UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Financial Economics

Investing Without Conscience

Comparing a sin investment strategy to Benchmark S&P 500

Bachelor thesis 15 hp
By Olle Blennskog & Markus Gillesén
Tutor: Oben K. Bayrak
Spring term 2022

Abstract

The chase for maximum returns is a race every investor participates in. The number of investing strategies is almost equal to the number of investors, and everyone claims that their strategy is the best. Socially responsible investing is a popular strategy and is gaining a lot of attention by the masses, investors are ready to pay a high premium for stocks that are considered ethical and have low impact on the environment. The opposite of this is to invest in companies operating in questionable moral sectors. These companies may be undervalued and perform better than the market as they are not often purchased at a premium.

This paper has examined the returns of a portfolio, only including companies that operates in these unethical sectors. The sectors have been selected by thorough research among peers and academics and are the following: *Aerospace & Defense, Brewers, Casinos & Gaming, Distillers & Wineries* and *Tobacco.* The returns of this portfolio were then compared to the S&P 500 index, an index chosen to represent the US market which this research is based on.

The comparison was measured by several ratios and calculations. These includes Sharpe ratio, Information ratio, Treynor ratio and Sortino ratio. The most comprehensive analysis was the ordinary least squares regression, this was also followed up by a T-test. Overall, the results indicates that the S&P 500 index performed better in all aspects. It had a lower risk and a higher return. All results were not statistically significant but after careful consideration and discussion the conclusion was made that the S&P 500 did perform better under the set time period.

Acknowledgement

We would like to express our gratitude for our supervisor Oben K. Bayrak. You helped us tremendously and gave us key insights and suggestions during the entire period. We would especially like to thank you for the mental support. Writing the thesis was a struggle, not only in academic terms but mentally as well. Without your support, calming feedback and the reassuring words the paper would not hold the standard it does today.

Gothenburg, May 20, 2022.

Markus & Olle

Table of Contents

1. Introduction

In this section a brief background regarding the subject is presented, followed by the underlying problem at hand. Here you can also find the research question and the limitations set when conducting the research.

1.1 Background

Ethical and moral questions about what is right and what is wrong are today more current than ever. This is also something that can be witnessed in business and finance. This essay will cover and investigate how an investor will be financially affected by not making unethical investments, by comparing how unethical "sin" stocks performs in contrast to the overall market.

Financial decisions are as already mentioned, becoming increasingly affected by social and ethical aspects. Fama and French (2007) states that investors which they call socially responsible investors, tend to avoid unethical stocks, also called sin stocks which will be introduced and further described in following segments. However, every investor does not take these moral aspects into account, meaning that many investors are still willing to invest in unethical companies. Fama and French (2007) argue that the first group of investors described, drive up the prices of these socially responsible stocks and simultaneously lowering the returns investors can expect from these stocks. However, the other group of investors do the opposite to the socially responsible investors. Thus, the question regarding which of these groups of stocks and investment opportunities has the highest return still exists.

Unfortunately, answering this question is easier said than done. For example, several studies are made on US stock markets where Shank et al. (2005) concludes that investors willing to sacrifice investing in sin stocks to invest in more socially responsible stocks find a better financial return. However, Luck and Wood (1992) as well as Chong et al. (2006) both reach the conclusion that the opposite is financially better i.e., to invest in sin stocks yields a higher return. Furthermore, Lobe and Walkshäusl (2014) refers to several studies, conducted with various approaches on different markets and with different measurements that ultimately reaches the same conclusion; no noticeable inequalities were found measuring the returns between sin stocks and socially responsible stocks.

In order to showcase some examples of sin stocks an examination into the Vitium Global Fund, is made, originally called the Vice Fund. The former name of the fund indicates that the investments made by this fund are heavily in the area regarding sin stocks. In fact, the Vitium Global Fund are exclusively making investments in industries seen as socially irresponsible. These industries are gambling, defense, alcohol and tobacco. So, the stocks the Vitium Global Fund invests in are for example alcohol and tobacco producers, manufacturers of defense equipment and casino operators. (Usamutuals, 2021)

However, these sin industries are not officially stated. Instead, what is seen as a sin stock in a particular market depends entirely on how society's view on the company in question and their business model. Lobe and Walkshäusl (2014) mentions that not only the return of the stock, but also the determination of a sin stock or not depends on cultural characteristics etc. in a specific country.

1.2 Problem Description

Every investor is looking for the best strategy to maximize their return while minimizing their exposure and risk. A common strategy is to use ESG investing (Environmental, Social and Governance). This means that they use non-financial criteria and factors when they are evaluating different firms and its growth opportunities. This research will explore the other side of the spectrum, which is not as heavily researched compared to ESG. Sin stocks are shares in companies that are active in markets and sectors that are considered unethical i.e., alcohol, tobacco, gambling, and weapons. These companies are often undervalued because many investors will face backlash if they were to invest in these companies, especially in these times when ESG investing is becoming popular.

1.3 Research Question

Because of the lack of consensus regarding the performance of sin stock compared to the overall market, we advocate the need for further research in the matter. Therefore, the aim for this study is to bring further clarification and data regarding the research question:

Can a portfolio including only sin stocks outperform the overall market?

1.4 Research Purpose

The purpose of this study is to determine whether investing in sin stocks gives an investor better result in comparison to the overall market. This is done by comparing the performance of a sin stocks portfolio to a benchmark index on the same market. The end goal from this result is therefore to see if an investor has advantages for choosing to make unethical investments.

1.5 Limitations

As in any research there will be some limitations and exclusion of data, especially when the authors have limited time and financial resources. The time frame of 4 years was based on a compromise between having enough companies in the portfolio while having period length of as many years as possible. The most vital criteria were that all companies included had to be listed during the whole period. With four years 66 companies could be included and it was then decided it was sufficient for this paper. The companies were carefully selected following the criteria described in section 3.1.1.

The decision for researching the United States market was made after the conclusion that it had the most actively traded companies during the chosen time frame. Therefore, this paper will focus on the US market and will therefore be based on data collected from companies listed in the US and are being traded on the US stock exchange. This will exclude any company and other market index outside the US, thus there might be different results in other regions and stock exchanges. This will be further explained in section 6.1.

As these different limitations add up it might give misguiding results if one were to apply the outcome of this study on other markets and the make a general assumption. This will severely affect the credibility of the study.

2. Theoretical Framework

There has been some similar researched published where the authors examined the question if there is excess return for an investor who only invests in sin stocks. Prior to this paper, extensive research was done in the subject in order to understand the field this paper would explore. We believed that thoroughly examining other authors work would benefit us as we could avoid certain traps but also help us understand our own findings. In this section we will review some of this literature.

2.1 Sin Stocks

To evaluate what is considered a sin stock, a researcher should first take into account how different cultures and regions may have different opinions on what is deemed to be a sin stock or not. Papers written by Roca and Wong (2010) as well as Stulz and Williamson (2003) explore this aspect and conclude that the status “sin stock” can vary among different countries. I.e., a firm that produces alcoholic beverages could be labeled “sin stock” in almost every country but is only classified as an official sin stock in countries where the population have a negative view on the production as well as consumption of acholic beverages.

Therefore, ambiguities may occur in the classifications system. In their paper, Blitz and Fabozzi (2017) gives an explanation for the definition of a sin stock. They use the following definition:

> *A stock of a company either directly involved in or associated with activities widely considered to be unethical or immoral. Sin stocks are found in sectors whose activities are frowned upon by some or most of society, because they are perceived as making money from exploiting human weaknesses and frailties. Sin stock sectors therefore include alcohol, tobacco, gambling, sexrelated industries, weapons manufacturers, and the military.*

This definition can then be strengthened by another source they use in their paper. *Sin stock report* (2015)*,* an online magazine covering sin stocks claims that the biggest three categories of sin stocks are alcohol, tobacco and gambling. Furthermore, they also mention other categories as well including weapons, pornographic and marijuana stocks. The website concludes their arguments by stating that there might be companies working in other sectors that could still be labeled as sin stocks because of the working conditions in their factories.

There is also the already mentioned vice fund, which is a mutual fund and has the strategy to invest in companies that derive a significant fraction of their revenue from sectors that are considered vice industries. In their prospectus they claim that 80% of the net assets shall be invested in equity securities from companies operating in the sectors of alcoholic beverages, defense/aerospace, gaming/gambling and tobacco. They further explain the definition of vice industries: (Usamutuals, 2021)

> *"Vice industries" are those industries whose focus, in the Adviser's assessment, may be morally questioned by members of the general public or face funding or regulatory challenges because of social disapproval.*

2.2 Literature Review

Findings made by Lobe and Walkshäusl (2014) conclude that there is no evidence of statistically significant difference in returns between a sin portfolio and its benchmark index. Under further examination they find that during the years 1960s and 1970s there existed an outperformance from the sin stocks compared to the benchmark index but in recent years this has not been the case. During their research they found other characteristics that investors may find interesting, such as the fact that sin stocks often get priced by value and therefore bear less market risk, which is indicated by an average beta below 1.

This result may be expected as it is commonly known that beating the market is a struggle many investors face. Despite this claim, research which proves that sin stocks portfolios may outperform the market exists.

A study made by Fabozzi, Ma and Oliphant (2008) collected samples over the period 1970-2007 from 21 national markets. They designed their portfolios by selecting equity securities from companies operating in industries such as alcohol, tobacco, defense, biotech, gaming and adult service industries. Then they excluded companies with 30% or less of the total revenue from operation in these fields. In their findings they stated that sin stocks did in fact outperform the market by over 3% yearly.

Another aspect that also can explain a difference in the performances is lobbying. In a paper, Ghouma and Hewitt (2019) explored the impact lobbying had on returns that were considered sin stocks. In their conclusion they stated that companies that invested in lobbying had higher returns than companies that did not do similar activities. They also examined if CSR (Corporate Social Responsibility) activities had some impact on the return of sin stocks. Their findings suggested that these kinds of expenditures had a negative effect on the sin stock performance.

As mentioned in section 2.1 the cultural differences may play a significant role in the performances of sin stocks. This theory has been proven by Cheung & Lam (2015) who found that in Hong Kong, sin stocks are more likely to have abnormal returns relative to the US. According to the authors this suggests that the differences in country-specific cultural norms influence sin stock performance. This once again points out that investors in different countries may differ in their views on what is considered to be a sin stock or where it is on the unethical scale. Furthermore, the literature shows that the influence of investor attitude on sin stock performance also alter between different regions and countries (Liston, 2016).

2.3 Sharpe Ratio

The Sharpe ratio was introduced in 1966 and it measures the volatility adjusted performance of mutual funds. The Sharpe ratio does not only calculate the excess return of a portfolio, but it also measures the return in relation to its risk (Sharpe, 1994). It is well known that investors, both professional and amateurs want to maximize return and minimize risk. Therefore, the Sharpe ratio is applicable in this situation as it will consider the volatility when examining the historical return. The formula for this ratio can be seen below.

$$Sharpe\ ratio = \frac{Excess\ return}{Standard\ deviation\ of\ excess\ return}$$

Equation 1.

$$SR_i = \frac{\Delta R_i}{\sigma_i}$$

The Sharpe ratio (Sharpe (1994) defines Excess return (ΔR) as the monthly return above the risk-free rate, often the one month treasury bill. This is then divided by the standard deviation of the excess return σ which gives us the SR. A high Sharpe ratio implies a better performance. In conclusion the Sharpe ratio present the risk adjusted performance per extra risk taken. For example, a higher standard deviation will have a negative effect on the total ratio. So even if the return is abnormally high, the standard deviation will burden the ratio if it is also high.

here are some limitations to this measurement. As the Sharpe ratio is built on the standard deviation of a portfolio, it is based on certain assumptions. For example, if the data is contradicted with this assumption, errors will occur. According to Bernardo and Ledoit (2000) the Sharpe ratio can be inaccurate when the shape of the returns is not normally distributed. There will also be limitations of historical periods, as investors and managers can choose a suitable period to maximize their Sharpe ratio rather than choosing a period that best reflect the overall performance of the fund (Goetzmann et al., 2002).

2.4 Information Ratio

Another very similar ratio is the Information ratio (Treynor and Black, 1973). The information ratio's only mathematical difference is that instead of using a T-bill or equivalent as a risk-free rate, it measures the excess return from a relevant benchmark index.

$$Information\ ratio = \frac{Excess\ return}{Standard\ deviation\ of\ excess\ return}$$

Equation 2

2.5 Treynor ratio

The Treynor ratio is similar to the Sharpe ratio but instead of being based on volatility, it focuses on the systematic risk of the investment. The ratio is therefore calculated by the risk premium divided by the beta of the security (Pilotte & Sterbenz, 2006). In other words, the ratio measures the excess return from a risk-free investment per unit of market risk. A high value of the ratio indicates that the security is yielding a high return in regard to the market risk. The formula is the following.

$$Treynor\ Ratio = \frac{R_p - R_f}{\beta}$$

Equation 3

$R_P = Return\ Portfolio$

$R_f = Risk\text{-}free\ rate$

$\beta = Beta\ of\ the\ portfolio$

2.6 Sortino Ratio

The Sortino ratio is also conducted in a similar way to the Sharpe ratio. However, with one important difference. The Sortino ratio distinguish between upside and downside volatility and the ratio emphasizes on downside deviation. In more specific terms, it focuses on the returns that fall under a specified target level. So, instead of dividing the numerator by the standard deviation the Sortino ratio uses the target downside deviation (TDD). In order to calculate the ratio a target return must be set. This target return will change the outcome of the ratio and it is therefore essential to use the same target return when comparing two different portfolios/securities. The numerator is the average period return subtracted by the target return. The TDD is calculated by taking each data point and then calculating the difference between the data point and the selected target level. For each data point that is above the target, the value zero is set. If it is below the target, the actual difference will be used. Next, calculating the square of each value that is below the target return and afterwards an average of all observations is calculated. The final step of the TDD calculation is to take the square root of the previous value mentioned, then the TDD value is obtained. Lastly, the average return is divided by the TDD and the end value obtained is the Sortino ratio (Rollinger & Hoffman, 2013).

$$Sortino\ Ratio = \frac{R - T}{TDD}$$

Equation 4

$R = Average\ return\ for\ period$

$T = Target\ or\ required\ rate\ of\ return$

$TDD = Target\ Downside\ Deviation$

2.7 Efficient Market Hypothesis

When it comes to examining the performance of a stock or an index as this paper will do, it is essential that the efficient market hypothesis assumption hold. The Efficient Market Hypothesis (Malkiel, 1989) assumption is based on how a capital market is said to be efficient if it correctly reflects all relevant information when determining security prices. In practice, this means that it is impossible to make profit by trading with information that is publicly available. This might be hard to accept as a truth when there is a whole industry based on the theory that this rule does not apply. In his paper, Malkiel (2003) explores this theory and review some of the biggest critics to it. His conclusion expresses that the collective judgement of the mass investor, both professionals and amateurs will occasionally make mistakes. These mistakes will lead to pricing malfunctions, these errors can then form a pattern over a short time and actually give inefficient return. Therefore, he claims that the market cannot be fully efficient, because that case there would be no incentives for firms to enter this industry. He emphasizes on the importance of time. These professionals may find excess return by interpretating the information before the stock market can adjust.

In conclusion he believes that there might be irrationalities and mispricing, but the market will quickly correct itself. This strengthens our case when it comes to the assumption that the data will be priced correctly and according to public information.

2.8 Behavioral Finance

When it comes to studying the relationships between sin stocks, ESG and the overall market it becomes almost a necessary to examine behavioral finance. In Ritter´s (2003) paper he defines behavioral finance as models where some individuals are not fully rational, which can be derived from their preferences and beliefs. This is clear violation to the efficient market hypothesis mentioned above. The efficient market hypothesis does not assume that all investors are rational, but it does assume that the market is. In contrast to this, behavioral finance assumes that financial markets are inefficient.

2.9 Jensen’s Alpha

Jensen’s Alpha measures the performance of a specific portfolio, compared to the overall market. This measurement of the portfolio return is based on the Capital Asset Pricing Model (CAPM) and therefore measures the portfolio return with regards to the risk involved.

Jensen’s alpha is calculated via the following formula:

$$\alpha = R_P - r_f - \beta(R_M - r_f)$$

Equation 5

$\alpha = Jensen's\ alpha$

$R_P = portfolio\ return$

$r_f = risk\text{-}free\ rate$

$\beta = beta$

$R_M = market\ return$

The sign α in the equation above, means alpha and in this specific equation, it is Jensen’s alpha. This value states how the portfolio has performed compared to a benchmark index, considering the risk of which this portfolio holds. A positive alpha value states that the portfolio has outperformed the risk which is associated with it. On the other hand, a negative alpha value in fact states that with the given return of the portfolio, it held an unnecessary amount of risk (Corporatefinanceinstitute, 2020). The beta variable has a significant impact on the equation. Beta measure the volatility of the stock/portfolio in relations to the market, this is then considered to be the risk of the security. A beta of one indicates that the security moves exactly like the market, if the beta is below one, the security has lower risk compared to the market and vice versa. In order to compute Jensen´s alpha and the beta equation 6 needs to be rearranged. The following model is then presented.

$$r_{i,t}^{i} - r_{ft} = \alpha_i + \beta_i\left(r_t^{BM} - r_{ft}\right) + \varepsilon_{i,t}$$

Equation 6

$r_{i,t}^{i} = Logarithmic\ monthly\ return\ of\ strategy\ i\ at\ time\ t$

$r_{ft} = Monthly\ risk\ free\ rate\ at\ time\ t$

$\alpha_i = Estimated\ Jensen's\ alpha$

$\beta_i = Estimated\ systematic\ risk\ for\ strategy\ i$

$r_t^{BM} = Monthly\ logarithmic\ return\ of\ benchmark\ index$

$\varepsilon_{i,t} = Error\ term\ for\ strategy\ i\ at\ time\ t$

2.10 Risk-Free Rate

Throughout this thesis, models including excess return will be used for reasons such as calculation of performance of the sin portfolio. In order to reach the value of excess return, a risk-free rate must be determined. By definition, the risk-free rate is the return one can expect from an investment with one hundred percent certainty i.e., without any risk. Thus, this expected return should equal the actual return received. It should be neither more, nor less. According to Damodaran, the government of a developed country can be seen as default free. Thus, the actual assets that are viewed as risk-free are government bonds (Damodaran, 2019).

In this thesis, the focus lay on the United States stock market. Therefore, the risk-free assets used in models, will be the government bonds of the United States. In more detail, the risk-free rate will be collected from the US one month treasury bill.

3. Method

In this chapter the method will be explained. In more detail, in section 3.1 the data collection method is presented. The sin portfolio, index and risk-free rate is divided in different sections to clarify how each data set was composed. Then calculations of the different ratios are described as well. The OLS regression will also be explained. The assumptions regarding the OLS regression are explored and examined in appendix A.

3.1 Data Collection

This thesis is done by investigating and comparing the financial performance of a benchmark index and a portfolio computed for this paper, containing sin stocks. When collecting the data for the thesis, Thomson Reuters Refinitiv database was used. The data was collected for the four most recent years, the first data point being the last of April 2018 and the last data point being the last of March 2022. The datapoints collected are prices for the last of each month during the period i.e., monthly price points are collected for all stocks in the portfolio, as well as for the index used. As the measured performance is based on the stock and index prices, a passive investment strategy is assumed, implying a buy and hold strategy.

3.1.1 Sin Portfolio

To identify our chosen sin stocks to include in the portfolio, the listed companies were filtered by industries on the United States stock market. The industries classification system is The Refinitiv Business Classification (TRBC) which classifies global companies into their fitted industry, based on the degree of impacts on markets (refinitiv, 2022). Thus, the industries filtered for are *Aerospace & Defense, Brewers, Casinos & Gaming, Distillers & Wineries* and *Tobacco* on The New York Stock Exchange and NASDAQ. The found stocks were then screened and companies who were not listed on the stock market for the entire period were excluded from the portfolio.

In the end, a portfolio containing 66 sin stocks had been designed, all with an equal portfolio weight of circa 1.52 percent, including the following companies divided by their respective industry:

Table 1

COMPANY	SECTOR	EXCHANGE
AAR Corp	Aerospace & Defense	NYSE
Aerojet Rocketdyne Holdings Inc	Aerospace & Defense	NYSE
AeroVironment Inc	Aerospace & Defense	NASDAQ
Allegheny Technologies Inc	Aerospace & Defense	NYSE
Astronics Corp	Aerospace & Defense	NASDAQ
Astrotech Corp	Aerospace & Defense	NASDAQ
Axon Enterprise Inc	Aerospace & Defense	NASDAQ
Boeing Co	Aerospace & Defense	NYSE
BWX Technologies Inc	Aerospace & Defense	NYSE
Curtiss-Wright Corp	Aerospace & Defense	NYSE

Ducommun Inc	Aerospace & Defense	NYSE
General Dynamics Corp	Aerospace & Defense	NYSE
HEICO Corp	Aerospace & Defense	NYSE
Hexcel Corp	Aerospace & Defense	NYSE
Howmet Aerospace Inc	Aerospace & Defense	NYSE
Huntington Ingalls Industries Inc	Aerospace & Defense	NYSE
Innovative Solutions and Support Inc	Aerospace & Defense	NASDAQ
Intevac Inc	Aerospace & Defense	NASDAQ
Kaman Corp	Aerospace & Defense	NYSE
Kratos Defense and Security Solutions Inc	Aerospace & Defense	NASDAQ
L3harris Technologies Inc	Aerospace & Defense	NYSE
Lockheed Martin Corp	Aerospace & Defense	NYSE
Mercury Systems Inc	Aerospace & Defense	NASDAQ
MICT Inc	Aerospace & Defense	NASDAQ
Moog Inc	Aerospace & Defense	NYSE
National Presto Industries Inc	Aerospace & Defense	NYSE
Northrop Grumman Corp	Aerospace & Defense	NYSE
Park Aerospace Corp	Aerospace & Defense	NYSE
Raytheon Technologies Corp	Aerospace & Defense	NYSE
Spirit AeroSystems Holdings Inc	Aerospace & Defense	NYSE
Textron Inc	Aerospace & Defense	NYSE
TransDigm Group Inc	Aerospace & Defense	NYSE
Triumph Group Inc	Aerospace & Defense	NYSE
VirTra Inc	Aerospace & Defense	NASDAQ
VSE Corp	Aerospace & Defense	NASDAQ
Boston Beer Company Inc	Brewers	NYSE
Constellation Brands Inc	Brewers	NYSE
Molson Coors Beverage Co	Brewers	NYSE
Boyd Gaming Corp	Casinos & Gaming	NYSE
Caesars Entertainment Inc	Casinos & Gaming	NASDAQ
Canterbury Park Holding Corp	Casinos & Gaming	NASDAQ
Century Casinos Inc	Casinos & Gaming	NASDAQ
Churchill Downs Inc	Casinos & Gaming	NASDAQ

Everi Holdings Inc	Casinos & Gaming	NYSE
Full House Resorts Inc	Casinos & Gaming	NASDAQ
Golden Entertainment Inc	Casinos & Gaming	NASDAQ
International Game Technology PLC	Casinos & Gaming	NYSE
Las Vegas Sands Corp	Casinos & Gaming	NYSE
Melco Resorts & Entertainment Ltd	Casinos & Gaming	NASDAQ
MGM Resorts International	Casinos & Gaming	NYSE
Monarch Casino & Resort Inc	Casinos & Gaming	NASDAQ
Penn National Gaming Inc	Casinos & Gaming	NASDAQ
PlayAGS Inc	Casinos & Gaming	NYSE
Red Rock Resorts Inc	Casinos & Gaming	NASDAQ
Scientific Games Corp	Casinos & Gaming	NASDAQ
Wynn Resorts Ltd	Casinos & Gaming	NASDAQ
Brown-Forman Corp	Distillers & Wineries	NYSE
Eastside Distilling Inc	Distillers & Wineries	NASDAQ
MGP Ingredients Inc	Distillers & Wineries	NASDAQ
Willamette Valley Vineyards Inc	Distillers & Wineries	NASDAQ
22nd Century Group Inc	Tobacco	NASDAQ
Altria Group Inc	Tobacco	NYSE
Philip Morris International Inc	Tobacco	NYSE
Turning Point Brands Inc	Tobacco	NYSE
Universal Corp	Tobacco	NYSE
Vector Group Ltd	Tobacco	NYSE

An aspect that needs to be considered is each sector´s weight to the overall portfolio, in table 2 it can be seen how many companies operate in each sector.

Table 2

Industry	#	%
Aerospace & Defense	35	53%
Brewers	3	4.5%
Casinos & Gaming	18	27.3%
Distillers & Wineries	4	6.1%
Tobacco	6	9.1%
Total	66	1

3.1.2 Index

In order to get a better understanding of the performance of the sin stocks portfolio, a comparison with the overall market is made. Here difficulties occur as the performance of the overall market is not that obvious. However, in our attempt to do so the S&P 500 index is used as a benchmark index to represent the overall market. Consisting of 500 large-cap companies across several sectors, the S&P 500 index is considered a valid approximation of the U.S. stock market. Although, the index only contains large-cap companies of the market, it is still considered to be one of the best ways to portrait the performance of the overall market and is widely used as a benchmark index for measurement of portfolios (Spglobal, 2022).

Similarly as the portfolio data collection, the price points for the S&P 500 index are collected for the last four years, in a monthly interval. The data points are likewise taken from the Thomson Reuters Refinitiv database.

3.1.3 Risk-free Rate

The risk-free rate was collected and calculated by first gathering the monthly yields from the US one month treasury bill for each period in the set time frame. The data was collected from the website fred.stlouisfed.org managed by the Federal Reserve bank of St. Louise (2022). The data was stated in a yearly yield and therefore had to be calculated to a monthly return. The following formula was used

$$Return_M = (1 + Return_A)^{1/12} - 1$$

Equation 7

$Return_M = Monthly\ Return\ US\ 1\ Month\ Treasury\ Bill$

$Return_A = US\ 1\ Month\ Treasury\ Bill\ With\ Constant\ Maturity$

In order to compare this risk-free rate to our portfolio and index, this rate was converted to a logarithmic value which will be further described in the following section.

3.2 Descriptive Statistics & Ratios

As the data is collected, the management of this is done in Excel. The following formulas and methods are applied in this stage.

Total Return – The S&P 500 total return is calculated by dividing the price point from the final period, by the first price point of the period. Subtracting by one, the total return over the period is reached.

The calculation of the total portfolio return is constructed in a similar way. The total value of the portfolio from the final time period is divided by the total value of the portfolio from when the portfolio first is constructed. Again, subtracting by one gives the total return of the portfolio during set time frame.

Logarithmic returns – The next step is to calculate logarithmic returns and is done on all returns in this thesis. This method accounts for compounding by the formula assuming continuous compounding and is therefore chosen instead of non-logarithmic returns. This is done by firstly calculating the percentual return for each time period, based on the price levels compared to the time period before. Secondly, the natural logarithm is derived from these returns, resulting in a logarithmic return for each time period. The following formula is thereby used.

$$r_{i,t}^{log} = \log\left(\frac{p_{i,t}}{p_{i,t-1}}\right)$$

Equation 8

Average Monthly Return – The average monthly return is obtained from the results of the previous section. The average monthly return is thus obtained by calculating the arithmetic mean of the logarithmic returns. The arithmetic mean is calculated by simply dividing the sum of all returns, by the number of returns.

Volatility – The volatility of both the S&P500 index and the sin portfolio is calculated via the formula below.

$$\sqrt{\frac{\sum(x-\overline{x})^2}{n-1}}$$

Equation 9

Accordingly, the variance is calculated for the two data sets respectively, afterwards taking the square root from these values in order to receive two volatilities, one for each data set respectively.

Descriptive statistics – Further descriptive statistics are calculated and shown to get a better understanding of the two data sets. Maximum and minimum values from the two data sets will be shown, as well as the median values.

Sharpe Ratio – The Sharpe ratio is being based on a monthly basis. The average monthly logarithmic return is subtracted by the average monthly logarithmic risk-free return. The difference in the numerator is then divided by the standard deviation of return.

Information Ratio- Here, similar calculations have been made expect for using the S&P 500 index to calculate the excess return instead of the risk-free rate. See section 4 for further details.

Treynor ratio- When calculating the ratio for the sin portfolio the average monthly logarithmic return was used. The risk-free return was the average monthly logarithmic return of the US one month treasury bill. The time period from this data set is the same as used throughout this thesis. The beta of the sin portfolio was taken from the OLS regression which is further explained in section 3.3.1.

Calculating the ratio for the S&P 500 index was done by using the average monthly logarithmic return of the index, the risk-free assumptions is the same as mentioned above. The beta however is equal to one as the S&P 500 index was considered to represent the market.

Sortino ratio –In this paper, the average monthly logarithmic return is used as the return in the numerator, the targeted return is set at zero because there is no need to set a target rate when comparing to different strategies. The TDD was calculated by taking every monthly logarithmic return and following the procedure mentioned in section 2.6.

3.3 OLS Regression and Jensen's alpha

3.3.1 Model

The next step of this thesis is to conduct an ordinary least squares linear regression. This is performed get a deeper understanding of how the portfolio has performed compared to the overall market. After this regression, an estimated value of alpha and beta will be extracted. The beta has already been mentioned in 2.9 and explains how the portfolio moves when the overall market moves. The alpha in question, is Jensen's alpha and is also further described in section 2.9. Jensen's alpha is calculated via the following formula:

$$\alpha = R_P - r_f - \beta(R_M - r_f)$$

Equation 10

Accordingly, this equation will be rearranged, and the OLS regression will therefore take a shape as below:

$$R_P - r_f = \alpha + \beta\left(R_M - r_f\right) + \varepsilon$$

Equation 11

In this OLS regression, the excess return is the dependent variable, or equivalently the return of the portfolio subtracted by the risk-free rate as can be seen on the left-hand side of the equation. The independent variable is the excess return of the overall market, or equivalently the return of the benchmark index representing this, subtracted by the risk-free rate. Furthermore, an estimated value of beta will be developed, as well as an estimated value of Jensen's alpha, being the intercept of this OLS Regression. Lastly, an error term is added.

3.3.2 Hypothesis

The expected outcome from this regression is to conclude if the sin portfolio is either overperforming or underperforming compared to the overall market. Therefore, the already described Jensen's alpha is measured. As a negative alpha value implies a worse performance than the market and a positive alpha value an outperformance, the null and alternative hypotheses will be the following:

$H_0: \alpha = 0$

$H_A: \alpha \neq 0$

3.3.3 OLS Assumptions

When conducting a regression, a set of seven assumptions must be met. If they are not met the results cannot be accepted as valid. Therefore, the sample has been tested for these underlying assumptions.

After investigating and testing for these seven assumptions, the conclusion is made that the data set does fulfill all of these. Thus, no changes or adjustments needs to be made to the data in order to conduct the OLS regression. There is also no reason for any concern to the reliability of this regression, or the results achieved from this. Some of the tests conducted are for example the Durbin-Watson test for autocorrelation in the error terms, a White test for heteroscedasticity and a Shapiro-Wilk test to see if the residuals are normally distributed. All seven assumptions are further explained and thoroughly tested in Appendix A.

3.4 T-test: Paired Two Sample for Means

This method is used when comparing sample means from two groups that may have some correlation. This method was used based on the reality that there are some companies in both samples. Therefore, we cannot say that they are completely independent, and the paired method was chosen. Then the sample mean was taken from the monthly returns from both sets and the equation was calculated using Excel. The following null hypothesis was used.

$H_0: \mu_1 \leq \mu_2$

$H_A: \mu_1 > \mu_2$

Where μ_1 is the average monthly logarithmic returns for the sin portfolio and μ_2 is the average monthly logarithmic return for the S&P 500 index. If the null hypothesis can be rejected it can then be stated that the sin portfolio has higher monthly logarithmic return at a certain significance level.

4. Results

In this section, the findings from our study will be presented. The section has been divided into subsections to enable a clear description of the findings. The result will be briefly presented, a more thorough analysis and interpretation can be viewed in section 5.

4.1 Net return

The sin portfolio was created with data from 2018-04-30 until 2022-03-31. The time series data of monthly closing prices, allowed for calculations for the total value of the portfolio for each period. The initial value of the portfolio was then compared to the value at the end of the period. We then had the total return of the sin portfolio. The same calculation was then done for the S&P 500 index.

In this study we were also interested in seeing the monthly returns. Therefore, the average monthly return was calculated. This was derived by first calculating the logarithmic monthly returns and thereafter dividing the sum of these by the number of observations. In table 6 the results can be seen.

Table 3

Group	Total Return	Average Monthly Return
Sin Portfolio	25.21%	0.48%
S&P 500 index	71.08%	1.14%

4.2 Descriptive Statistics

The standard deviation is a measure of risk, which has been explained in section 2.3. This has been calculated in the report to give a better view of the overall performance of the two strategies. As already explained, performance must be measured in regard to risk and in this case, done via volatility. Thus, the standard deviation of the two strategies is calculated. As can be seen in table 4 the sin portfolio has a higher standard deviation than the S&P 500 index. This means that the sin portfolio returns has fluctuated more under the measured period. The median, maximum and minimum values are also shown in the table.

Table 4

	Sin Portfolio	S&P 500	Risk-free Rate
Standard Deviation	7.20%	5.0%	0.80%
Median	-0.20%	2.14%	0.02%
Max Value	12.22%	11.94%	0.20%
Min Value	-26.73%	-13.37%	0.001%

4.3 Sharpe Ratio

With an obtained standard deviation, the Sharpe ratio for each strategy could be calculated. This was done using the formula presented in section 2.3. In table 5 the results can be seen. The table shows that the S&P 500 index had a better Sharpe ratio during the period, implying that the index carried less risk for each gain in return, compared to the sin portfolio.

Table 5

	Sin Portfolio	**S&P 500 index**
Monthly return	0.48%	1.14%
Risk free return	0.08%	0.08%
Volatility	7.20%	5.03%
Sharpe Ratio	0.0557	0.2114

4.4 Information Ratio

The information Ratio could only be applied to the sin portfolio, as comparing the S&P 500 index to itself would not give any information that could lead to a better understanding of the different performances. A negative information ratio implies that the sin portfolio did not outperform the benchmark S&P 500 index.

Table 6

	Sin Portfolio
Monthly return	0.48%
INDEX (S&P 500)	1.14%
volatility	7.20%
Information Ratio	-0.0921

4.5 T-test: Paired Two Samples

In this section, the results from the T-test are presented. In this paired T-test a significance level of 5% was used. As the null hypothesis used the symbol ≤ the test is left tailed and therefore the *t critical one tail* value is used as the critical t-value. The observed t value is 1,0757 and in terms of absolute numbers that is lower than the critical value. Thus, the null hypothesis cannot be rejected at 5% significance level. More specific, the null hypothesis which states that the average monthly logarithmic returns from the sin portfolio are equal or less than the average monthly logarithmic returns from the S&P 500 index cannot be rejected.

Table 7

	Sin Portfolio	S&P 500 Index
Mean	0.0048	0.0114
Variance	0.0052	0.0025
Pearson Correlation	0.8174	
Hypothesized Mean Difference	0	
df	46	
t Stat	1.0757	
P(T<=t) one-tail	0.1438	
t Critical one-tail	1.6787	
P(T<=t) two-tail	0.2877	
t Critical two-tail	2.0129	

4.6 Treynor Ratio & Sortino Ratio

The results from the Treynor and Sortino ratios are presented in table 8. In both ratios, the sin portfolio is underperforming compared to the S&P 500 index. At first glance it can be explained by stating that the S&P 500 index have a larger average return then the sin portfolio, but when examining this deeper it can be seen that the TDD in the sin portfolio is higher which means that it has a higher volatility when only looking at the downside deviation. This heavily affects the outcome of the Sortino ratio. As for the Treynor ratio, the larger result for the S&P 500 index can be affected by the lower beta compared to the sin portfolio. As mentioned, the S&P 500 index has a beta of 1 as it is considered to represent the market while the beta for the sin portfolio exceeds 1.

Table 8

Ratio	Sin Portfolio	S&P 500 index
Average return	0.48%	1.14%
TDD	5.33%	3.39%
Sortino Ratio	**0.0898**	**0.3374**
Beta	1.167	1
Treynor Ratio	**0.0034**	**0.0712**

4.7 OLS regression & Jensen´s Alpha

To receive estimated alpha and beta values, an OLS regression was conducted. The results from this regression can be seen in table 9. As the table states, the regression's intercept, or equivalently the alpha (α) coefficient has a value of -0.0084. As mentioned in section 2.9 a negative alpha value gives the interpretation of an underperformance of the portfolio, compared to the overall market. However, the p-value for this coefficient is 0.185, indicating a non-significant alpha value, regardless of the level of significance chosen. Therefore, the null hypothesis regarding the alpha value cannot be rejected.

The beta (β) coefficient does on the other hand, receive a very small P-value of 0.000. Thus, the beta coefficient of 1.167 is significant on every significance level. The beta value is greater than one, meaning that the portfolio is likely to be more volatile than the market.

The R^2 value from the regression is 0.6678. The value describes how well the dependent variables' variance is described by the independent variables. In this case, the interpretation that 66.78% of the sin portfolio's movements are described by the movements of the S&P 500 index can be made.

Table 9

	Coefficient α	Coefficient β	p-value α	p-value β	R^2
Sin Portfolio	-0.0084	1.167	0.185	0.000	0.6678
S&P 500	0	1			

See Appendix B for full information.

5. Analysis

In this chapter the findings will be discussed and analyzed. Here an effort to link the findings with the previous discussed theories and literatures will be made.

5.1. Net return & Descriptive Statistics

When taking a first look at the net return it becomes clear that the S&P 500 index have performed better than the sin portfolio over the time period. The S&P 500 have a net return of 71,08% while the sin portfolio has a return of 25,21%. As this was firstly calculated in the report it set the tone of the following tests and metrics. Because there are no scientific calculations behind this result, no actual conclusion was drawn from this historic record.

Another finding made in the descriptive statistics was the difference in median value. The sin portfolio and the S&P 500 index had a median value of -0,20% and 2,14% respectively. This indicates that the sin portfolio was facing more periods of negative returns but when the returns were positive, they were larger in absolute terms. The S&P 500 is showing the opposite characteristics as its median is bigger than it is monthly average. Thus, the time periods which faced a negative return had a bigger absolute value than the periods of positive returns. When looking at the standard deviation it becomes clear that the S&P 500 carried less risk than the portfolio under the period. This impacts the results that has been calculated in the report.

5.2. Ratios

In order to compare the two different strategies, several ratios were calculated. They all have different aspects and emphasize on different components. It is therefore crucial to investigate them all. To analyze the different ratios, the result of each ratio is written in table 10.

Table 10

	Sin portfolio	S&P 500
Sharpe Ratio	0.0557	0.2114
Information ratio	-0.0921	
Treynor Ratio	0.0034	0.0712
Sortino Ratio	0.0898	0.3374

As the table confirms, the S&P 500 is outperforming the sin portfolio in every ratio that has been calculated. Examining the different ratios further gives a deeper understanding of the underlying reason for the results. The Sharpe ratio does as mentioned, rely deeply on the standard deviation of the portfolio and as stated the standard deviation of the sin portfolio is greater than the S&P index during the period. Something that should be revisited is the limitations stated by Bernardo and Ledoit (2000), who wrote that the Sharpe ratio is based on the assumption that the return is normally distributed. If that is not the case the Sharpe ratio may give an inaccurate result. Nevertheless, the results of the Sharpe ratio implies that the S&P 500 index have a better risk adjusted performance than the sin portfolio.

The information ratio could only be applied to the sin portfolio as excess return is measured against the S&P 500 index. This negative result indicates once again that the sin portfolio did not have any excess return against the benchmark (S&P 500).

The Treynor ratio strengthened the argument that the S&P 500 index performed better than the sin portfolio. The beta of the S&P 500 had the value of one, this was because it was considered to represent the market. It is one of the reasons why the S&P 500 had a better ratio then the sin portfolio, the sin portfolio had bigger market risk and was therefore negatively affected by the denominator in the formula.

The Sortino ratio results align with previous results, the S&P 500 index outperform the sin portfolio once again. The interesting key aspect here is the TDD, the sin portfolio has bigger downside volatility than the S&P 500. This is plausible because it also had a bigger overall volatility.

5.3. T-test: Paired Two Samples

The null hypothesis for the T-test was the following:

The average monthly logarithmic returns from the sin portfolio are equal or less than the average monthly logarithmic returns from the S&P 500 index.

This could not be rejected at a significance level of 5%, which strengthened the arguments in sections 5.1 and 5.2 that the S&P 500 index have been a better investment between the two strategies. These results contradict the findings made by Fabozzi, Ma and Oliphant (2008) where they found evidence which said that the sin stocks outperformed the market by roughly 3% yearly. A factor that differs between these studies is the time-period, a variable further examined in section 6.1.

5.4. OLS Regression

This statistical test was done to receive estimated values of the coefficients Jensen's alpha and beta. The obtained alpha value was negative, implying that the sin portfolio has performed worse than the compared index during the period, seen to risk involved in the investment. As mentioned in the previous chapter, the alpha coefficient had a p-value too large to be statistically significant. However, as the other tests and measurements are also stating that the sin portfolio performs worse than the index, the regression result assumingly has some underlying validity. Thus, this OLS regression further backs the finding that the S&P 500 index has performed better than the sin portfolio, even when risk is involved in the assessment.

The p-value of the beta coefficient did on the contrast obtain a p-value very close to zero, giving a statistically significant estimation of the beta value. The value is as can be seen in the result section, greater than one. Thus, this contradicts the findings that Lobe and Walkshäusl (2014) reached in their research. These findings were in short that sin stocks often had a beta value below one and are further described in the literature review of this thesis.

To summarize the results of this OLS regression, an estimated beta value implying that the return of the sin portfolio is more volatile than the return of the market index was obtained. Furthermore, an alpha value saying that the benchmark index that represents the overall market performed better than the sin portfolio, considering risk was obtained. The beta value did as previously mentioned contradict one of the earlier research done on the topic, while the alpha value strengthens the already reached result of the inferior performance of the sin portfolio.

6. Research assessment

When conducting a quantitative research, many limitations have to be set and a lot of compromises must be taken. The underlying reason in this case is time and resources. It would have taken too much time to explore other markets and regions. This is described in detail in section 1.6. The decisions that have been made will have significant effect on the outcome of the result and will therefore be discussed in this chapter.

6.1 Region and time

The US stock market was chosen to be the field of the research because of the size and number of companies traded there. Only choosing one country to examine makes the report vulnerable to criticism regarding cultural differences. In the literature review it was stated that there were differences in sin stock performance in different regions, and the different cultures may have different attitude regarding what is considered a sin stock and the moral of investing in them. This paper has not investigated the definition of US but instead used a more general worldwide consensus. It could have been beneficial to have a clear US definition when creating the sin stock portfolio.

Another implication that could have impacted the result of the paper is the possibility of foreign investors in the US market. An aspect that could be explored to give further understanding in the subject, is to research nationalities among the owners of sin stocks to see if there is a clear trend or difference in sin stock companies compared to the overall market. The counter argument here is that this paper only measure the returns of sin stock not exploring the definition and cultural views on sin stocks.

The time frame in which the data has been collected can also be criticized, the period of 48 months between April 2018 and March 2022 could be considered too short. The decision for this period was based on the compromises between a longer time period and having a certain number of companies in the portfolio. If a longer time period were chosen a fewer number of companies would be included as monthly price points for every month was a criteria, this would make the portfolio smaller and harder to compare to the S&P 500 index. Thus, the period of 48 months was chosen in order to get the maximum number of datapoints and still have enough companies in the portfolio.

Another factor regarding the time period is the pandemic, during the time period the world was facing a global pandemic, and this heavily affected the stock market. Firstly, a huge drop in stock prices followed by an expansive monetary and fiscal policy allowed the market to regain the drop and even reach all time high. This have made the period very volatile and might have affected the result different if there had not been a crisis.

6.2 Companies

The argument that the sin portfolio and the S&P 500 index differ in number of enlisted companies can be made, this problem is well discussed and is linked to the previous section. The S&P 500 index has as named 500 companies in contrast to the sin portfolio that only has 66. This may be a contributing factor of why the sin portfolio has a higher standard deviation than the S&P 500 index, as more companies are included the individual risk is spread out among companies and is therefore less volatile.

A high volatility will heavily burden some of the ratios and could have a large impact of the results. Fortunately, a T-test and an OLS regression have been conducted and focuses more on the average return and not the risk factor.

The different sectors of the companies are also something to consider, a very large amount of them is operating in the aerospace & defense sector, in fact over 50%. This means that the portfolio is very exposed to this sector. Therefore, the portfolio might not be representative as a sin stock portfolio but instead a portfolio invested in aerospace & defense companies. This have been discussed but in effort to include as many companies as possible, the pros of having more companies outweigh the cons of too much exposure in one sector.

There are also some companies that are included in both investing strategies, therefore there are some correlations between the two. The correlation is the beta and was estimated with the regression analysis. The value of beta has been affected by companies appearing in both groups, this is something to be expected as there are many portfolio managers comparing themselves to the market when they are holding companies listed in different benchmark indexes.

7. Conclusion & Discussion

Here the conclusion is presented, a summarization of the data collected and its results. Some of the limitations and future improvements are discussed as well.

When writing this thesis, the complete goal was to answer the research question "*Can a portfolio including only sin stocks outperform the overall market?*". Several limitations were set in regard to this question, to make the research possible and thereby being able to conduct this thesis. Thus, the research to answer this question was constructed by creating a sin portfolio and comparing this to a benchmark index, representing the overall market.

During the period this thesis was made, both weaknesses and possibilities to take this research further, were discovered. As already touched upon, one of this is the benefits of a longer time series. The longer time series could give a better understanding of the overall performance.

Then, to ensure enough companies are included a more complicated portfolio could be created, with the ability to be more dynamic in price points. Allowing companies that were delisted or listed on the stock market during the time-period could be included and not only companies being listed from the start until the end. Furthermore, a more diversified sin portfolio, in terms of industries could also benefit the report. The more dynamic portfolio could help to improve the diversification of the companies listed and therefore give a more representative selection. These improvements, combined with a broader research, i.e. comparing sin portfolios with a benchmark indices on different markets, could lead to a more accurate result.

Although the research could have been further elaborated the result reached in this thesis is very one-sided. During the period and the market measured, the sin portfolio did clearly perform worse than the S&P 500 index. This is stated not only by looking at the total and monthly average return, but also from further descriptive statistics and different ratios measured. From the descriptive statistics, it is found that the sin portfolio is more volatile than the S&P 500 index. The sin portfolio is also beaten in all ratios measured, including the Sharpe, Treynor and Sortino ratios, indicating that the S&P500 not only performs better, but also with a lower risk associated. The Information ratio is also measured for the sin portfolio but the comparison with the index is not available for this ratio. In addition, these results are further strengthened by an OLS regression, by saying that the sin portfolio once again performed worse than the S&P 500 index, while being more volatile. Finally, the results from the T-test said that the null hypotheses could not be rejected, meaning that it cannot be said that the sin portfolio outperforms the compared benchmark index.

To summarize the findings in this report in can be concluded that during the specific time-period the S&P 500 index outperformed the sin stock portfolio. Thus, answering the research question, the sin portfolio did not outperform the US market. Even though all findings in this report were not statistics significant, all evidence strongly suggest that this is the case.

8. References

Admin. (2015, July 20). What are sin stocks? Retrieved April 18, 2022, from https://sinstocksreport.com/what-are-sin-stocks/

Bernardo, A., & Ledoit, O. (february 2000). Gain, loss, and asset pricing. Journal of Political Economy, 108(1), 144-172. doi:10.1086/262114

Blitz, D., & Fabozzi, F. J. (2017). Sin stocks revisited: resolving the SIN stock anomaly. The Journal of Portfolio Management. doi:10.3905/jpm.2017.2017.1.070

CFI (Ed.). (2020, October 02). Risk-adjusted return ratios. Retrieved May 21, 2022, from https://corporatefinanceinstitute.com/resources/knowledge/finance/risk-adjusted-return-ratios/

Chong, J., Her, M., & Phillips, G. M. (2006). To sin or not to sin? now that's the question. *Journal of Asset Management,6*(6), 406-417. doi:10.1057/palgrave.jam.2240191

Cheung, W. M., & Lam, D. (2015). Comparing the price of sin: Abnormal returns of cross-listed casino gaming stocks in the Hong Kong and US markets. International Journal of Hospitality Management, 45, 73-76. doi:10.1016/j.ijhm.2014.12.002

Damodaran, A. (2019) *Discount Rates: The D in the DCF.*. [Powerpoint] New York: Stern School of Business. From https://pages.stern.nyu.edu/~adamodar/pdfiles/eqnotes/dcfrates.pdf

Fama, Eugene F., and Kenneth R. French. "Disagreement, Tastes, and Asset Prices." *Journal of Financial Economics*, vol. 83, no. 3, 2007, pp. 667–689., https://doi.org/10.1016/j.jfineco.2006.01.003

Fabozzi, F. J., Ma, K., & Oliphant, B. J. (2008). Sin stock returns. The Journal of Portfolio Management, 35(1), 82-94. doi:10.3905/jpm.2008.35.1.82

Federal Reserve Bank of St. Louis. Market Yield on U.S. Treasury Securities at 1-Month Constant Maturity. Retrieved 20 April, 2022 from Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/DGS1MO

Goetzmann, W., Ingersoll, J., Spiegel, M., & Welch, I. (february 2002). Sharpening Sharpe ratios. National Bureau of Economic Research. doi:10.3386/w9116

Ghouma, H. H., & Hewitt, C. S. (october 2019). Lobbying expenditures and Sin Stock Market Performance. Research in International Business and Finance, 49, 176-190. doi:10.1016/j.ribaf.2019.03.006

Malkiel, B. (1989). Efficient market hypothesis. Finance, 127-134. doi:10.1007/978-1-349-20213-3_13

Malkiel, B. G. (2003). The efficient market hypothesis and its critics. *Journal of Economic Perspectives, 17*(1), 59-82. doi:10.1257/089533003321164958

Lobe, S., & Walkshäusl, C. (2014). Vice versus virtue investing around the world. Review of Managerial Science, 10(2), 303-344. doi:10.1007/s11846-014-0147-3

Luck, C. G., & Wood, K. (1992). Wages of sin. *The Journal of Investing, 1*(2), 15-21. doi:10.3905/joi.1.2.15

Liston, D. P. (february 2016). Sin stock returns and investor sentiment. The Quarterly Review of Economics and Finance, 59, 63-70. doi:10.1016/j.qref.2015.08.004

Pilotte, E., & Sterbenz, F. (2006). Sharpe and Treynor ratios on Treasury bonds*. The Journal of Business, 79(1), 149-180. doi:10.1086/497409

Refinitiv Messenger Overview. (n.d.). Retrieved April 18, 2022, from https://www.refinitiv.com/content/dam/marketing/en_us/documents/fact-sheets/refinitiv-messenger-overview.pdf?elqCampaignId=15498

Ritter, J. R. (2003). Behavioral finance. Pacific-Basin Finance Journal, 11(4), 429-437. doi:10.1016/s0927-538x(03)00048-9

Roca, E., Wong, V. S., & Anand Tularam, G. (2010). Are socially responsible investment markets worldwide integrated? Accounting Research Journal, 23(3), 281-301. doi:10.1108/10309611011092600

Rollinger, T & Hoffman, S. (2013). Sortino: a Sharper Ratio. Red Rock Capital. Retrived May 11, 2022 from http://ea.kitgain.com/content/uploadfile/202102/9e631613532179.pdf

Sajwan, Rashmi, & Priya Chetty (2018, Oct 22). How to test time series autocorrelation in STATA?. Knowledge Tank; Project Guru. https://www.projectguru.in/time-series-autocorrelation-stata/

Shank, Todd M., et al. "Is It Better to Be Naughty or Nice?" *The Journal of Investing*, vol. 14, no. 3, 2005, pp. 82–88., https://doi.org/10.3905/joi.2005.580553

Sharpe, W. F. (1994). The Sharpe ratio. *The Journal of Portfolio Management, 21*(1), 49-58. doi:10.3905/jpm.1994.409501

Starnes, D. S., Yates, D., & Moore, D. S. (2011). The practice of statistics. 3rd edition. New York: Macmillan.

Stulz, R. M., & Williamson, R. (2003). Culture, openness, and Finance. Journal of Financial Economics, 70(3), 313-349. doi:10.1016/s0304-405x(03)00173-9

Summary prospectus July 29, 2021 - usamutuals.com. (n.d.). Retrieved April 18, 2022, from https://usamutuals.com/wp-content/uploads/2021/08/VICEX-Vice-Fund-Summary-Prospectus.pdf

S&P U.S. indices - S&P global. (n.d.). Retrieved April 18, 2022, from https://www.spglobal.com/spdji/en/documents/methodologies/methodology-sp-us-indices.pdf

Treynor, J. L., & Black, F. (january 1973). How to use security analysis to improve portfolio selection. *The Journal of Business, 46*(1), 66. doi:10.1086/295508

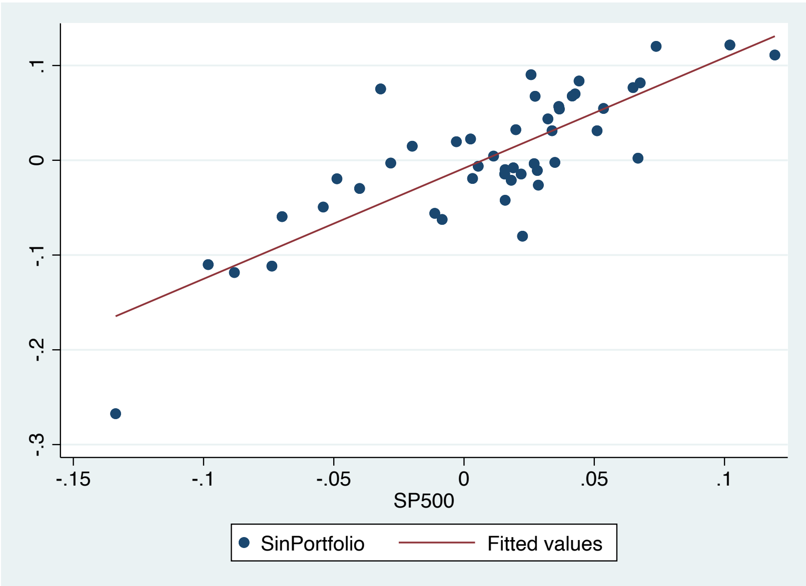
9. Appendices

Appendix A. OLS Assumptions

OLS Assumption 1: The regression model is linear in the coefficients and the error term

Based on the scatter plot in figure 1 it can be stated that the regression is following a linear pattern, therefore the assumption is satisfied.

Figure 1



OLS Assumption 2: The error term has a population mean of zero

The mean of the error term is assumed to be zero because it has already been concluded that a constant is included in the regression. This causes the mean of the error term to equal zero.

OLS Assumption 3: All independent variables are uncorrelated with the error term

This assumption was tested by first deriving each error term for every observation. The calculation was done by subtracting the fitted value from the observed value, this gave us the residuals. Then a correlation matrix (table 11) was conducted between the residuals and the independent variable. The correlation equals zero and therefore no correlation between them exists and the assumption holds.

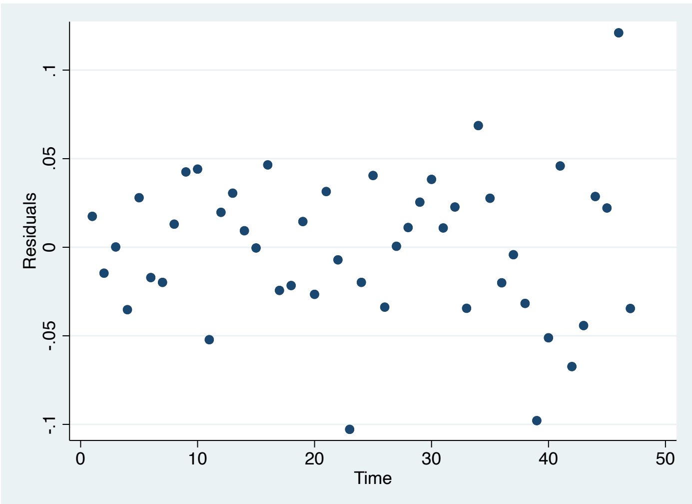
Table 11

	S&P 500 Index	Residuals
S&P 500 Index	1.00	
Residuals	0.00	1.00

OLS Assumption 4: Observations of the error term are uncorrelated with each other

To check for this assumption several tests need to be conducted. The first test is to see if the residuals are showing symptoms of serial correlation. This is checked visually in figure 2, as can be seen the residual are randomly scattered throughout the time series. As the risk for autocorrelation is higher when using time series data, two other tests were made ensuring that the assumption holds.

Figure 2



The Durbin-Watson statistics is a common way to test for autocorrelation in the error terms. The test examines if the sample suffer from positive or negative serial correlation. The test will take values between zero and four. A value close to zero implies positive autocorrelation, a value closer to four indicates a negative autocorrelation. If the test shows a value of approximately two, there is no autocorrelation in the error term. (Starnes et al., 2011) The following null hypothesis is stated.

H_0: *The sample does not exhibit autocorrelation*

H_A: *The sample exhibits autocorrelation*

The test gave a result of 1,9713 that can be seen from table 12. Therefore, we cannot reject the null hypothesis.

The second test is the Breusch-Godfrey test, the test will also examine if there is serial correlation in the regression. The following null hypothesis is stated (Sajwan and Chetty, 2018).

$H_0: There\ is\ no\ serial\ correlation$

$H_A: There\ is\ serial\ correlation$

As can be seen in table 12, the p-value is 0,9731. That is a bigger value than 0,05 and therefore the null hypothesis cannot be rejected at a 5% significance level. This strengthened the result from the previous tests and therefore it can be concluded that the assumption is fulfilled.

Table 12

	d-statistic	p-value
Durbin-Watson Test	1.9713	
Breusch-Godfrey Test		0.9731

Assumption 5: The error term has a constant variance (no heteroscedasticity)

The residuals variance should be constant over the time series. This means that the variance should not change over time This phenomenon is called homoscedasticity and is preferable when working with OLS.

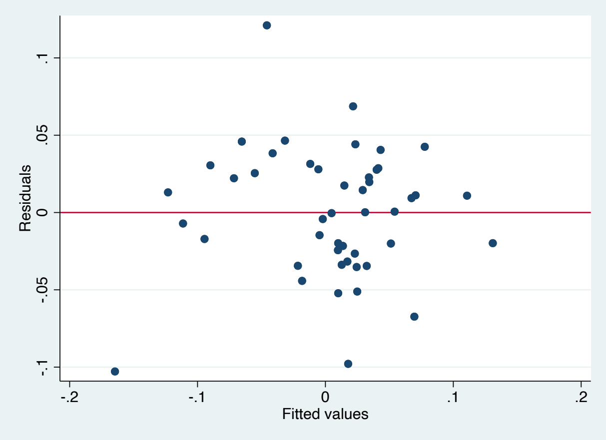
To check for this the White test for heteroscedasticity is conducted. The test states a null hypothesis where the residual variances are equal. The alternative hypothesis says that variances will differ from among the observations.

$H_0: \sigma_1^2 = \sigma_2^2 = \cdots = \sigma^2$

$H_A: \sigma_1^2 \neq \sigma_2^2 \neq \cdots \neq \sigma^2$

A p-value of 0.1541 was derived from Stata. This value says that the null hypothesis cannot be rejected and is therefore implying that the assumption holds. This can also be reinforced by figure 3, showing the residuals of the fitted values.

Figure 3



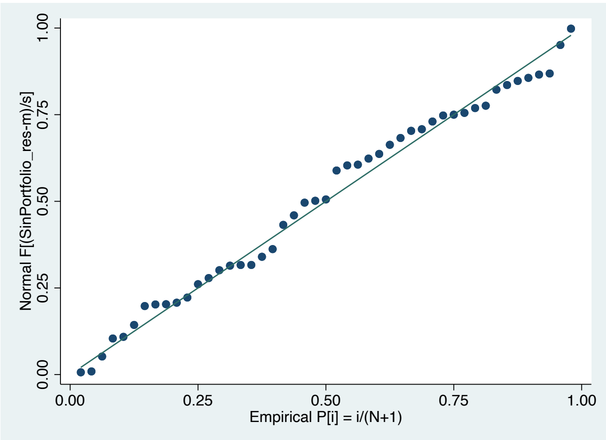
OLS Assumption 6: No independent variable is a perfect linear function of other explanatory variables

This is not an issue in this thesis as the OLS only contains one explanatory variable. Thus, this assumption is not examined when validating the sample.

OLS Assumption 7: The error term is normally distributed

This assumption is necessary to examine when studying hypothesis testing and conducting confidence intervals. As this was explored in this paper the matter was thoroughly examined by analyzing the data. Firstly, the sample was displayed creating a normal probability plot of the residuals

Figure 4



.

Firstly, the sample was displayed creating a normal probability plot of the residuals. As can be seen in figure 4, the points are placed on or close to the line. This implies that the residuals points are indeed, normally distributed.

The final test is the Shapiro-Wilk test. This test is a well accepted test when controlling for non-normality. A null hypothesis was stated saying the residual sample is normally distributed. If the p-value is larger than 0,05 we cannot reject the null hypothesis.

$H_o: The\ residuals\ are\ normally\ distributed$

$H_A: The\ residuals\ are\ not\ normally\ distributed$

As can be seen in the table below, the received p-value did exceed 0.05. Therefore, no evidence of non-normality was found during the test.

Table 13

	Observations	Test Statistic	P-value
Shapiro-Wilk Result	47	0.97260	0.33151

Appendix B. Regression results

Source	SS	df	MS			
Model	.159110767	1	.159110767	Number of obs	=	47
Residual	.07913521	45	.00175856	F(1, 45)	=	90.48
				Prob > F	=	0.0000
				R-squared	=	0.6678
				Adj R-squared	=	0.6605
Total	.238245977	46	.00517926	Root MSE	=	.04194

SinPortfolio	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
SP500	1.167373	.1227266	9.51	0.000	.9201894	1.414557
_cons	-.0084226	.0062546	-1.35	0.185	-.02102	.0041749