2022). However, as the demand for socially responsible assets increases, so does the risk associated with these investments (Yue et al. 2020). This suggests that the volatility of these investments should increase ahead.

2.3 Research on *Sin Stocks*

2.3.1 Social Norms

When analyzing the stock market in relation to *traditional* and *new sin stocks*, previous research has shown the influence of social norms on market behavior (Akerlof, 1980; Kim & Venkatachalam, 2011; Liu, Lu, & Veenstra, 2014). Akerlof (1980) investigated the subject on the labor market in an unemployment setting. He concluded that customs with moderately low costs in terms of lost utility would persist, as disobeying the underlying norm would result in a loss of reputation. In contrast, a social code that is too costly to obey will not persist, and the norm will therefore disappear. However, even in situations of almost universally accepted norms, he stated that some people with unusual tastes would violate the social code to benefit from it monetarily. In the context of SRI, this is where investments in *sin stocks* are positioned.

When focusing on capital markets and investing, adhering to social norms means considering social context and the ethicality of investment decisions (Kim & Venkatachalam, 2011). Liu, Lu, and Veenstra (2014) analyzed the interaction effect between social norms and financial incentives and how this influences the behavior of stock market participants concerning alcohol, tobacco, and gaming. They concluded that investment decisions are largely based on how the investor's behavior is affected by the social context, meaning that these industries tend to be avoided. Notably, when both motive and opportunity exist, investors are willing to cross these social norms in pursuit of financial gain (Liu, Lu & Veenstra, 2014). In the following two sections, research surrounding investments in *sin-industries* will be discussed to see if investors can be rewarded by deviating from the social norm.

2.3.2 Performance of *Traditional Sin Stocks*

This part reviews previous research on the performance of *traditional sin stocks*. In the definition of *traditional sin stocks*, this study includes listed companies from the alcohol, tobacco, casino and gaming, and defense industries, a frequently used definition (Kim & Venkatachalam, 2011). This field of research emerged by studying the American stock market and how the performance of stocks differ depending on industry classifications over time (e.g., Colonnello, Curatola & Gioffré, 2019; Hong & Kacperczyk, 2009; Luo & Balvers, 2017; Richey, 2017). The research field states that a societal norm restricts investors from funding *sin-industries* and that they pay a financial cost for avoiding these investments (Kim & Venkatachalam, 2011). Hong and Kacperczyk (2009) found that norm-constrained institutions are less likely to hold *traditional sin stocks*, leading to less analytical coverage due to lower interest. As a result, they conclude that the expected returns of *traditional sin stocks* are higher than comparable stocks in other industries. More specifically, they stated that in the period 1965-2006, *traditional sin stocks* generated a return of 29 basis points higher than their peer stocks per month. They calculated this by holding a portfolio of *sin stocks* and shorting a portfolio of non-*sin stocks* after accounting for past returns, market-to-book-ratio, and market size.

Building from previous work, Richey (2017) conducted a similar study on US *vice stocks* (which includes *traditional sin stocks* plus payday lenders) between 1987 and 2016. Using the Fama-French Three-factor model and the Carhart Four-factor model, he found a positive and significant alpha for the period, which supports the previous findings. However, when introducing the Fama-French Five-factor model, he saw that the significance of alpha disappeared. It is therefore argued that the overperformance of vice stocks comes from the higher profitability and stricter capital budgeting in the industries, which can be predicted by a given level of risk that is included in RMW and CMA factors.

The reason why *traditional sin stocks* enjoy an excess stock return in the first place can be traced back to them being underpriced compared to similar non-*sin stocks* (Colonnello, Curatola & Gioffré, 2019; Richey, 2017). This excess return is referred to as a *sin premium*, which cannot only be attributed to the lower levels of institutionalized ownership but to a boycott risk factor coming from all socially responsible investors refusing to own *sin-companies* (Colonnello, Curatola & Gioffré, 2019; Luo & Balvers, 2017). This boycott factor highlights how the formation of investment decisions, yet also asset prices, is significantly influenced by non-monetary factors (Colonnello, Curatola & Gioffré, 2019). In addition, *traditional sin stocks* in the US are generally less sensitive to negative media coverage regarding environmental, social, and corporate governance (ESG) aspects, meaning that the *sin premium* seems to withstand strict media scrutiny (Wong & Zhang, 2022).

In summary, previous research reports that *traditional sin stocks* on the American stock market have abnormal positive returns compared to *non-sin stocks*, but this premium disappears when the Five-factor model is used (e.g., Colonnello, Curatola & Gioffré, 2019;

Fabozzi, Ma, & Oliphant 2008; Hong & Kacperczyk 2009; Luo & Balvers, 2017; Richey, 2017; Statman & Glushkov 2009). The reason behind the *sin premium*, however, is debated, with suggestions being, for example, low levels of institutional ownership (Hong & Kacperczyk, 2009) or the boycott factor from all socially responsible investors (Luo & Balvers, 2017).

2.3.3 Defining *New Sin Stocks*

Several scholars have claimed that as the political, economic, and social climate develops, new industries should be added to expand the composition of *sin stocks* (Blitz & Fabozzi, 2017; Richey, 2017). Recently, several initiatives have been launched by the United Nations (UN) to combat climate change, where the Paris Agreement is one of the most prominent (UNFCCC, n.d.b). In the Paris Agreement, article 2, it is stated that the signatories to the agreement should increase their ability to adapt to the impacts of climate change and work towards lower greenhouse gas emissions. Moreover, article 4 states that "[p]arties aim to reach global peaking of greenhouse gas emissions as soon as possible … and to undertake rapid reductions thereafter in accordance with best available science" (UNFCCC, n.d.b, p. 4). Therefore, firms that engage in industries relating to high carbon emissions can be counted as next to *traditional sin stocks* (Blitz & Swinkels, 2020).

In their taxonomy of current research within climate finance, Hong, Karolyi, and Scheinkman (2020) also suggest that energy companies have become the *new sin stocks*, facing critique or even lawsuits based on their improper environmental disclosure and impact on climate change. Also, they state that the energy sector faces what the tobacco industry went through a generation ago, i.e., institutions screening out investments with high carbon impact. Building from this, Bolton & Kacperczyk (2021) empirically studied the relationship between stock performance and carbon emissions. They found that, much like in research on *traditional sin stocks*, institutional investors tend to avoid investing in corporations with high carbon emissions, allowing a carbon premium reflecting a lower investor demand for the stocks. They argue that this also holds even though the US under Trump's administration exited the Paris Agreement, as major global obstacles are expected when it comes to carbon emissions, affecting even American companies. In addition, the US entered the Paris Agreement again under Biden's administration (Agliardi, Alexopoulos, & Karvelas, 2023). However, it should be stated that Bolton and Kacperczyk (2021) study companies in many industries, ranging from manufacturing to services, and distinguish between them based on emission levels. As such, it lacks the perspective of the industry in itself being ‘sinful’ rather than just drawing conclusions on unethical emission levels.

Recent research by Agliardi, Alexopoulos, and Karvelas (2023) found similar findings, namely that low-rated environmental companies earn, on average, greater returns than high-rated environmental companies. In addition, they concluded that investing in companies with high environmental ratings means a lower risk, which in turn leads to lower returns. Just as with Bolton and Kacperczyk (2021), the authors of this thesis argue that looking at environmental ratings lacks the perspective of *sin-industries*, as any type of company can score low in these ratings. This type of distinction is not enough to answer the research question of this study.

However, Tronslien Sagbakken and Zhang (2022) have developed a new set of *sin stocks* and measured their stock performance in the European market between 2006-2020. They claim that their study makes the first attempt to update the definition of *sin stocks*, and this is the first time anyone has explicitly investigated this area. Therefore, their study, together with the previously mentioned research on *traditional sin stocks*, will lay the foundation for this paper. In their research, Tronslien Sagbakken and Zhang (2022) extend the previously discussed scope that carbon emissions are viewed as *sin* to focus on the corporations extracting oil and coal, the producers of oil- and gas-related equipment as well as companies in the rock and metal mining sector. They discuss that while greenhouse gas emissions contribute to global warming, the mining sector exhibits harsh working conditions from a social context, and mining erodes and damages local ecosystems. As such, following the principles of SRI, they should be included in the *new sin* definition.

Because *new sin stocks* were starting to be regarded as such quite recently, Tronslien Sagbakken and Zhang (2022) measured data beginning in 2006, when the United Nations Principles for Responsible Investment (UNPRI) were introduced. In addition, they distinguish between the period before and after the Paris Agreement. They found no significant alpha before the Paris Agreement but a moderately significant alpha in the period after, i.e. 2016-2020, even when using the Fama-French Five-factor model. Therefore, they suggest that market perceptions are beginning to change and include the *sin-character* of *new sin stocks*, but more time needs to pass before accurate conclusions can be drawn. Furthermore, they tested a portfolio of traditional European *sin stocks,* finding the same results as Richey

(2017) did on American vice stocks, i.e., when using the Five-factor model, there is no significant *sin premium*.

Based on the research of Tronslien Sagbakken and Zhang (2022), this thesis positions itself as the first to analyze *new sin stocks* on the American stock market. The authors of this thesis have researched extensively to find any previous research on the topic, but nothing was found. Tronslien Sagbakken and Zhang (2022) also claimed that there is no other research; as such, it is fair to say that this field is new in the American setting. As mentioned, previous research has looked at American carbon stocks or the carbon emissions of stocks in general. However, this thesis introduces the concept of *new sin stocks* to an American setting.

2.4 Hypotheses Development

As the research question aims to determine the difference in return between the portfolios, the first step is to test whether there is a difference. Therefore, two overarching hypotheses for the study were formulated:

- H_1: *There is a difference in return between traditional sin stocks, new sin stocks and their peer stocks.*
- H_0: *There is no difference in return between traditional sin stocks, new sin stocks and their peer stocks.*

In order to answer the second aspect of the research question, namely, what the difference in return is, under-hypotheses were formed. When comparing the factor models, it can be seen how adding new factors affects the results and, thus, from where the difference in return comes. Regarding *traditional sin stocks*, previous research has identified a pattern in how the stocks behaved to comparable, *non-sin industries*. Hong and Kacperczyk (2009), Richey (2017), and Tronslien Sagbakken and Zhang (2022), among others, have unitedly argued that portfolios of *traditional sin stocks* perform significantly better than non-*sin stocks*. However, as the asset pricing model has been extended, such as introducing additional factors in the Five-factor model, more aspects of the regressions have been explained by the independent variables CMA and RBW; thus, alpha disappears (Richey, 2017; Tronslien Sagbakken & Zhang, 2022). Given this evidence from previous studies, the following three hypotheses were formulated regarding *traditional sin stocks*:

- *Hypothesis 1: There is a significant risk-adjusted return for traditional sin stocks when using the Fama-French Three-factor model.*
- *Hypothesis 2: There is a significant risk-adjusted return for traditional sin stocks when using Carhart's Four-factor model.*
- *Hypothesis 3: There is a significant risk-adjusted return for traditional sin stocks when using the Fama-French Five-factor model.*

When it comes to the area of *new sin stocks*, it is a scarcely researched area; thus, this study aims to fill the research gap by testing the performance of *new sin stocks* on the American stock market. Previous research points to the fact that the coal, oil, and mining industries are beginning to classify as *new sin stocks* (Bolton & Kacperczyk, 2021; Hong, Karolyi & Scheinkman, 2020; Tronslien Sagbakken & Zhang, 2022). Also, Tronslien Sagbakken and Zhang (2022) have laid the foundation for *new sin stocks* as a research area, concluding that there was no significant alpha for these industries before the Paris Agreement in 2016. From 2016, there is a moderately significant alpha, however, it was too early to state with certainty due to the industry not being fully developed as *sin* (Tronslien Sagbakken & Zhang, 2022). The hypotheses for *new sin stocks* are divided between before and after the Paris Agreement. Based on the argumentation of Bolton and Kacperczyk (2021), it is anticipated that the US views *new sin-industries* similarly to Europe, despite exiting the Paris Agreement, and the following hypotheses are formed:

- *Hypothesis 4: For the period 2006-2015, there is a significant risk-adjusted return for new sin stocks, when using the Fama-French Three-factor model.*
- *Hypothesis 5: For the period 2006-2015, there is a significant risk-adjusted return for new sin stocks, when using Carhart's Four-factor model.*
- *Hypothesis 6: For the period 2006-2015, there is a significant risk-adjusted return for new sin stocks, when using the Fama-French Five-factor model.*

- *Hypothesis 7: For the period 2016-2022, there is a significant risk-adjusted return for new sin stocks, when using the Fama-French Three-factor model.*
- *Hypothesis 8: For the period 2016-2022, there is a significant risk-adjusted return for new sin stocks, when using Carhart's Four-factor model.*

- *Hypothesis 9: For the period 2016-2022, there is a significant risk-adjusted return for new sin stocks, when using the Fama-French Five-factor model.*

2.5 Chapter Summary

In this chapter, the hypotheses were developed based on a theoretical review of financial models and previous research in the fields of sustainable investing and *sin stocks*. To summarize, social norms affect investment decisions in several ways. As a first example, research states that there have been large capital inflows in sustainable investing, leading to these stocks performing well. As a second example, researchers claim that *traditional sin stocks* perform better than their peers and that institutional investors avoid investing in these industries due to contrasting social norms. As a final example, research on European *new sin stocks* found no strongly significant alpha but a tendency that a *sin premium* may emerge in the future as social norms are developing in favor of environmentally-friendly investments (Tronslien Sagbakken & Zhang, 2022). Also, the results of previous research differ depending on the asset pricing model used. Thus the hypotheses were formed around three of them to capture these differences.

3 Methodology

This chapter starts by describing the research approach and design. Then, the data collection method is described in detail before discussing the validity and reliability of the study. Thirdly, the data analysis process is presented, and lastly, the limitations of the methodology.

3.1 Research Approach

This thesis adopts a deductive research approach, defining hypotheses based on established theories and empirical research (Bell, Bryman & Harley, 2019). The current state of research surrounding *traditional* and *new sin stocks*, as well as financial models, was collected to answer the research question. Based on the findings of *traditional sin stocks* on the American stock market, and findings on *new sin stocks* on the European stock market, hypotheses were formed. This approach was chosen since the research topic is not new. Instead, this research paper contributes with insights based on a new sample, time period, and region to complement already established research.

Moreover, as the objective is to study the stock performance of several portfolios of stocks, a quantitative approach was adopted. This entails that the conclusions of this research paper are based on statistical tests of time-series regressions of portfolios, including *traditional sin stocks*, *new sin stocks*, and their respective peer stocks. The research approach is also similar to that of previous research, which is beneficial for making findings comparable.

3.2 Research Design

This research paper focuses on comparing portfolios of stocks based on their total shareholder return and discusses the differences. Total shareholder return means the total capital gains plus the dividends for the specific period (Ganti, 2021). Portfolios were built based on industry classifications, focusing on whether the industry is seen as a *traditional sin-industry*, a *new sin-industry*, or a peer-industry for comparisons. As such, this research paper adopts a comparative research design, as is common in this field of research (e.g., Hong & Kacperczyk, 2009; Richey, 2017; Tronslien Sagbakken & Zhang, 2022). In addition, it is required to be comparative to answer the research question.

At the core of the research design is running time-series regressions using the Fama-French Three-factor model, the Carhart Four-factor model, and the Fama-French Five-factor model. In these regressions, the dependent variable is always the return of the portfolio of interest minus the risk-free rate. The independent variables vary depending on how many factors are used but include pre-calculated data from the American stock market. The data collection method, the construction of portfolios, and more detailed information on the variables used will follow later in this methodology section.

3.3 Data Collection Method

3.3.1 Kenneth R. French's Data Library

Conveniently, Kenneth R. French supplies a data library of value-weighted portfolios of 49 industries, from which most of the data used in this research paper was extracted (French, n.d). It is a frequently used source of data in previous research on *sin stocks*, thus it is suitable to use for this research paper as well (e.g., Hong & Kacperczyk, 2009; Richey, 2017; Tronslien Sagbakken, 2021; Tronslien Sagbakken & Zhang, 2022). French's database is credible from several perspectives. First of all, it provides necessary data for performing the Three-, Four- and, Five-factor models, as French is one of the co-creators of these financial models. The authors considered calculating the variables from scratch, but it was decided to download the data from French's database. The decision was based on the fact that French's data provides higher reliability due to his credibility as a financial modeler and his experience in the field. Secondly, value-weighted portfolios based on *sin* and *non-sin industries* are also needed to answer the research question. Since the variables needed in all the factor models are pre-calculated by French, it also makes sense to base portfolio data from the same source to allow for coherency.

To summarize, the independent factor variables SMB, HML, MOM, RMW, and CMA were pre-calculated and downloaded from French (n.d.). Also, industry data for all industries used in this research paper (except the casino, renewable energy, and forest and wood products industries) were taken from French's (n.d.) data library. The portfolios created by French (n.d.) are based on the American stock market, more precisely, NASDAQ, NYSE, and AMEX. The industries are classified by Standard Industry Classification (SIC) codes.

3.3.2 Portfolios and Screening

In order to test the research question and to determine the differences and similarities between *traditional* and *new sin stocks* and their peers, portfolios containing stocks from these categories were created. The four portfolios are Traditional Sin, Traditional Sin Peers, New Sin, and New Sin Peers. Each of the four main portfolios consists of several sub-portfolios, more specifically industry portfolios. The first step to creating the main portfolios was to determine what categories of stocks (industries) to include based on the given market, the American stock market. The choice of *new* and *traditional sin-industries* was based on previous research made on *traditional sin stocks* on the American stock market and *new sin stocks* on the European stock market (Hong & Kacperczyk 2009; Tronslien Sagbakken & Zhang, 2022). Table 3.1 below displays which industry sub-portfolios (and their respective SIC codes) were included in the four main portfolios. The industries where data is non-applicable have no SIC definition. Instead, these were created from scratch, as described later in this section.

Table 3.1 List of Industries in Each Portfolio

Traditional Sin		**Traditional Sin Peers**	
Industry	SIC Code	Industry	SIC Code
Beer and Liquor	2080, 2082-2085	Candy and Soda	2064-2068, 2086-2087, 2096-2097
Tobacco Products	2100-2199	Food Products	2000-2046, 2050-2063, 2070-2079, 2090-2092, 2095, 2098-2099
Defence	3760-3769, 3795, 3480-3489	Electrical Equipment	3600, 3610-3613, 3620-3621, 3623-3629, 3640-3646, 3648-3649, 3660, 3690-3692, 3699
		Machinery	3510-3536, 3538, 3540-3569, 3580-3582, 3585-3586, 3589-3599
Casinos and Gaming	N/A	Entertainment	800-7829, 7830-7833, 7840-7841, 7900, 7910-7911, 7920-7933, 7940-7949, 7980, 7990-7999
New Sin		**New Sin Peers**	
Industry	SIC Code	Industry	SIC Code
Mines	1000-1039, 1050-1099, 1100-1119, 1400-1499	Renewable Energy	N/A
Coal	1200-1299	Forrest and Wood Products	N/A
Oil	1300, 1310-1339, 1370-1382, 1389, 2900-2912, 2990-2999		

For the Traditional Sin portfolio, data from the Beer and Liquor, Tobacco Products, and Defence industries were retrieved from Kenneth R. French's data library (n.d.). However, as previous researchers have also noted, there is no SIC code definition for casinos and gaming and, thus, no industry portfolio in French's data library (Hong & Kacperczyk, 2009). In order to complete the Traditional Sin portfolio, a Casino and Gaming industry portfolio was created from scratch using the Bloomberg Industry Classification Standard (BICS). This screening method was chosen since Bloomberg is a well-respected financial data provider, accessible through the Bloomberg Terminal in the Finance Lab at Lund University School of Economics and Management. The screening filters applied for casinos and gaming were:

- Trading status: Active, exported individually for each year
- Security attributes: Show Primary Security of Company only
- Exchanges: Nasdaq, NYSE, and AMEX
- Sectors: Casinos and Gaming
- Primarily traded in the US, companies with a secondary listing were removed

The screened companies were then exported to Microsoft Excel for each year in order to use the FactSet add-in function in Excel to get the monthly return data for each company and their respective monthly market capitalization. Monthly data was collected to create an industry portfolio compatible with the industry portfolios retrieved from French's (n.d.) data library, as those are based on monthly return data and value-weighted for each month. After creating the casinos and gaming industry portfolio, it was added to the Traditional Sin portfolio.

To compare the results from the Traditional Sin portfolio, the Traditional Sin Peers portfolio was created composed of industries that are seen as similar to the traditional *sin-industries*. This allows for a clearer indication of the effect of sin. Previous research has highlighted specific industries comparable with each *traditional sin-industry*. These are; industrial machinery and equipment, heavy machinery and vehicles, and electrical components and equipment for defense; non-alcoholic beverages for liquor; leisure and recreation and hotels, motels, and cruise lines for casinos and gaming; and food processing for tobacco production (Hong & Kacperczyk 2009; Tronslien Sagbakken & Zhang, 2022). Based on these industries, this paper uses data retrieved from French's database (n.d.). The SIC-industries used are displayed in Table 3.1 above.

In previous research on the European stock market, coal, oil and gas, oil and gas-related equipment and services, metals and mining, rock mining, and uranium were used as the industries composing the *new sin stocks* portfolio (Tronslien Sagbakken & Zhang, 2022). For this paper to accurately replicate previous research, the mines, coal, and oil industries were used to compose the *new sin stocks* portfolio. These industries all have SIC definitions and a value-weighted industry portfolio with monthly return data created by French (n.d). Although not perfectly representing the industries researched by Tronslien Sagbakken and Zhang (2022), the SIC definitions were chosen as they cover the same areas while also coming with all the benefits of French's (n.d.) data library mentioned earlier.

In line with the same reasoning as above, previous research uses the renewable energy, and forest and wood products industries as peer stocks for the *new sin stocks* (Tronslien Sagbakken & Zhang, 2022). Since no SIC-industries resembled these industries, the BICS was again used to screen companies to create industry portfolios from scratch. Two different screeners were applied to match Tronslien Sagbakken and Zhang's (2022) renewable energy, and forest and wood products. Afterward, the same process for obtaining data as with the casinos and gaming industry, i.e., through Microsoft Excel and FactSet, was applied. For renewable energy, the screening criteria were:

- Trading status: Active, exported individually for each year
- Security attributes: Show Primary Security of Company only
- Exchanges: Nasdaq, NYSE, and AMEX
- Sectors: Renewable Energy
- Primarily traded in the US, companies with a secondary listing were removed

For forest and wood products, the screening criteria were:

- Trading status: Active, exported individually for each year
- Security attributes: Show Primary Security of Company only
- Exchanges: Nasdaq, NYSE, and AMEX
- Sectors: Forestry & Logging, Paper & Pulp Mills, Wood Products Manufacturing
- Primarily traded in the US, companies with a secondary listing were removed

In addition, the New Sin portfolio was divided in two periods, one between 2006 and 2015 and one from 2016 to 2022. This makes the study comparable to Tronslien Sagbakken and

Zhang’s (2022) European study. They made this distinction since the Paris Agreement was signed in 2015, and it is interesting to study the differences due to the importance of the agreement.

3.3.3 Selection and Exclusion

Table 3.2 on the next page summarizes the number of companies included in each industry. The portfolios hold a sufficient number of stocks to assume a well-enough diversified portfolio. First of all, this can be assumed since most of the portfolios have been pre-calculated by French (n.d.). Secondly, a study by Statman (1987) concluded that around 30 stocks on a total portfolio basis are enough to be well-diversified. As such, the selection of stocks should be more than enough. Although the New Sin Peers portfolio only included 28 stocks in 2006, it is deemed close enough to 30 not to be excluded from this study (Statman, 1987). All the other portfolios hold a number of stocks above 30.

Moreover, the Renewable Energy, Forest and Wood Products, and Casino and Gaming portfolios were manually screened and created as described in section 3.3.2. This also entailed that stocks were excluded on a yearly basis if return data was missing.

Table 3.2 Number of Stocks Included in Each Portfolio

	New Sin			New Sin Peers	
# Included New Sin Companies	**Mines**	**Coal**	**Oil**	**Renewable Energy**	**Forrest and Wood Products**
2006	10	10	151	24	4
2007	15	12	160	33	3
2008	21	13	162	32	4
2009	21	12	156	34	4
2010	21	14	151	43	11
2011	20	12	146	47	12
2012	21	11	144	45	12
2013	19	10	140	43	13
2014	19	9	150	43	12
2015	18	7	140	44	12
2016	17	5	122	42	12
2017	18	8	129	44	12
2018	17	8	128	39	11
2019	18	9	120	38	11
2020	16	9	102	41	11
2021	17	9	101	50	10
2022	16	9	96	53	9

	Traditional Sin				Traditional Sin Peers				
# Included Traditional Companies	**Casino & Gaming**	**Beer and Liquor**	**Tobacco Products**	**Defence**	**Food Products**	**Candy and Soda**	**Entertainment**	**Machinery**	**Electrical Equipment**
2006	25	12	5	10	60	8	59	122	70
2007	25	11	5	9	58	8	54	118	69
2008	25	9	7	10	59	11	56	111	72
2009	24	9	6	10	58	11	49	107	67
2010	27	9	6	9	61	10	45	107	71
2011	26	9	6	9	55	11	42	103	58
2012	26	10	5	9	54	10	42	106	53
2013	25	11	5	9	51	9	43	102	50
2014	23	10	5	9	49	10	45	103	52
2015	23	10	4	9	46	10	46	97	55
2016	25	10	4	9	44	9	43	95	49
2017	24	11	3	8	42	11	42	92	49
2018	22	11	3	7	41	9	45	94	48
2019	20	10	3	7	41	8	37	93	41
2020	24	8	3	7	43	8	39	91	40
2021	30	9	3	8	48	7	43	93	45
2022	31	12	3	13	50	10	46	95	51

Table 3.3 below summarizes the number of companies that were excluded each year. For the industries pre-calculated by French (n.d.), there is no information available regarding the number of excluded stocks.

Table 3.3 Number of Manually Excluded Stocks from Screened Portfolios

# Excluded Companies	Renewable Energy	Forrest and Wood Products	Casino and Gaming
2006	5	0	2
2007	3	1	1
2008	3	0	2
2009	1	0	2
2010	5	2	0
2011	2	1	0
2012	2	1	0
2013	2	0	0
2014	2	0	0
2015	2	0	0
2016	2	1	0
2017	0	0	0
2018	2	0	1
2019	2	0	4
2021	4	1	2
2022	1	0	0

3.3.4 Weighting of Portfolios

The separate industry portfolios were weighted based on their market capitalization. In a market capitalization-weighted index, a company is represented based on its size so that stock returns are proportional. According to FTSE Russell (n.d.), this weighting method is the most commonly used today, and even though other methods exist, this approach remains relevant. This method provides a more fair overview of the performance of the portfolio compared to utilizing an equally-weighted industry portfolio. Plyakha, Uppal, and Vilkov (2012) support this argument by stating that equally-weighted portfolios based on market capitalization imply skewed results. The latter results from smaller companies being given greater weight in the portfolio, which could be misleading since smaller companies with higher risk premiums will have a disproportionately high percentage of the portfolio.

Formula for weighting:

$$\textit{Formula 6:}\quad Weight_{\,Stock\ A} = \frac{Market\ Value\ Stock\ A}{Market\ Value\ of\ the\ Portfolio}$$

Due to French's (n.d.) pre-constructed industry portfolios providing monthly returns, the newly created portfolios (Casinos and Gaming, Renewable Energy, and Forest and Wood Products) were built on the same basis, making them comparable. Hence, the companies' returns have been used to create monthly matrices for each separate industry portfolio.

Formula for monthly portfolio return:

$$Formula\ 7:\ R_P = X^T * R$$

R_P = Total return of the portfolio, X^T = Transposed weight, R = The stock's total return

Alternative formula for calculating the monthly portfolio return:

$$Formula\ 8:\ R(P) = X_a * R_a + X_b * R_b + \ldots + X_n * R_n$$

R_P = Total return of the portfolio, X = Weight, R = The Stock's total return

The formula for monthly returns for each separate company can be calculated more efficiently using the alternative formula. Using the matrix algebra formula "MMULT" in Microsoft Excel, the total weighted return for the portfolios was calculated efficiently.

Based on the 14 industry sub-portfolios, the four main portfolios were constructed. Since the industry portfolios were already value-weighted, the construction of the main portfolios was equally weighted between the number of industry portfolios. This was done based on the reasoning that each industry should be directly comparable to its peer industry, e.g., Beer and Liquor, compared to Candy and Soda, and the effects of weighing based on size were already included in the industry portfolios. Also, the authors chose to weigh them equally to mimic an investment in the portfolio split evenly between the different industries.

3.3.5 Time Period

The time period for the analysis is from 2006 to 2022. The reasoning for the start date of 2006-01-01 was based on the information stated in section 2.3.3 regarding the UNPRI (n.d.), the Paris Agreement, and the evolution of *new sin* being a recent concept. In addition, Tronslien Sagbakken and Zhang (2022) also use 2006 as the start year. Furthermore, as mentioned, the New Sin portfolio will be divided into two periods, 2006-2015 and 2016-2022. In this way, the difference between pre- and post-Paris Agreement can be analyzed, as Tronslien Sagbakken and Zhang (2022) did with European *new sin stocks*. Additionally, the end date of 2022-12-31 was chosen in order to be as up-to-date as possible on a full-year basis, and also due to the years 2021 and 2022 not being included in any previous research within the subject (Hong & Kacperczyk 2009; Tronslien Sagbakken & Zhang, 2022). By extending the sample period by two years, this research paper will contribute to developing the field of research by drawing conclusions from new data.

3.3.6 Data Collection Process

The primary tool for collecting the data, based on the given companies in the portfolios and the fixed time period, was the financial data and software tool FactSet through the add-in function in Microsoft Excel. Since the analysis performed in this paper has a global perspective and requires a large amount of data, the requirements were high in the data collection process. FactSet was used due to its ability to provide reliable data in large amounts in an efficient way (Corporate Finance Institute, 2023). The first data point collected from FactSet was each stock's total monthly return. To collect the total return, the "Total Return - Compound" function was used in FactSet:

P_TOTAL_RETURNC: "Returns the compound total return, with dividends reinvested by default on the exdate, for dates requested." (FactSet Research Systems, n.d)

The Total Return - Compound was chosen due to its ability to adjust for dividends, which is vital for making the portfolios comparable. It adjusts for the companies that decide to keep the money in the company, to the ones with negative capital outflow in the form of dividends (FactSet Research Systems, n.d). The monthly data was withdrawn from FactSet by using the add-in formula builder in Microsoft Excel. The formula used collects the closing price from the last day of the previous months, and the closing price of the month of interest. The exact formula used was:

(FDS("company ticker","P_TOTAL_RETURNC("last day of previous month","last day in the month of interest",,USD)"))

The second specific data point collected was the Market Value of each company. The market capitalization is needed to weigh the portfolios based on the size of all firms. FactSet defines the Market Value as:

FREP_MARKET_VALUE_COMPANY: "Returns the total public market value of the company's listed equity. This aggregates across all shares classes, with options for currency and handling of non traded shares. Prices are latest available, and by default adjusted to the trading currency of the security being evaluated. The NOW date argument is not supported by this code in Screening. By default, non-traded shares are added to the calculation bases by the proportion of their nominal or par value" (FactSet Research Systems, n.d).

The market capitalization was calculated based on the last trading day of tha month. The following formula was used in Excel to extract the data from FactSet:

(FDS(DJ$3,"FREF_MARKET_VALUE_COMPANY("last day of the month of interest",,USD,,0,,""LEGACY"")")

3.4 Validity and Reliability

Validity refers to whether the research measures what it is supposed to measure (Bell, Bryman & Harley, 2019). For this research paper, validity is important to discuss as the *sin premium* is difficult to isolate by using alpha. In this paper, it is isolated using the factor models, which are well-renowned in this field of research and credible measures (e.g., Colonnello, Curatola & Gioffré, 2019; Fabozzi, Ma, & Oliphant, 2008; Hong & Kacperczyk 2009; Luo & Balvers, 2017; Richey, 2017; Statman & Glushkov 2009; Tronslien Sagbakken & Zhang, 2022). Theoretically, results that indicate significant alpha could stem from another reason than the *sin-character* of the stocks. However, all the factor models were created to capture common reasons for excess return so that the only aspect left in alpha would reflect what the stocks all have in common. When building the portfolios, the common denominator between the stocks is the belongingness to *sin-industries*. Thus, when running the time-series regressions, the portion of their return not attributed to any other factor should stem from the *sin-factor* captured in alpha. As such, the validity of the results should be high.

Reliability refers to the consistency of a measure, i.e., if replicating the same study under the same conditions will provide the same results (Bell, Bryman & Harley, 2019). For this research paper, reliability has strengthened with the use of public stock return data, which should be the same for all studies within the same time period and markets. Also, the authors of this thesis argue that this type of data is more reliable than, for example, surveying, where results would heavily rely on the answers of the specific sample. In addition, the data were screened and retrieved using the Bloomberg Terminal, FactSet, and Microsoft Excel, which are all reliable programs customary to use in finance (WallStreetPrep, n.d.). Thus, the data collection process for this research paper has limited bias and consists of fully transparent information.

Moreover, when discussing the consistency of a measure, it is essential to discuss how exactly the chosen method is in measuring the return of *sin stocks*. The chosen method relies on time-series regressions and testing of regression assumptions. However, one could have performed numerous statistical tests and done more extensive testing on the reliability of the measure or used another financial model. For example, if the CAPM was used, alpha would likely be higher as there are not as many explanatory factors. As such, the replicability of the results may also depend on which measures are used.

3.5 Data Analysis

3.5.1 Dependent and Independent Variable

For each portfolio, the dependent variable is defined as the excess return for the portfolio. The return for each respective portfolio is subtracted with the risk-free rate to get the excess return *(r - rf)*.

The independent variables in the study vary between the different models and are all pre-calculated by French (n.d.). For the Fama-French Three-factor model, the first variable is the market return subtracted with the risk-free rate (MKT-rf), which represents the specific risk for the market. The second variable in the Three-factor model is SML, which explains returns attributable to the portfolio composition between large and small companies. The third variable is HML, accounting for returns associated with the correlation between high- and low-valued companies.

Regarding the Carhart Four Factor Model, the three first independent variables are the same as for the Three-factor model. The Carhart Four-factor model adds a fourth factor: Momentum (MOM). This factor seeks to explain returns assignable to the differences between the returns of the companies in the portfolio with recent high performance and those with recent low performance.

The Fama-French Five-factor model builds upon the Three-factor model by adding two additional factors. Firstly, Robust Minus Weak (RMW) quantifies the difference between companies with high operating profitability and those with low operating profitability. Secondly, Conservative Minus Aggressive (CMA) measures the difference in return between companies with low and those with high investments.

3.5.2 Risk-Free Rate

The risk-free rate is a theoretical rate of return based on the notion of yielding a certain return without the investor taking any risk (Hayes, 2022). Thus, an investor expects a minimum return of the risk-free rate as it is an investment that theoretically has no risk. Investments in portfolios like the ones created for this paper pose a risk to investors, and they, therefore, expect higher returns (Hayes, 2022). Furthermore, a return on investment above the risk-free rate is considered a risk-premium, a premium the investor receives for bearing the additional risk (Binsbergen, Diamond & Grotteria, 2021). The risk-free rate used for the calculations in this paper is the one-month treasury bill rate from Ibbotson Associates because it is the risk-free rate used by French (n.d.). The reason for choosing this risk-free rate is intuitive, as this paper uses a number of portfolios from the data library.

3.5.3 Intercept

In this paper, Jensen's Alpha is used as the regression intercept, which can be seen by the adapted Three-, Four- and Five-factor models above. A significant alpha is to be viewed in the regression as an excess return on the portfolio that cannot be attributed to any of the factors in the models (Jensen, 1968). Thus, it can be seen as the risk-adjusted return of the portfolios. The intercept displays Jenen's Alpha because the original factor formulas have been rewritten, so the risk-free rate is subtracted from the left side of the equation. These changes have been made as it is convenient to make the intercept value created by the regression analysis only to display alpha. If not rewritten, the risk-free rate is also included in the intercept, making the results more difficult to interpret.

3.5.4 The Coefficient of Multiple Determination

As mentioned in previous sections, a time-series regression model was applied to answer the research question. In such a model, the coefficient of multiple determination is r^2. According to Berenson, Levine, Szabat & Stephan (2020), it shows the proportion of variance in the dependent variable that can be explained by the variance in the independent variables. In line with their writing, a more appropriate measure to use is the adjusted r^2, as this paper uses three different models, and separate regressions were made on each one. This is because a model that has more independent variables, like the Four- and Five-factor models compared to the Three-factor model, will always have the same or higher r^2, according to them. In order to take this into account, the adjusted r^2 was deemed a more appropriate measure as it provides a more appropriate interpretation when comparing the models.

3.5.5 Time-series Regressions and OLS

This research paper compares the results of 18 time-series regressions. More specifically, an ordinary least squares (OLS) was made as it is a widely used method for regression analyses with the aim to fit a line to the observed data by minimizing the sum of the squared differences between the observed and predicted values (Berenson et al. 2020). For all the portfolios, three regressions each were run using the Three-, Four- and Five-factor models as independent variables. In addition, the New Sin portfolio was divided into two periods, before and after the Paris Agreement. That means that six extra regressions were run for the New Sin portfolio. All regressions were run using the Analysis ToolPak add-in to Microsoft Excel.

To be able to calculate Jensen's Alpha (1968) as the intercepts, the original formulas for the factor models were modified as depicted by the formulas below. This decision was based on previous research (e.g., Blitz & Fabozzi, 2017; Hong & Kacperczyk, 2009; Tronslien Sagbakken, 2021). Below are the exact formulas depicting how the variables were entered as dependent and independent when running time-series regressions in Microsoft Excel.

Adjusted formula for the Three-factor model (French, n.d.):

$Formula\,9$: $r_i - rf = a_i + \beta(r_m - rf) + \beta_s SMB + \beta_v HML$

Adjusted formula for the Carhart Four-factor model (French, n.d.):

$$Formula\ 10:\ r_i - rf = a_i + \beta(r_m - rf) + \beta_s SMB + \beta_v HML + \beta_{mom} MOM$$

Adjusted formula for the Five-factor model is (French, n.d.):

$$Formula\ 11:\ r_i - rf = a_i + \beta(r_m - rf) + \beta_s SMB + \beta_v HML + \beta_r RMW + \beta_c CMA$$

3.5.6 Statistical Tests

In this section, the statistical tests made in order to determine the validity of the regression are laid out. First of all, for all 18 regressions, F-tests were performed to see if there was a significant relationship between the dependent variable and the entire set of independent variables (Berenson et al., 2020). For all 18 regressions, the *F*STAT was greater than the *F* critical value, indicating a significant relationship between the dependent variable and the set of independent variables.

In order to test the hypotheses mentioned in previous sections with a regression, a significance test was utilized. What is being tested is whether the regression, specifically the coefficients, is statistically significant (Brooks, 2015). The significance levels used were 0.1, 0.05, and 0.001. The coefficients were viewed as statistically significant if the P-values were smaller than the significance level.

Moreover, when performing regressions, the four assumptions are assumed: Linearity, Independence of errors, Normality of error, and Equal Variance (LINE) (Brooks, 2015). As a regression is a linear model, the assumption of linearity assumes that the relationship between variables is linear (Brooks, 2015). In order to evaluate linearity, the residuals were plotted on the Y-axis, and the corresponding predicted values from the model were plotted on the X-axis. If a pattern can be derived when plotting the values, there is a relationship between the X-values and residuals. Thus if a linear model is appropriate for the data, there will be no apparent pattern (Brooks, 2015).

The independence assumption was also evaluated by plotting the residuals and the corresponding predicted values to see if a residual was related to the residual that preceded it (Brooks, 2015). If there is a relationship as the one explained, the plot tends to show a cyclical pattern and alternative approaches must be considered.

The normality of errors is another assumption for the regression model, which was evaluated to validate the results. The assumption was evaluated by creating a histogram of the residuals for each regression model (Brooks, 2015).

The last assumption, equal variance, was evaluated by plotting predicted values on the horizontal axis and residuals on the vertical axis. If the plotted graph shows patterns, like a fan-shape starting small and then expanding, it means that residual increases as X increases, and alternative approaches must be considered (Brooks, 2015).

3.6 Limitations

One limitation of this study concerns the construction of portfolios. As mentioned before, most industry data was collected from French's (n.d.) database, together with the variables needed for the factor models. However, there were no pre-constructed portfolios for casinos and gaming, renewable energy, or forest and wood products. Therefore, the authors of this thesis had to construct these portfolios from scratch, which also included defining industry classifications outside of the SIC framework. The data collection method of screening via the Bloomberg Terminal and collecting stock performance data via FactSet was not used by previous researchers, which might limit the comparability. However, the data has been thoroughly treated, double-checking all the formulas in Microsoft Excel and cross-checking the results by manually checking the stock returns. In addition, the BICS classifications of industries were chosen to mimic the definitions in previous research as closely as possible. By taking these precautions, the risk of inaccurate data has arguably been reduced to the greatest extent possible.

A second potential limitation is the definition of *traditional* and *new sin-industries*. This thesis has based the definitions on previous research, however, it is not certain that these capture all industries of *sin*. In some situations, it can even be arbitrary to which category an industry belongs. For example, forest and wood products are regarded as a peer stock to *new sin-industries*, even though it could be argued that they contribute to deforestation and should thus be of *sin-character*. Therefore, it is important to think critically about the accuracy of industry classifications and the fact that *sin* is difficult to define. For the sake of this thesis, previous literature was carefully analyzed to summarize the definitions presented in the introduction and theory chapter. The same definitions were used to allow for comparability and consistency in the research field.

A third limitation is the accuracy and number of statistical tests performed to validate the results of the study. More specifically, how the assumptions were evaluated could be further developed. The authors chose to evaluate the assumptions of the regressions by plotting values and making histograms to look for unwanted patterns. What could have been done additionally is performing econometrics tests such as the Durbin-Watson test for autocorrelation to be extra sure the assumptions were fulfilled. However, it would most likely show the same result as plotting values is an established method for evaluating assumptions. Therefore, the tests made are deemed enough for validating the statistical assumptions, and adding more tests would only give a marginal contribution and increase validity. In addition, one could have performed other types of regressions, such as Fama-Macbeth regressions, that some previous scholars did (e.g., Tronslien Sagbakken & Zhang, 2022). The choice to exclude the Fama-Macbeth regression was made partly due to Fama-French and Carhart's regressions being more frequently used and more applicable for finance and partly due to its weakness in adjusting for autocorrelation (Khalaf & Schaller, 2011).

3.7 Chapter Summary

To summarize, three models were used to determine if an alpha exists and, thus, if there is a part of the excess return that can not be explained by the factor models. The Fama-French Three-factor model, the Carhart Four-factor model, and the Fama-French Five-factor model were specifically chosen as previous research utilizes the same models alongside the fact that they incorporate important market factors to isolate alpha. Portfolios consisted mainly of already existing data from French's (n.d.) data library. As some industries were missing in the data library, they were added manually by screening through the Bloomberg Terminal, and data was retrieved from FactSet. Monthly company return data was collected from 2006 to 2022. The structure of the portfolios was based on previous research made in *traditional* and *new sin stocks* in order to get a comparable result. The same reasoning was applied to the peer portfolios.

The creation of portfolios from Bloomberg and FactSet was one of the limitations presented. While previous researchers also had to create their own industry portfolios as all industries were not covered by French's (n.d.) data library, they did not use the Bloomberg Terminal and FactSet but other databases. Therefore there are discrepancies between the industry definitions. The effect of this limitation was constrained by choosing industry classifications that mimicked previous research as closely as possible while also approaching the data collection with care.

4 Results

In this section, the results of the regressions are displayed. First, descriptive statistics and results from the factor models for the whole period (2006-2022) are presented. Second, the results from the new sin stocks before the Paris Agreement (2006-2015) and after (2016-2022) are presented. Lastly, the outcomes of the hypotheses are summarized.

4.1 Descriptive Statistics

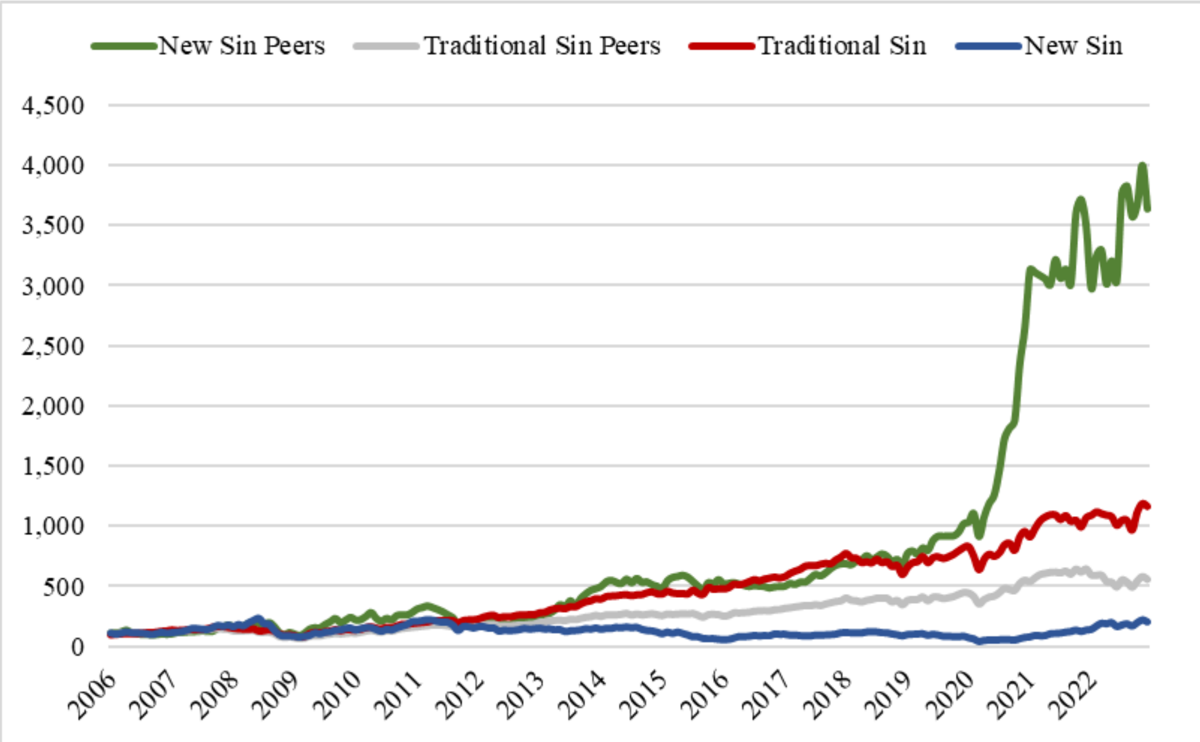

Figure 4.1 Total Portfolio Returns

The line chart above is indexed at a value of 100 from 2006-01-01, displaying the total return for each portfolio in a comparable way for the determined period. As can be seen in the chart, the New Sin Peers portfolio yielded the highest return for the period, 3,531%, to be precise, implying a compound annual growth rate of 22.4%. The second best-performing portfolio was the Traditional Sin portfolio, returning a total of 1,059% for the given period, which resulted in a compound annual growth rate of 15.2%. The third best-performing portfolio was the Traditional Sin Peers portfolio, with a total return of 461%, implying a compound annual growth rate of 10.3%. The New Sin portfolio was the least-performing portfolio, with a total return of 107%, resulting in a compound annual growth rate of 3.5%.

After the enforcement of the Paris Agreement in 2016, the New Sin portfolio had a total return of 221%, implying a compounded annual growth rate of 19.1% between 2016 and 2022. During the same period, the New Sin Peers portfolio yielded 549%, which can be expressed with a compound annual growth rate of 31.8%.

As can be seen in the chart, the performance of the New Sin Peers portfolio is extraordinarily high in 2020. There are a few underlying reasons that can support the high performance. First, a few companies stand out with relatively high market capitalization, e.g., Plug Power Inc, Enphase Energy Inc, and Solaredge Technologies Inc, to name a few. Plug Power and Enphase Energy are, according to Mitchell (2023), two of the best-performing stocks over the last ten years. Hence, the high weight of the companies, in conjunction with the strong performance, significantly impacts the performance of the portfolio. However, an important note is that the construction of the portfolio follows the one used by French (n.d.) to make the analysis as comparable as possible.

Table 4.1 Descriptive Statistics of Portfolio Returns

Variables	**Traditional Sin**	**Traditional Sin Peers**	**New Sin**	**New Sin Peers**
Total Return	1059%	461%	107%	3531%
Mean	1.3%	0.9%	0.7%	2.1%
Maximum	27.0%	22.8%	23.7%	29.0%
Minimum	-18.9%	-23.7%	-31.6%	-29.4%
Standard deviation	0.0525	0.0540	0.0891	0.0875
Variance	0.0028	0.0029	0.0079	0.0077
Skewness	0.0760	-0.4527	-0.3419	0.0124
Kurtosis	3.6760	3.0350	0.9266	0.8562
# of observations	204	204	204	204

In addition to the total return of each portfolio, Table 4.1 above displays some descriptive statistics for all portfolios. While the New Sin Peers portfolio has the highest monthly mean as well, the New Sin portfolio has the highest volatility of all portfolios, with a standard deviation of 0.0891. In addition, the period before the Paris Agreement has a slightly higher volatility than the period after. As such, this portfolio displays the greatest difference between the minimum and maximum monthly return. When it comes to the Traditional Sin and

Traditional Sin Peers portfolios, they both display a relatively low standard deviation, meaning these portfolios are less volatile.

Regarding skewness, the Traditional Sin Peers and New Sin portfolios display negative, left-skewed distributions. The Traditional Sin Peers portfolio has the highest negative skewness, indicating that more negative values can be observed for this portfolio. The Traditional Sin and New Sin Peers portfolio display positive skewness, where the Traditional Sin has the highest. However, all the skewness values are relatively low, and the distributions are almost normally distributed. When it comes to kurtosis, the table shows excess kurtosis calculated in Microsoft Excel. All the portfolios display positive values and are thus leptokurtic. The higher the positive kurtosis, the more centralized are the values around the mean. This indicates that Traditional Sin and Traditional Sin Peers portfolios have a lower spread than the other portfolios, supported by the lower standard deviation.

4.2 Regression Results

4.2.1 Results from the Three-factor Model

Table 4.2 Fama-French Three-Factor Model with Coefficients and Significance Level

Variables	Traditional Sin	Traditional Sin Peers	New Sin	New Sin Peers
α	0.0058***	0.0013	-0.0017	0.0108***
Standard error	0.1993	0.1316	0.4490	0.3866
Mkt-rf β	0.9426***	1.0506***	1.1592***	1.2693***
Standard error	0.0460	0.0304	0.1036	0.0892
SMB β	-0.1056	0.1686***	0.4477**	0.8426***
Standard error	0.0854	0.0564	0.1924	0.1656
HML β	0.2252***	0.0421	0.4047***	-0.1559
Standard error	0.0633	0.0418	0.1427	0.1229
Adjusted R Square	0.7147	0.8823	0.4963	0.6133

***1%, **5%, and *10% significance

Table 4.2 highlights that the Traditional Sin and New Sin Peers have significant alphas in the Fama-French Three-factor model at a one percent significance level. At the same time, Traditional Sin Peers and New Sin do not display significant alphas. Additionally, the betas for Mkt-rf for all the portfolios are significant, at a level of one percent. Furthermore, all the portfolios, except Traditional Sin, have significant SMB betas, Traditional Sin Peers and New Sin Peers at a one percent significance level, while New Sin is at a five percent significance. The Traditional Sin and New Sin portfolios both have significant results for the HML Beta at a one percent significance level. Lastly, the variations among the different adjusted r^2 between the portfolios are high. However, all of them are substantial, making the model good in predicting the return for the portfolios.

4.2.2 Results from the Four-factor Model

Table 4.3 Carhart's Four-Factor Model with Coefficients and Significance level

Variables	Traditional Sin	Traditional Sin Peers	New Sin	New Sin Peers
α	0.0064***	0.0016	-0.0018	0.0109***
Standard error	0.1919	0.1276	0.4513	0.3884
Mkt-rf β	0.8836***	1.0148***	1.1702***	1.2558***
Standard error	0.0463	0.0308	0.1090	0.0938
SMB β	-0.1310	0.1532***	0.4524**	0.8368***
Standard error	0.0822	0.0547	0.1934	0.1664
HML β	0.1364**	-0.0117	0.4212***	-0.1763
Standard error	0.0644	0.0428	0.1514	0.1303
MOM β	-0.2040***	-0.1238***	0.0379	-0.0468
Standard error	0.0485	0.0323	0.1141	0.0982
Adjusted R Square	0.7367	0.8898	0.4940	0.6118

***1%, **5%, and *10% significance

The results from the Four-factor model are generally similar to that of the Three-factor model. Therefore, the differences between them will be highlighted instead. Notably, adjusted r^2 does decrease, although only marginally, for the New Sin and New Sin Peers portfolios. For the Traditional Sin Portfolio, adjusted r^2 increases from 0.7147 to 0.7367, and it also increases marginally for the Traditional Sin Peers. As seen in the table, MOM is significant at a one percent level for the Traditional Sin and Traditional Sin Peers portfolios, indicating negative momentum for these portfolios.

4.2.3 Results from the Five-factor Model

Table 4.4 Fama-French Five-Factor Model with Coefficients and Significance level

Variables	Traditional Sin	Traditional Sin Peers	New Sin	New Sin Peers
α	0.0048**	0.0012	-0.0031	0.0133***
Standard error	0.2061	0.1365	0.4663	0.3976
Mkt-rf β	0.9549***	1.0423***	1.1967***	1.2370***
Standard error	0.0474	0.0314	0.1074	0.0915
SMB β	-0.0475	0.1833***	0.4972**	0.7002***
Standard error	0.0907	0.0601	0.2053	0.1750
HML β	0.1738**	0.0760	0.2496	-0.0207
Standard error	0.0811	0.0537	0.1836	0.1565
RMW β	0.1913*	0.0762	0.0972	-0.4628**
Standard error	0.1131	0.0750	0.2561	0.2183
CMA β	0.0994	-0.1037	0.3902	-0.2691
Standard error	0.1336	0.0885	0.3023	0.2577
Adjusted R Square	0.7169	0.8825	0.4959	0.6206

***1%, **5%, and *10% significance

Results from the Five-factor model are also similar to that of the Three-factor model. One difference is that the HML coefficient is not significant for the New Sin portfolio. Notably, the CMA coefficient is not significant at any significance level, whereas the RMW coefficient is significant only for the Traditional Sin and New Sin Peers. Lastly, the adjusted r^2 stays almost the same as for the Three-factor model. The exception is the New Sin Peers portfolio, where the adjusted r^2 increases from 0.6133 in the Three-factor model to 0.6206 in the Five-factor model.

4.2.4 *New Sin Stocks* Pre-Paris-Agreement and Post-Paris-Agreement

Table 4.5 New Sin Stocks Pre- and Post-Paris-Agreement

Pre-Paris-Agreement (2006-2015)				Post-Paris-Agreement (2016-2022)			
Factor Model	**3**	**4**	**5**	**Factor Model**	**3**	**4**	**5**
α	-0.0098	-0.0097	-0.0113*	**α**	0.0070	0.0069	0.0054
Mkt-rf β	1.3986***	1.3879***	1.4523***	**Mkt-rf β**	1.0418***	1.0507***	1.1902***
SMB β	0.1962	0.1986	0.2794	**SMB β**	0.7134***	0.7239***	0.6152**
HML β	-0.3657	-0.3953	-0.1317	**HML β**	0.7651***	0.7738***	0.5090**
MOM β		-0.0410		**MOM β**		0.0327	
RMW β			0.7031	**RMW β**			-0.4143
CMA β			-0.7271	**CMA β**			0.7725**
Adjusted R Square	0.4664	0.4622	0.4768	**Adjusted R Square**	0.6474	0.6431	0.6719

***1%, **5%, and *10% significance

As can be viewed in the table, no significant alpha is displayed for the portfolio, except for the Five-factor model before the Paris Agreement. This alpha is moderately significant, at a 10 percent significance level. The Mkt-rf factor is significant at one percent for all models, while SMB and HML are only significant post-Paris-Agreement. Therefore, the adjusted r^2 is also higher after the Paris Agreement than before.

4.2.5 Regression Diagnostics

As mentioned in the method section, multiple plots were created to evaluate the regression assumptions. These plots can be found in Appendix A. First of all, the residuals do not show a pattern implying linearity among the regressions. Secondly, the residual plots further indicate no pattern, cyclical or anything else, that would indicate that the assumption of independence has been violated. Thirdly, in the same appendix, histograms show the normality of errors. As can be seen from the histograms, the residuals are close to a normal distribution for all regressions, and thus the assumption of normality is not violated. Finally, it can also be derived from the residual plots that there is no shape, such as a fan, that would indicate that residual increases as X increases. Thus, there is no evidence that the assumption of equal variance (homoscedasticity) among residuals is violated.

4.3 Outcome of Hypotheses

- *Hypothesis 1: There is a significant risk-adjusted return for traditional sin stocks when using the Fama-French Three-factor model.*

It is significant at a one percent significance level. Therefore, the null hypothesis was rejected.

- *Hypothesis 2: There is a significant risk-adjusted return for traditional sin stocks when using Carhart's Four-factor model.*

It is significant at a one percent significance level. Therefore, the null hypothesis was rejected.

- *Hypothesis 3: There is a significant risk-adjusted return for traditional sin stocks when using the Fama-French Five-factor model.*

It is significant at a five percent significance level. Therefore, the null hypothesis was rejected.

- *Hypothesis 4: For the period 2006-2015, there is a significant risk-adjusted return for new sin stocks, when using the Fama-French Three-factor model.*

It is not significant at any significance level. Therefore, the null hypothesis could not be rejected.

- *Hypothesis 5: For the period 2006-2015, there is a significant risk-adjusted return for new sin stocks, when using Carhart's Four-factor model.*

It is not significant at any significance level. Therefore, the null hypothesis could not be rejected.

- *Hypothesis 6: For the period 2006-2015, there is a significant risk-adjusted return for new sin stocks, when using the Fama-French Five-factor model.*

It is significant at a ten percent significance level. Therefore, the null hypothesis was rejected.

- *Hypothesis 7: For the period 2016-2022, there is a significant risk-adjusted return for new sin stocks, when using the Fama-French Three-factor model.*

It is not significant at any significance level. Therefore, the null hypothesis could not be rejected.

- *Hypothesis 8: For the period 2016-2022, there is a significant risk-adjusted return for new sin stocks, when using Carhart's Four-factor model.*

It is not significant at any significance level. Therefore, the null hypothesis could not be rejected.

- *Hypothesis 9: For the period 2016-2022, there is a significant risk-adjusted return for new sin stocks, when using the Fama-French Five-factor model.*

It is not significant at any significance level. Therefore, the null hypothesis could not be rejected.

4.4 Chapter Summary

This section outlined the result of 18 time-series regressions for the three models and four portfolios. The main point on the result is that the New Sin Peers portfolio has performed the best, followed by the Traditional Sin portfolio, which both show significant alpha through all of the models. The Traditional Sin portfolio has the lowest standard deviation, followed by the Traditional Sin Peers portfolio, which is lower than the New Sin and New Sin Peers portfolios. Another notable result is that all models show a high adjusted r^2 for all portfolios, which generally increases as more independent variables are added. Moreover, the market factor is another notable factor as it is highly significant and shows a high beta for all portfolios through all models.

In the last part, the New Sin portfolio was split into before and after the Paris Agreement. The results of those regressions show only one moderately significant alpha, in the Five-factor model pre-Paris-Agreement. From this, it was concluded that one null hypothesis could be rejected for the New Sin stock portfolio. In contrast, all null hypotheses were rejected for the Traditional Sin portfolio.

5 Analysis and Discussion

This chapter divides the analysis and discussion into three main parts, starting with the difference in return between traditional and new sin stocks. It is followed by analyzing how the financial models contribute to the findings. Lastly, it is finalized with a discussion on new sin stocks and if they could potentially obtain a sin premium in the future.

5.1 Traditional Sin Outperforms New Sin

The research purpose of this paper was to delve deeper into the scarcely researched field of *new sin stocks*, also investigating the difference in returns to *traditional sin stocks* and their peers. As previously mentioned, alpha can be seen as the part of portfolio returns attributable to the effect of *sin*; thus, this is also the variable of focus when analyzing the differences in return. It should be noted that it could, in theory, be due to other factors that the models do not capture. It is, however, most likely due to their belongingness to *sin-industries*. This is because the independent factors capture all the most common underlying reasons for excess return, so the main thing left is the 'sinfulness' that the two Sin portfolios share.

An apparent difference from previous research is that the alpha remains for the *Traditional Sin Stocks* portfolio as more variables are added to the model (Richey, 2017; Tronslien Sagbakken & Zhang, 2022). However, the alpha decreases, indicating that adding factors such as RMW adds to the model, i.e., the Five-factor model can explain a portion of the unexplained return from the Three-factor model. It is difficult to say why the results are different from previous research. However, one likely reason is that this research paper uses data from an additional number of years, expanding on the sample period compared to other studies. Moreover, Tronslien Sagbakken and Zhang (2022), the most recent study found on this topic, researches the European market, which is a different market than what this paper analyzes. These reasons can help explain why there are differences in the results of the Traditional Sin portfolio.

Regarding the New Sin portfolio, the only significant alpha found was for the Five-factor model in the period before the Paris Agreement. In addition, the alpha generated is negative, showing that the portfolio underperforms compared to the overall market. This is an interesting result as this research paper presents the first findings on the American market around *new sin stocks*, adding to the current knowledge in the field. Moreover, the results are different from those found on the European stock market, researched by Tronslien Sagbakken and Zhang (2022), as they found a moderately significant alpha post-Paris-Agreement. As such, the results from this research paper suggest that there is a difference in the perception of *new sin stocks* between the European and the American stock markets, as no significant alpha exists post-Paris-Agreement. The insignificance of alpha does not prove per se that there is no risk-adjusted return; it means that the null hypothesis could not be rejected.

As an interesting note, though, the significant alpha for the pre-Paris-Agreement period is in line with the argumentation of Hong, Karolyi & Scheinkman (2020), suggesting that carbon-intensive industries undergo exclusion from institutional investors. The negative alpha of -0.0113 points to a capital outflow from the portfolio, presumably to environmentally friendly energy sources. However, there needs to be more evidence to support this fully, as there is only one moderately significant alpha.

In that light, even though this paper focuses on the comparison between *new* and *traditional sin stocks*, it is interesting to note the performance of the New Sin Peers portfolio. The accumulated return of the portfolio is remarkably high, and it also has a significant alpha much higher than the other portfolios. This relates to what previous research on sustainable investing has stated, that it is an industry on the rise with high capital inflows (Yue et al. 2020). Also, research claimed that the returns for these types of stocks should be high (Engelhardt, Ekkenga & Posch, 2021; Rennings, Schröder & Ziegler, 2003; Rodionova, Skhvediani & Kudryavtseva, 2022; Yue et al. 2020). The New Sin Peers portfolio returns can arguably be related to this study using only the renewable energy, and the forest and wood product sectors. In contrast, some studies utilized broader indexes (e.g., Garcia-Amate, Ramírez-Orellana & Rojo Ramirez, 2022). In this light, the finding of this study points to their being some form of premium on renewable energy, and forest and wood products, and that they have outperformed other types of stocks. It can be argued that the popularity of combating climate change has positively impacted the performance of these stocks and that the inflow of capital is one reason for these abnormal returns.

Although this study was conducted to compare *traditional* and *new sin stocks* to their respective peers to identify a potential *sin premium*, the results can be generalizable to the broader CSR area. The findings suggest that investors on the American stock market consider social norms and companies' ethicality when making investments. This is because if investors did not consider the ethical nature of the industry as important, a premium would not appear for investors willing to defy social norms because there would be no social norms to defy. Thus, the results show that due to the existence of social norms, *sin premiums* appear, which they would not if all investors viewed the purpose of investments as purely financial.

5.2 The Differences Between the Factor Models

One of the aims of this study was to capture the differences between the three different asset pricing models. Therefore, the coefficients for each factor can be analyzed to capture the benefits of each model. In these sections, this will be presented separately for each factor to illuminate what each factor contributes with.

The Mkt-rf factor is derived from the original CAPM model and has been kept in all other developments of the asset pricing model after. Thus, it is an important factor for determining the future return of a security. In this thesis, most portfolios have a statistically significant Mkt-rf coefficient relatively close to one, indicating an almost one-to-one relationship with the market (Brooks, 2015). This means that if the market increases by ten percent, so will the portfolios. It is of value that the peer portfolios have a beta similar to that of their respective Sin Portfolios as they are meant to be similar types of companies as the Traditional Sin and New Sin portfolios but without the *sin-factor*.

Furthermore, it is displayed in the result section that the portfolios with the highest standard deviation are the New Sin portfolio and the New Sin Peers portfolio. This can be further seen when analyzing the Mkt-rf factor as these portfolios have the highest betas, both being above one, indicating that for each market movement, they move in the same direction but more. The New Sin Peers portfolio has a beta of 1.2693, meaning that for every movement in Mkt-rf, the portfolio moves in that direction but with 1.2693 instead of 1. Thus, the higher volatility of the New Sin and New Sin Peers portfolio can partially be attributed to their relatively high beta for the Mkt-rf factor. The relationship is consistent through all the models at a highly significant level, indicating that all models successfully capture the market factor.

By adding the SMB factor to the Three-factor model, Fama & French (1993) aims to include the return explained by small companies' higher risk premium. Thus, if the beta coefficient is significantly positive for the SMB factor, the different portfolios of this paper are considered to be affected by the higher expected return captured by small companies. The opposite is true if there is a significant negative beta coefficient. For the Three-factor model, Traditional Sin is the only portfolio that does not display a significant coefficient, meaning that no direct conclusion can be drawn from that portfolio regarding the SMB factor. However, all the other portfolios (Traditional Sin Peers, New Sin, and New Sin Peers) display positively significant coefficients for the SMB factor. Most notably, the New Sin Peers portfolio has an SMB coefficient of 0.8426, the highest among the portfolios, indicating that the portfolio has a higher exposure to small companies than the others. A potential explanation for the beta could be that, as mentioned previously, sustainable investing is growing which gives rise to new, smaller companies resulting in the New Sin Peers portfolio having a high positive exposure to the SMB factor. How portfolio returns vary depending on the company's size is not captured in the original CAPM formula, and thus a clear benefit of using the Three-factor model.

The HML factor, added in the Three-factor model, explains the portfolio returns correlation to the difference between high and low-valued companies (Fama & French, 1993). A positive beta indicates that the portfolio has higher exposure to value companies (high book-to-market-value), while a negative beta states that the portfolio includes more growth companies (lower book-to-market-value). Previous studies emphasize that institutional investors avoid investing in *sin-businesses*. Hence, sin-companies are undervalued compared to *non-sin companies* (Colonnello, Curatola & Gioffré, 2019). Table 4.2 highlights that the New Sin and Traditional Sin portfolios have significant HML betas, 0.4047 and 0.2252, respectively, with the Three-factor model, while the other portfolios show no significant beta. The result from the regression supports the reasoning from previous research. Thus, the analysis confirms previous research on companies belonging to the *sin-industries*, both *traditional* and *new*, which tend to have a high book-to-market ratio (value companies). The reason for this could be that new risky investments tend to occur in companies that are expected to have a bright future, which is the opposite of the predictions of *sin-industries*. Therefore, *sin-industries* tend to have a lower market value compared to their book value.

Building upon the Three-factor model, Charhart (1997) adds a fourth factor, MOM. The MOM factor explains the returns attributable to the difference between the returns of the companies in the portfolio with recent high performance and those with recent low performance. In Table 4.3, it can be seen that Traditional Sin and Traditional Sin Peers have significant negative MOM coefficients. This means that the monthly return of the firms that performed well the previous year is lower than those that performed poorly the previous year. It further indicates that *traditional sin* companies will perform worse when other firms gain momentum. For New Sin and New Sin Peers, the MOM factor is not significant at any level. This does not necessarily mean that the MOM factor does not affect the portfolios but that the statistical result is insignificant. Furthermore, the insignificant result of the momentum factor is in line with previous research that analyzed *new sin stocks* (Tronslien Sagbakken & Zhang, 2022). As such, it can be concluded that the MOM factor does not add to the discussion of *new sin stocks*, as the results are insignificant, but it can be used for analyzing *traditional sin stocks*.

Lastly, the Five-factor model adds the RMW factor, which considers profitability, or more precisely, operating profitability (Fama & French, 2015). A positive RMW beta indicates that the portfolio has higher exposure to companies with high operating margins. In contrast, a negative beta states that the portfolio includes more companies with lower operating margins. Richey (2017) argued that the overperformance of vice stocks (*sin stocks* plus payday lenders) stems from more robust profitability and stricter capital budgeting. Table 4.4 displays that the RMW betas are significant for the Traditional Sin portfolio (10% significance level) and New Sin Peers (5% significance level). The result for the Traditional Sin portfolio is moderately significant at this level; however, it aligns with Richey's (2017) argument. Furthermore, the coefficient for the New Sin Peer portfolio is negative, which states that the companies in the portfolio arguably have lower operating margins. The reasoning for the negative beta could be that the portfolio includes renewable energy companies, which during the period for this study have been an emerging industry where companies have focused on growth instead of profits.

The Five-factor model also adds the CMA factor, i.e., the return for companies with high and low investments can be explained. The CMA at significant levels can explain the return of companies with high or low investments. A positive CMA coefficient can be interpreted as the portfolio being impacted by companies with high investments, while a negative coefficient states the portfolio has companies with low investments. However, the CMA betas in the analysis are insignificant; hence it is not possible to draw any conclusion from the sample.

In conclusion, the Three-factor model arguably performs relatively well in this research. Adding new factors, the adjusted r^2 increases in some cases, but most of the new coefficients are insignificant and therefore do not add much to the discussion. The interesting aspect of the Four- and Five-factor models is that alpha changes as the new independent factors capture a greater portion of the return. Since alpha is also significant for all three models, using more factors should yield a more accurate description that captures more aspects of the returns. Therefore, even though the Three-factor model is a robust regression on its own, there are benefits with using several models.

5.3 Are *New Sin Stocks* Really Seen as Sin?

This final section discusses the most important insights regarding *sin stocks*. In doing so, the research purpose of advancing the research field of *new sin stocks* can be appropriately addressed.

As mentioned in the result section, volatility can be viewed as the risk taken when investing in a specific portfolio. In the case of this thesis, it displays how many percent the portfolio varies in return monthly. As the interest was to examine *traditional* and *new sin stocks* compared to their peers, it is noticeable that not only does the Traditional Sin portfolio have a higher return than the Traditional Sin Peers portfolio, but it also has a lower standard deviation and, thus, a lower risk. Moreover, the Traditional Sin portfolio shows a significant alpha, making it a better financial investment than its peers. In contrast, the New Sin portfolio shows the opposite results with higher volatility, lower overall return, and no significant alpha compared to its peer portfolio. From the results, it can therefore be derived that no *sin premium* exists for the New Sin portfolio, at least not for the period and sample researched in this paper.

Hong and Kacperczyk (2009) reasoned that *traditional sin stocks* are undervalued since societal norms restrict investors from funding *sin-industries*; thus, they invest in other industries with higher valuations to avoid *sin stocks*. Moreover, Bolton & Kacperczyk (2021) argue that institutional investors avoid investing in companies with high carbon emissions. This led the authors of this paper to hypothesize that the New Sin portfolio would generate significant alphas, which was not the case. However, *new sin stocks* are a relatively new phenomenon, especially compared to *traditional sin stocks*. Therefore, questions arise regarding the effect of the time frame and if not enough time has passed yet for the *new sin stocks* to obtain a *sin premium*. On that note, Tronslien Sagbakken and Zhang (2022) argued that the transition is ongoing and that the shift of money from brown to green assets is not yet finished. The case could then be that a *sin premium* develops during the transition.

While Tronslien Sagbakken and Zhang (2022) look at the European market and get a significant alpha, although moderate, this paper sees no significant alpha for the New Sin portfolio post the Paris Agreement. Thus, this paper indicates that no significant effect of the Paris Agreement exists on the risk-adjusted excess return for the New Sin portfolio. The reason for this is still unknown. It could be because the Paris Agreement has resulted in different reactions in the USA and Europe due to, for example, different political views. However, it could also be because not enough time has passed for an alpha to appear in the New Sin portfolio. With time, social norms are expected to form in favor of socially responsible investments, the same as Akerlof (1980) and Liu, Lu, and Veenstra (2014) concluded. When such norms are rooted, a new *sin premium* will probably emerge for those willing to violate the social code to gain monetary benefits, as Akerlof (1980) discussed. As a result, as Tronslien Sagbakken and Zhang (2022) mentioned, this field should be studied over time to map if market perceptions of new *sin-industries* will indeed change. Therefore, future research on this subject would be of interest as more time passes and more investments are made into renewable energy, as the New Sin portfolio might experience a *sin premium* in the future.

5.4 Chapter Summary

In this chapter, the results of the study were discussed and analyzed in relation to previous research. As discussed, the Traditional Sin portfolio outperforms the New Sin portfolio, arguably because the *new sin stocks* are not awarded with a *sin premium*. It seems like social norms have not yet formed against *new sin stocks* and that there is also a difference between the American and European stock markets. Whereas previous research saw a tendency for an emerging *sin premium* in the European stock market, this paper cannot draw such conclusions in the US. The reason for this is unknown, but a likely cause is that the investors of the US and Europe have reacted differently to the Paris Agreement or that the US is lagging in the transition. Furthermore, as the descriptives show, the Traditional Sin portfolio has the lowest standard deviation, indicating lower volatility and risk. Thus compared to its peers, it has better returns while being a less risky investment.

In addition, all three separate factor models perform almost equally well in answering the research question. The interesting difference between them is that alpha differs and that the Five-factor model is arguably displaying a more accurate one as a larger portion of the return is explained by the independent variables.

6 Conclusion

This chapter will answer this paper's research aims and objectives, followed by the practical implications of the findings. It ends with the potential future research within the studied field.

6.1 Research Aims and Objectives

The main aim of this study was to identify how *new* and *traditional sin stocks* perform compared to their respective peer stocks. In doing so, the objective was to answer the research question regarding what the difference in return is. It can be concluded that the Traditional Sin portfolio performed better than the Traditional Sin Peers and that the New Sin portfolio performed worse than the New Sin Peers. In addition, the Traditional Sin portfolio displays a significant alpha of 0.48% monthly returns, which as argumented is likely caused by a *sin premium*. However, when previous research depicted that alpha would disappear in the Five-factor model, no such relationship was found in this study. This study can also conclude that while no significant *new sin premium* was found, the New Sin Peers display a relatively large and significant alpha. This may indicate a premium on sustainable investments and that SRI is becoming deeply rooted in the investment culture.

In conclusion, this study has captured the differences in stock returns rather well. Therefore, the aims and objectives of the study have been fulfilled. This paper's results point to a difference between how the US views *new sin stocks* and what has previously been researched in Europe. These findings hold value for this field of research as it is the first study conducted on *new sin stocks* on the American stock market. Lastly, it was determined that while all three separate factor models output good regressions, the Five-factor model is the best to use as it arguably displays the most accurate alpha.

6.2 Practical Implications

The results from this thesis could be relevant for investors when allocating capital to publicly traded companies. This analysis concludes that the Traditional Sin portfolio yields greater returns at lower volatility (lower standard deviation) than its peers. Hence, investors could use an investment strategy of allocating capital toward *traditional sin stocks* to yield higher returns. However, it is essential to consider if one is willing to support and fund businesses that oppose social norms for a greater personal return. Furthermore, this research highlights no premium on the New Sin portfolio, while New Sin Peers has the highest alpha. The practical implication could be for investors to avoid *new sin stocks* since they are not currently worth the *sin*. Instead, they could focus on sustainable investments in rapidly developing industries with strong underlying market tailwinds. Lastly, this research is based on historical data; thus, one should remember that historical returns do not guarantee future returns. Therefore, even though this research suggests that investing in sustainable industries and *traditional sin stocks* is beneficial, it is unknown if these industries will keep performing in the future.

6.3 Future Research

The findings of this study raise interesting questions that can be researched further in the future. The result suggests that investments in the renewable sector should be of interest in future research. As the renewable and forest and wood product stocks have performed extraordinarily well, it would be interesting to apply the method of this study and investigate the difference between different classes of sustainable investments. In this way, one could map if there truly is a sustainability premium and if this type of investment yields alpha on a broader scale.

Another interesting research topic for the future is that of the ownership of *new sin stocks*. Hong and Kacperczyk (2009) have previously investigated the topic on *traditional sin stocks*, finding that these stocks are held less by norm-constrained institutional investors. However, no such research has been conducted for *new sin stocks* in the US. It would be interesting to analyze if there are differences between *new* and *traditional sin-industries* when it comes to the ownership of stocks and also where these differences originate. In doing so, the *new sin stocks* research area can be expanded even more than this research paper did.

Lastly, it would be interesting to replicate the method of this study in order to validate the results further. As this study was the first to investigate *new sin stocks* in the US stock market, more studies are needed to generalize the findings and broaden the research field. Moreover, as this study has discussed that what is seen as *sin* can change with time, it would be valuable to monitor future changes to see if a *new sin premium* may emerge in the US.

References

Agliardi, E., Alexopoulos, T. & Karvelas, K. (2023). The Environmental Pillar of ESG and Financial Performance: A portfolio analysis, *Energy Economics,* vol. 120, 106598, Available through: LUSEM library website https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=edselp&AN=S0140988323000968&site=eds-live&scope=site [Accessed 10 May 2023]

Akerlof, G. A. (1980). A Theory of Social Custom, of Which Unemployment May be One Consequence, *The Quarterly Journal of Economics*, vol. 94, no. 4, pp. 749-775, Available online: https://www.jstor.org/stable/pdf/1885667.pdf?refreqid=excelsior%3A0f77638c613a2d96a28f3b8a4fbebfa1&ab_segments=&origin=&initiator=&acceptTC=1 [Accessed 12 April 2023]

Avanza. (n.d.). Red Rock Resorts Inc, Available online: https://www.avanza.se/aktier/om-aktien.html/653255/red-rock-resorts-inc[Accessed 4 May 2023]

Baldridge, R. (2023). The Capital Asset Pricing Model (CAPM), Available online: https://www.forbes.com/advisor/investing/capm-capital-asset-pricing-model/ [Accessed 17 April 2023]

Banz, R. W. (1981). The Relationship Between Return and Market Value of Common Stocks, *Journal of Financial Economics*, vol. 9, no. 1, pp. 3-18., Available online: https://reader.elsevier.com/reader/sd/pii/0304405X81900180?token=ADCF6C05F0E61C441003A22A858A6BEF7D63AD33BCA708D0A36FACEE343225785317E735BC1E067D4037EB6F323A8B02&originRegion=eu-west-1&originCreation=20230417092001 [Accessed 17 April 2023]

Bell, E. Bryman, A. & Harley, B. (2019). Business Research Methods, Oxford: Oxford University Press

Berenson, M. L., Levine, D.M., Szabat, K.A. & Stephan, D.F. (2020). Basic Business Statistics: Concepts and applications, London: Pearson Education

Berk, J. B. & DeMarzo, P. M. (2015). Corporate Finance, New York: Pearson Education

Binsbergen, J. H., Diamond, W. F., Grotteria, M. (2021). A Three-Dimensional Conceptual Model of Corporate Performance, *Journal of Financial Economics*, vol. 143, no. 1, pp. 1-29, Available online: sciencedirect.com/science/article/pii/S0304405X21002786 [Accessed 26 April 2023]

Blitz, D., & Fabozzi, F. J. (2017). Sin Stocks Revisited: Resolving the sin stock anomaly, *The Journal of Portfolio Management*, vol. 44, no. 1, pp. 105-111, Available online: https://jpm.pm-research.com/content/44/1/105 [Accessed 11 April 2023]

Blitz, D., & Swinkels, L. (2020). Is Exclusion Effective?, *The Journal of Portfolio Management*, vol. 46, no. 3, pp. 42-48, Available Online: https://jpm.pm-research.com/content/46/3/42.short [Accessed 13 April 2023]

Bolton, P., & Kacperczyk, M. (2021). Do Investors Care About Carbon Risk?, *Journal of Financial Economics*, vol. 142, no. 2, pp. 517-549, Available online: https://www.sciencedirect.com/science/article/pii/S0304405X21001902 [Accessed 13 April 2023]

Boyde, E. (2023). ESG Accounts for 65% of all Flows Into European ETFs in 2022, Financial Times, 13 January, Available online: https://www.ft.com/content/a3e9d87f-fa6f-4e5e-be6e-e95b42af2fec [Accessed 11 April 2023]

Brooks, R. (2015). Financial Management: Core concepts, New York: Pearson Education

Carhart, M. M. (1997). On Persistence in Mutual Fund Performance, *The Journal of Finance* , vol. 52, no. 1, pp. 57-82, Available online: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1540-6261.1997.tb03808.x [Accessed 17 April 2023]

Carroll, A. B. (1979). A Three-Dimensional Conceptual Model of Corporate Performance, *Academy of Management*, vol. 4, no. 4, pp. 497-505, Available online: https://www.jstor.org/stable/pdf/257850.pdf?refreqid=excelsior%3A83b03666ed3830722a74eff19b79485a&ab_segments=&origin=&initiator=&acceptTC=1 [Accessed 11 April 2023]

Carroll, A. B. (2008). A History of Corporate Social Responsibility: Concepts and Practices, in Crane, A., McWilliams, A., Matten, D., Moon, J. and Siegel, D. S. (eds), *Oxford Handbooks in Business and Management*, Oxford: Oxford University Press, pp. 19-46, Available online: https://www.researchgate.net/profile/Archie-Carroll/publication/282746355_A_History_of_Corporate_Social_Responsibility_Concepts_and_Practices/links/561b229708ae044edbb210a1/A-History-of-Corporate-Social-Responsibility-Concepts-and-Practices.pdf?origin=publication_detail [Accessed 11 April 2023]

Chen, J. (2020). What Is Jensen's Measure (Alpha), and How Is It Calculated?, Available online: https://www.investopedia.com/terms/j/jensensmeasure.asp [Accessed 17 April 2023]

Chen, J. (2022). What Is a Socially Responsible Investment (SRI)?, Available online: https://www.investopedia.com/terms/s/sri.asp [Accessed 11 April 2023]

Cochrane, J. H. (2014). Eugene F. Fama, Efficient Markets, and the Nobel Prize, Available online: https://www.chicagobooth.edu/review/eugene-fama-efficient-markets-and-the-nobel-prize [Accessed 14 April 2023]

Colonnello, S., Curatola, G., & Gioffré, A. (2019). Pricing Sin Stocks: Ethical Preference vs. Risk Aversion, *European Economic Review*, vol. 118, pp. 69-100, Available online: https://www.sciencedirect.com/science/article/pii/S0014292119300686 [Accessed 12 April 2023]

Corporate Finance Institute. (2023). Factset, Available online: https://corporatefinanceinstitute.com/resources/economics/factset/ [Accessed 19 May 2023]

Downey, L. (2022). Efficient Market Hypothesis (EMH): Definition and Critique, Available online: https://www.investopedia.com/terms/e/efficientmarkethypothesis.asp [Accessed 17 April 2023]

Engelhardt, N., Ekkenga, J. & Posch, P. (2021). ESG Ratings and Stock Performance during the COVID-19 Crisis, *Sustainability*, vol. 13, no. 7133, Available through: LUSEM library website: https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=edsdoj&AN=edsdoj.53fedff0b5d45f9a9233dc1aad6b15b&site=eds-live&scope=site [Accessed 9 May 2023]

Fabozzi, F.j., Ma, K.C. & Oliphant, J. (2008). Sin Stock Returns, *The Journal of Portfolio Management*, vol. 35, no. 1, pp. 82-94, Available online: https://jpm.pm-research.com/content/35/1/82.abstract [Accessed 18 April 2023]

FactSet Research Systems. (n.d.). Available online: https://www.factset.com/why-factset?utm_feeditemid=&utm_feeditemid=&utm_device=c&utm_device=c&utm_term=factset& [Accessed 18 April 2023]

Fama, E. F. (1970). Efficient Capital Markets: A review of theory and empirical work, *The Journal of Finance*, vol. 25, no. 2, pp. 383-417, Available online: https://www.jstor.org/stable/2325486 [Accessed 14 April 2023]

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics*, vol. 33, pp. 3-56, Available online: https://www.bauer.uh.edu/rsusmel/phd/Fama-French_JFE93.pdf [Accessed 17 April 2023]

Fama, E. F., & French, K. R. (2004). The Capital Asset Pricing Model:
Theory and Evidence, *Journal of Economic Perspectives*, vol. 18, no. 3, pp. 25-46, Available online: https://pubs.aeaweb.org/doi/pdfplus/10.1257/0895330042162430 [Accessed 17 April 2023]

Fama, E. F., & French, K. R. (2015). A Five-factor Asset Pricing Model, *Journal of Financial Economics*, vol. 116, no. 1, pp. 1-22, Available online: https://www.sciencedirect.com/science/article/pii/S0304405X14002323 [Accessed 17 April 2023]

French, K. R. (n.d.). Current Research Returns, Available online: https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html [Accessed 17 April 2023]

FTSE Russell (n.d.). How are indexes weighted, Available online: https://www.ftserussell.com/education-center/how-are-indexes-weighted [Accessed 25 April 2023]

Ganti, A. (2021). Total Shareholder Return (TSR): Definition and Formula, Available online: https://www.investopedia.com/terms/t/tsr.asp [Accessed 22 May 2023]

Garcia-Amate, A., Ramírez-Orellana, A. & Rojo Ramirez, A. (2022). Is it Attractive to Invest in Alternative Energy? Evidence from a Five-factor Fama-French Model for Regional DJSI and Renewable Stock Indexes, *Sustainability Accounting, Management and Policy Journal*, vol. 13, no. 1, pp. 273-296, Available online: https://www-emerald-com.ludwig.lub.lu.se/insight/content/doi/10.1108/SAMPJ-09-2020-0317/full/pdf?title=is-it-attractive-to-invest-in-alternative-energy-evidence-from-a-five-factor-fama-french-model-for-regional-djsi-and-renewable-stock-indexes [Accessed 9 May 2023]

Hayes, A. (2022). What Is the Risk-Free Rate of Return, and Does It Really Exist?, Available online: https://www.investopedia.com/terms/r/risk-freerate.asp [Accessed 26 April 2023]

Hong, H., & Kacperczyk, M. (2009). The Price of Sin: The effects of social norms on markets, *Journal of Financial Economics*, vol. 93, no. 1, pp. 15-36, Available online: https://www.sciencedirect.com/science/article/pii/S0304405X09000634?via%3Dihub [Accessed 11 April 2023]

Hong, H., Karolyi, G. A., & Scheinkman, J. A. (2020). Climate Finance, *Review of Financial Studies*, vol. 33, no. 3, pp. 1011-1023, Available through: LUSEM Library website https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=ecn&AN=1823446&site=eds-live&scope=site [Accessed 14 April 2023]

Investopedia. (n.d.). Socially Responsible Investing (SRI), Available online: https://www.investopedia.com/socially-responsible-investing-4689738 [Accessed 11 April 2023]

Jensen, M. C. (1968). The Performance of Mutual Funds in the Period 1945-1964, *The Journal of Finance*, vol. 23, no. 2, pp.389-416, Available online: https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1540-6261.1968.tb00815.x [Accessed 17 April 2023]

Khalaf, L. & Schaller, H. (2011). How Fama-MacBeth Can Go Wrong – And an Informative Solution, *Social Science Research Network*, Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1785858 [Accessed 5 May 2023]

Kim, I. & Venkatachalam, M. (2011). Are Sin Stocks Paying the Price for Accounting Sins?, *Journal of Accounting, Auditing & Finance*, vol. 26, no. 2, pp. 415-442, Available online: https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=bth&AN=67004293&site=eds-live&scope=site [Accessed 11 April 2023]

Liu, Y., Lu, H., & Veenstra, K. (2014). Is Sin Always a Sin? The Interaction Effect of Social Norms and Financial Incentives on Market Participants' Behavior, *Accounting, Organizations and Society*, vol. 39, no. 4, pp. 289-307, Available online: https://www.sciencedirect.com/science/article/pii/S0361368214000415?via%3Dihub [Accessed 12 April 2023]

Luo, H. A., & Balvers, R. J. (2017). Social Screens and Systematic Investor Boycott Risk, *The Journal of Financial and Quantitative Analysis*, vol. 52, no. 1, pp. 365-399, Available online: https://www.jstor.org/stable/pdf/44157656.pdf?refreqid=excelsior%3A16b673fb39ea1578f2082d66d00f8311&ab_segments=&origin=&initiator=&acceptTC=1 [Accessed 13 April 2023]

Mitchell, C. (2023). Best Performing U.S. Stock in the Last Year, 3 Years, 5 Years, and 10 Years, Available online: https://tradethatswing.com/best-performing-stocks-in-the-last-year-3-5-and-10-years/ [Accessed 15 May 2023]

Plyakha, Y., Uppal, R., Vilkov, G., (2012). Why Does an Equal-Weighted Portfolio Outperform Value- and Price-Weighted Portfolios?, Available online:: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2724535 [Accessed 25 April 2023]

Rennings, K., Schröder, M. & Ziegler, A. (2003). The Economic Performance of European Stock Corporations: Does sustainability matter?, *Greener Management International*. vol. 44, pp. 33-43, Available through: LUSEM library website: https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=edsjsr&AN=edsjsr.greemanainte.44.33&site=eds-live&scope=site [Accessed 9 May 2023]

Richey, G. (2017). Fewer Reasons to Sin: A five-factor investigation of vice stock returns, *Managerial Finance*, vol. 43, no. 9, pp. 1016-1033, Available online: https://www.emerald.com/insight/content/doi/10.1108/MF-09-2016-0268/full/pdf?title=fewer-reasons-to-sin-a-five-factor-investigation-of-vice-stock-returns [Accessed 13 April 2023]

Rodionova, M., Skhvediani, A. & Kudryavtseva, T. (2022). ESG as a Booster for Logistics Stock Returns — Evidence from the US stock market, *Sustainability*, Vol. 14, no. 12356, Available through: LUSEM library website https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=edsdoj&AN=edsdoj.188af0582dc84806b95253964f53cb06&site=eds-live&scope=site [Accessed 9 May 2023]

Statman, M. (1987). How Many Stocks Make a Diversified Portfolio?, *Journal of Financial and Quantitative Analysis,* vol. 22, no. 3, pp. 353-363, Available online: https://www.jstor.org/stable/pdf/2330969.pdf?refreqid=excelsior%3A6fc2474378601716953ca0947aefc7dd [Accessed 4 May 2023]

Statman, M., & Glushkov, D. (2009). The Wages of Social Responsibility, *Financial Analysts Journal*, vol. 65, no. 4, pp. 33-46, Available online: https://www.jstor.org/stable/40390194 [Accessed 18 April 2023]

Tronslien Sagbakken, S. (2021). Sin Stock Returns on the European Market: A study on traditional sin and new sin industries, Master’s thesis, Department of Business Administration, Oslo Metropolitan University, Available online: https://oda.oslomet.no/oda-xmlui/bitstream/handle/11250/2823515/Sagbakken_SiriTronslien.pdf?sequence=1&isAllowed=y [Accessed 4 April 2023]

Tronslien Sagbakken, S., & Zhang, D. (2022). European Sin Stocks, *Journal of Asset Management*, vol. 23, no. 1, Available online: https://link.springer.com/content/pdf/10.1057/s41260-021-00247-9.pdf?pdf=button [Accessed 4 April 2023]

UNFCCC. (n.d.a.). Climate Neutral Now, Available online: https://unfccc.int/climate-neutral-now [Accessed 11 April 2023]

UNFCCC. (n.d.b). The Paris Agreement, Available online: https://unfccc.int/process-and-meetings/the-paris-agreement [Accessed 11 April 2023]

UNIDO. (n.d.). Our Focus, Available online: https://www.unido.org/our-focus/advancing-economic-competitiveness/competitive-trade-capacities-and-corporate-responsibility/corporate-social-responsibility-market-integration/what-csr [Accessed 11 April 2023]

UNPRI. (n.d.). About the PRI, Available online: https://www.unpri.org/about-us/about-the-pri [Accessed 11 April 2023]

WallStreetPrep. (n.d.). Bloomberg vs. Capital IQ vs. Factset vs. Refinitiv: Comparison of the costs and features of the four leading financial data providers, Available online: https://www.wallstreetprep.com/knowledge/bloomberg-vs-capital-iq-vs-factset-vs-thomson-reuters-eikon/ [Accessed 5 May 2023]

Wong, J. B., & Zhang, Q. (2022). Stock Market Reactions to Adverse ESG Disclosure via Media Channels, *The British Accounting Review*, vol. 54, no. 1, Available online: https://www.sciencedirect.com/science/article/pii/S0890838921000718?via%3Dihub [Accessed 12 April 2023]

Yue, X., Han, Y., Teresiene, D., Merkyte, J. & Liu, W. (2020). Sustainable Funds' Performance Evaluation, *Sustainability*, vol. 12, no. 8034, Available through: LUSEM library website https://ludwig.lub.lu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=edsdoj&AN=edsdoj.59cae8fd8fad4757a0ff6242dd0278df&site=eds-live&s [Accessed 9 May 2023]

Appendix A

This appendix displays the histograms and residual plots for all time-series regressions run for this thesis.

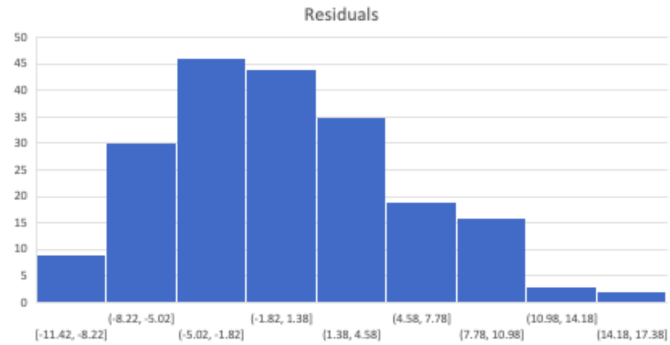

Figure A.1: Histogram of Residuals for New Sin Peers in the Three-factor model

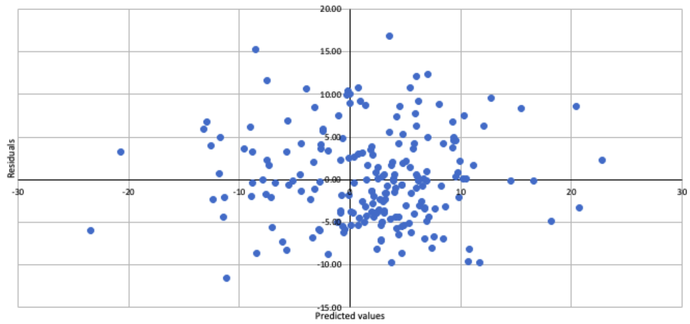

Figure A.2: Residual Plot for New Sin Peers in the Three-factor model

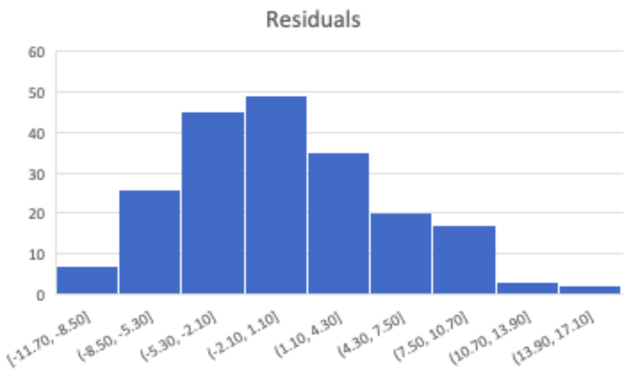

Figure A.3: Histogram of Residuals for New Sin Peers in the Four-factor model

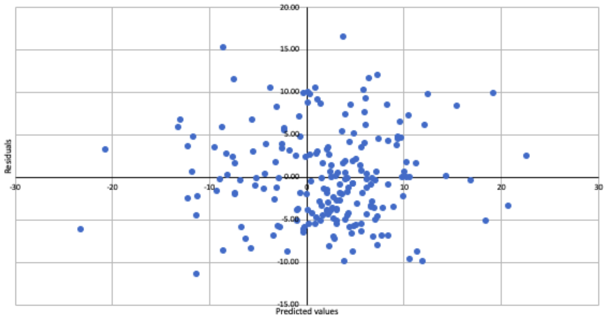

Figure A.4: Residual Plot for New Sin Peers in the Four-factor model

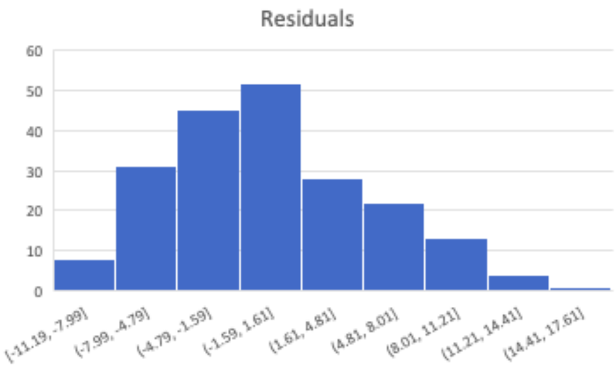

Figure A.5: Histogram of Residuals for New Sin Peers in the Five-factor model

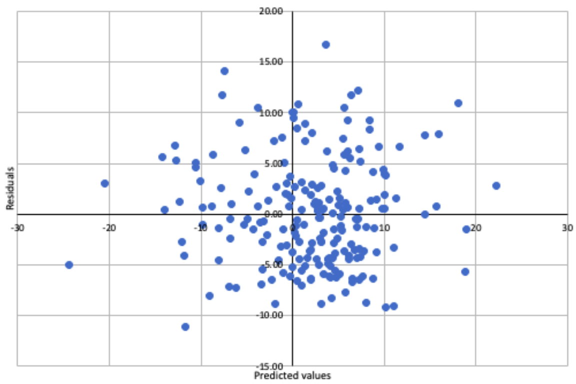

Figure A.6: Residual Plot for New Sin Peers in the Five-factor model

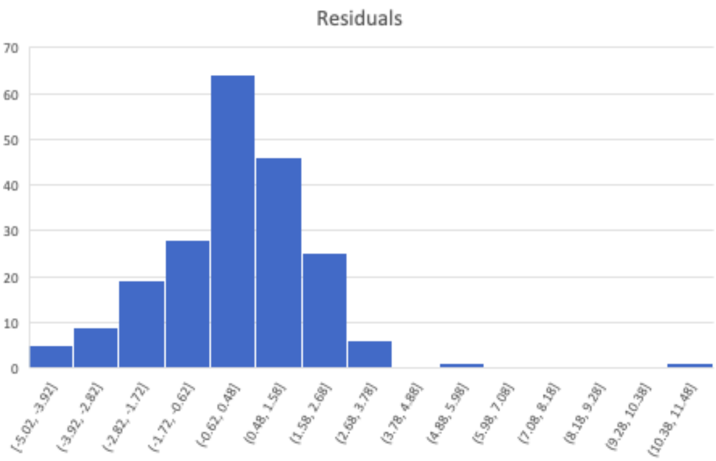

Figure A.7: Histogram of Residuals for Traditional Sin Peers in the Three-factor model

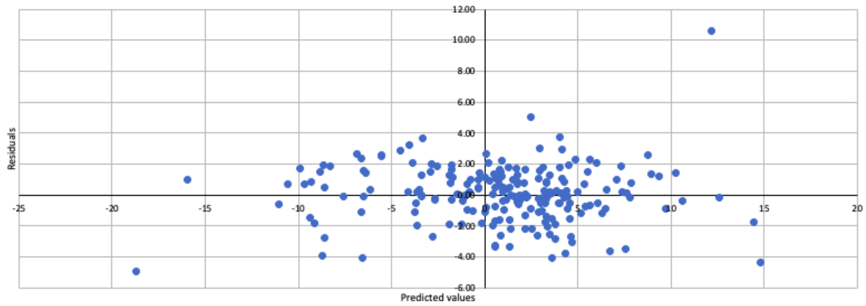

Figure A.8: Residual Plot for Traditional Sin Peers in the Three-factor model

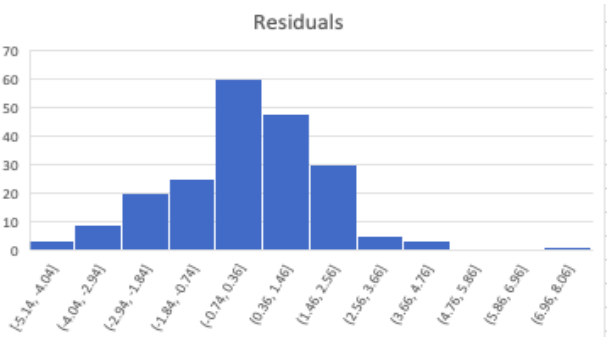

Figure A.9: Histogram of Residuals for Traditional Sin Peers in the Four-factor model

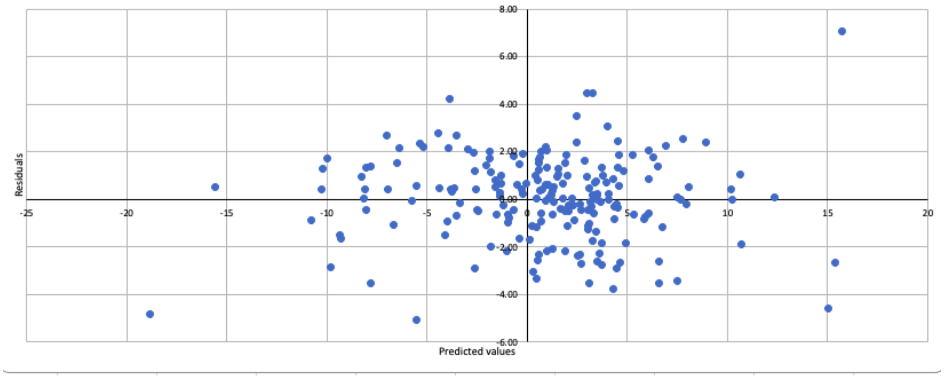

Figure A.10: Residual Plot for Traditional Sin Peers in the Four-factor model

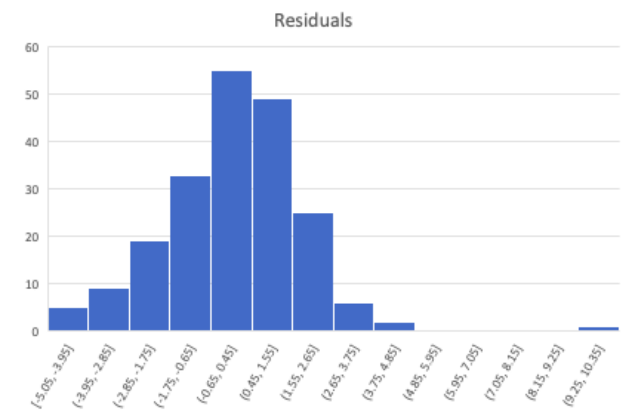

Figure A.11: Histogram of Residuals for Traditional Sin Peers in the Five-factor model

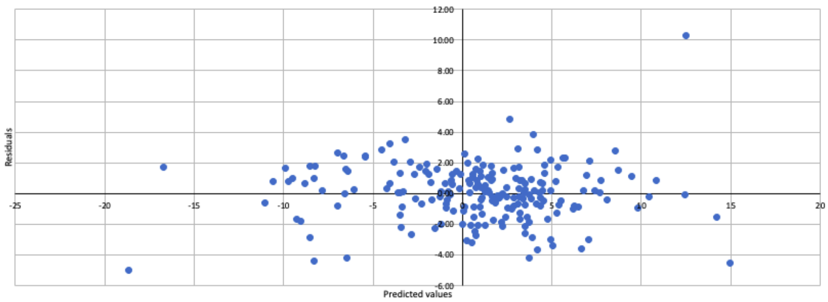

Figure A.12: Residual Plot for Traditional Sin Peers in the Five-factor model

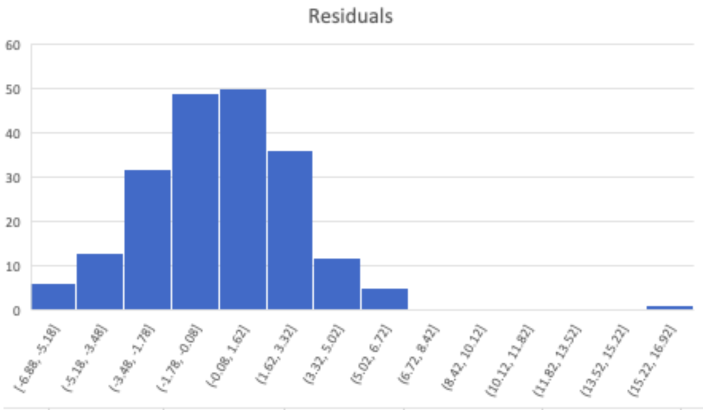

Figure A.13: Histogram of Residuals for Traditional Sin in the Three-factor model

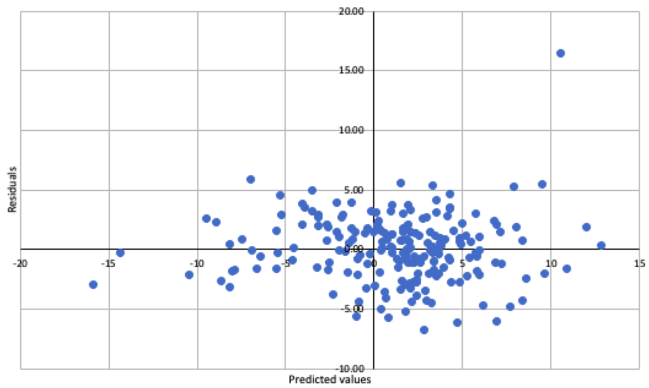

Figure A.14: Residual Plot for Traditional Sin in the Three-factor model

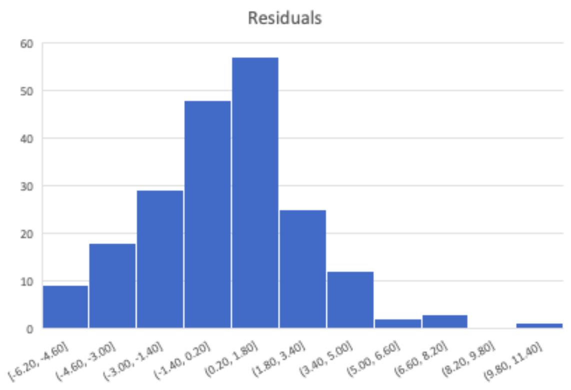

Figure A.15: Histogram of Residuals for Traditional Sin in the Four-factor model

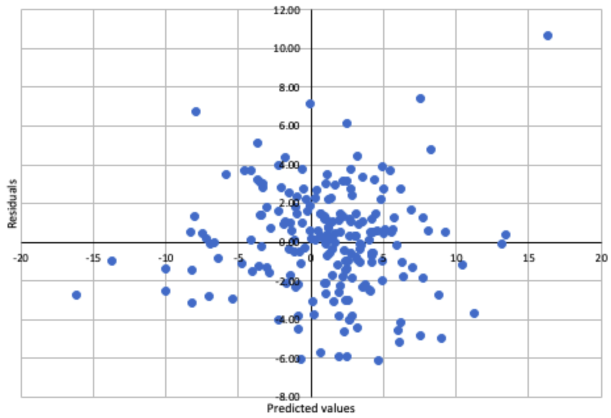

Figure A.16: Residual Plot for Traditional Sin in the Four-factor model

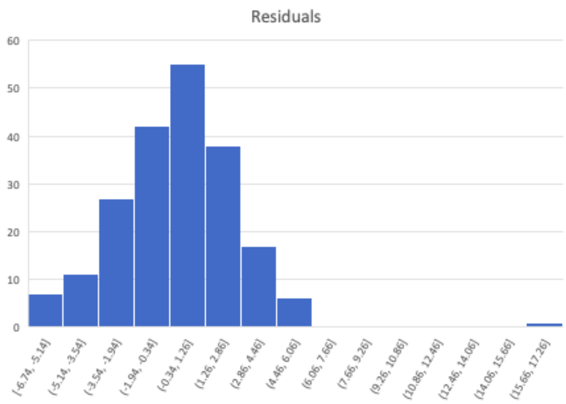

Figure A.17: Histogram of Residuals for Traditional Sin in the Five-factor model

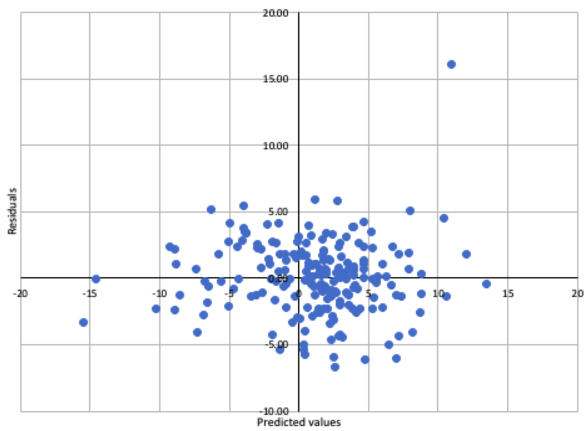

Figure A.18: Residual Plot for Traditional Sin in the Five-factor model

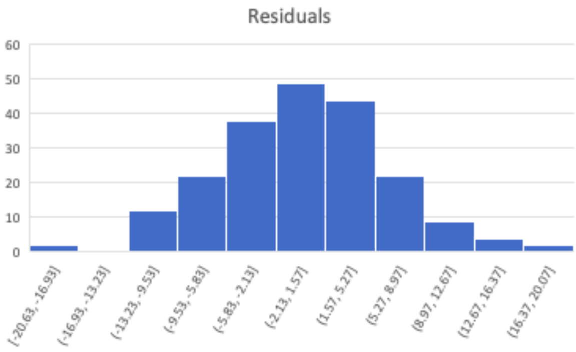

Figure A.19: Histogram of Residuals for New Sin in the Three-factor model

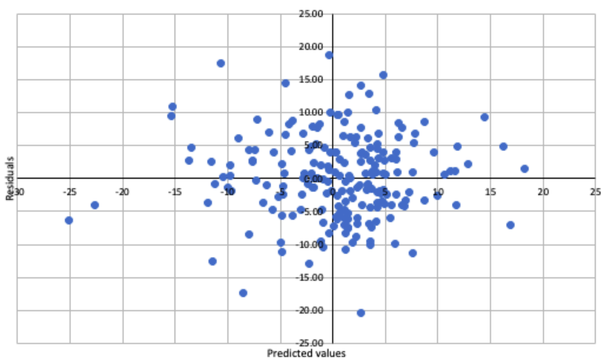

Figure A.20: Residual Plot for New Sin in the Three-factor model

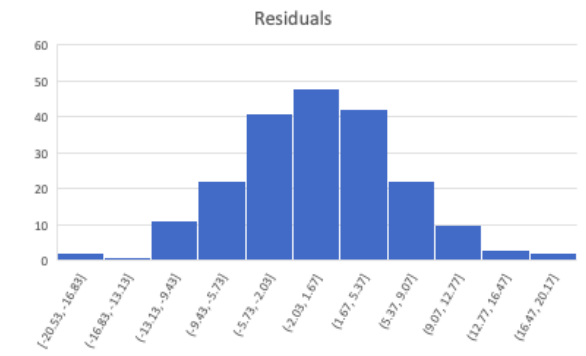

Figure A.21: Histogram of Residuals for New Sin in the Four-factor model

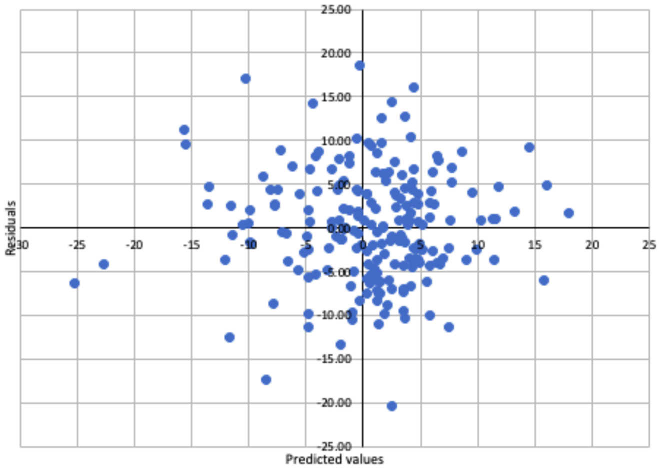

Figure A.22: Residual Plot for New Sin in the Four-factor model

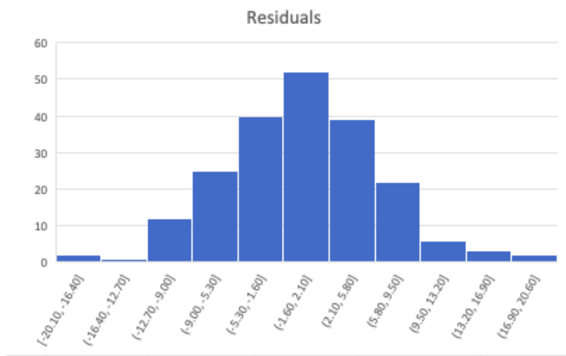

Figure A.23: Histogram of Residuals for New Sin in the Five-factor model

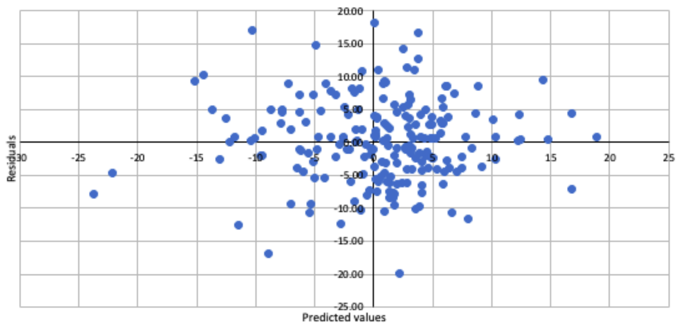

Figure A.24: Residual Plot for New Sin in the Five-factor model

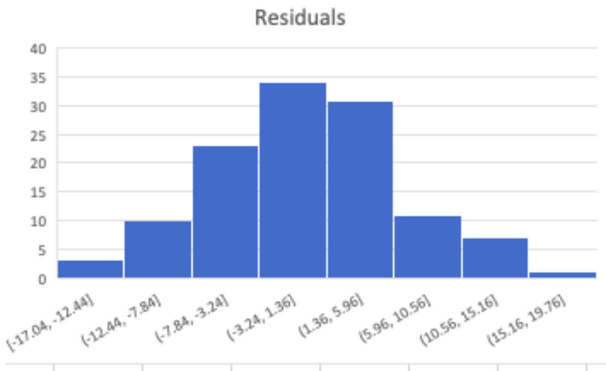

Figure A.25: Histogram of Residuals for New Sin Pre-Paris-Agreement in the Three-factor model

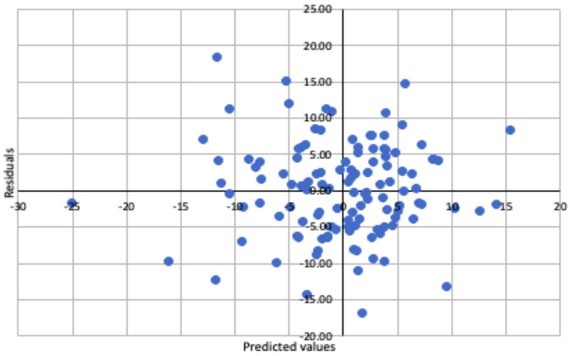

Figure A.26: Residual Plot for New Sin Pre-Paris-Agreement in the Three-factor model

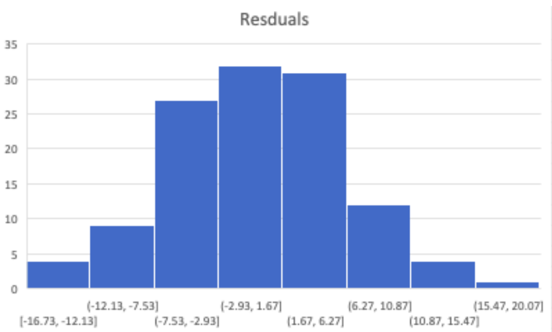

Figure A.27: Histogram of Residuals for New Sin Pre-Paris-Agreement in the Four-factor model

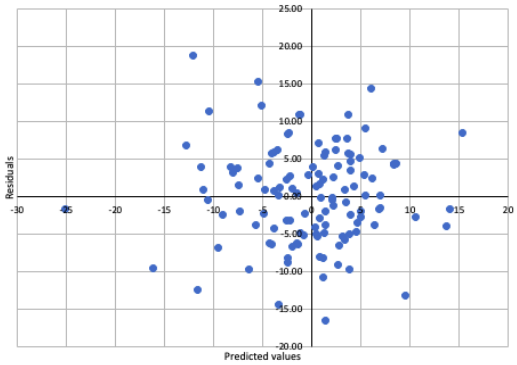

Figure A.28: Residual Plot for New Sin Pre-Paris-Agreement in the Four-factor model

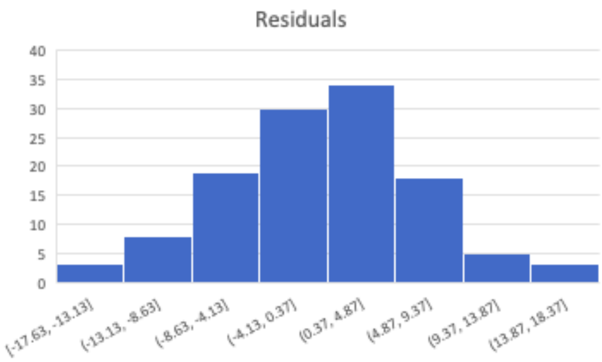

Figure A.29: Histogram of Residuals for New Sin Pre-Paris-Agreement in the Five-factor model

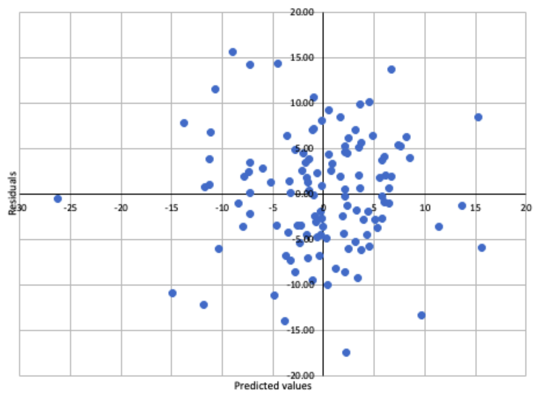

Figure A.30: Residual Plot for New Sin Pre-Paris-Agreement in the Five-factor model

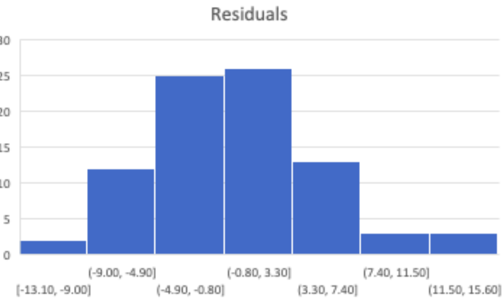

Figure A.31: Histogram of Residuals for New Sin Post-Paris-Agreement in the Three-factor model

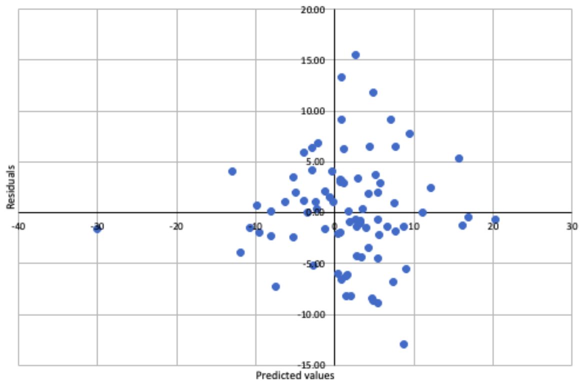

Figure A.32: Residual Plot for New Sin Post-Paris-Agreement in the Three-factor model

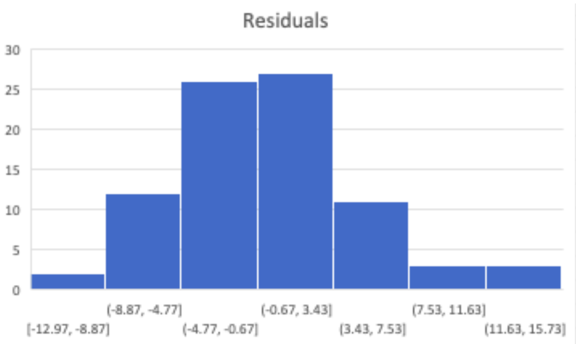

Figure A.33: Histogram of Residuals for New Sin Post-Paris-Agreement in the Four-factor model

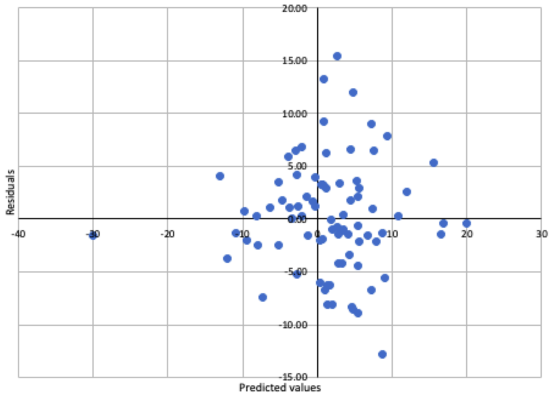

Figure A.34: Residual Plot for New Sin Post-Paris-Agreement in the Four-factor model

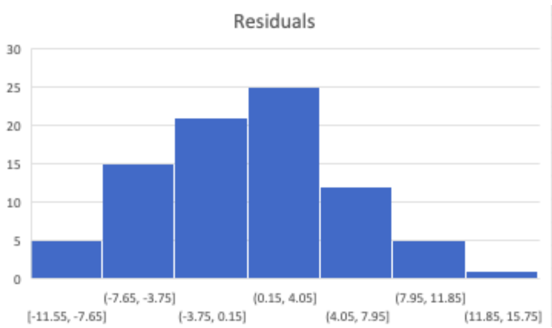

Figure A.35: Histogram of Residuals for New Sin Post-Paris-Agreement in the Five-factor model

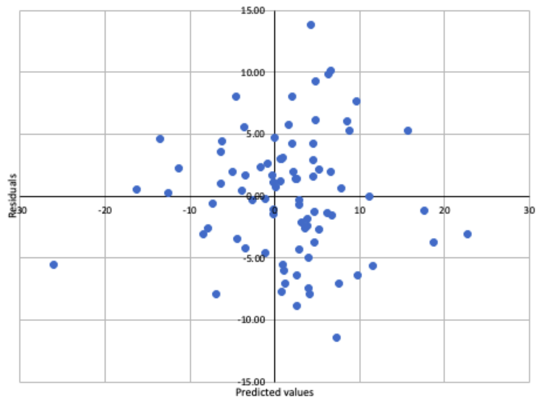

Figure A.36: Residual Plot for New Sin Post-Paris-Agreement in the Five-factor model