ICADE Business School

Master´s in Finance

Can Alternative Assets beat Warren Buffett?

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1. <u>Abstract</u>

The aim of this project is to demonstrate that diversification always adds value to traditional portfolios. This diversification will be based in alternative assets that their low correlation and powerful return risk relationship creates more efficient portfolios in terms of the Jensen´s alpha. To demonstrate this Warren Buffett´s investment vehicle, Berkshire Hathaway, will be used to add alternative assets with the expectation to obtain more return and a more efficient portfolio in terms of alpha. The main indexes of each alternative asset will be used as a reference to obtain the calculations required, they will be obtained from Thomson Reuters Eikon terminal and the Bloomberg terminal. Finally, the conclusions will show that even for one of the most profitable investments vehicles of the recent years is possible to obtain a better return risk relationship if they diversify in efficient alternative assets.

2. <u>Keywords</u>

Alternative assets, traditional portfolios, Warren Buffett, Berkshire Hathaway, asset allocation, diversification, low correlation, United States financial markets.

3. Introduction

3.1 Objective

The purpose of the project is to analyze the returns of the main alternative assets being real estate, commodities, private equity, venture capital, hedge funds, crowdfunding, direct lending, renewable energies, art, cryptocurrencies and other alternative assets all of them and commodities, private equity, real estate and venture capital the chosen ones to study in depth. The United States will be the country analyzed and the return as a consequence of being the owner of these assets is going to be the main aspect to consider, but the risks supported will also be the center of attention in this report. Once this information is collected, a study of how they can complement Warren Buffett´s portfolio, Berkshire Hathaway, will take place calculating the return, variance, standard deviation, correlation coefficient, Jensen´s alpha and Sharpe´s ratio and all the required information to get these variables and ratios. All these procedures and conclusions will reach to a conclusion over the efficiency and convenience of adding alternative assets to a traditional portfolio, even if you are Warren Buffett. Therefore, the project will be based in how these different kind of assets with their specific returns and risks could have boosted the results of Warren Buffett´s investment vehicle and why it is important to include them in a traditional portfolio.

Knowing the benefits of these kind of assets, portfolio managers and investors can build their portfolios incorporating some of these assets to make the most efficient asset allocation possible. In the report the recent past has been studied to see how to incorporate alternative assets into a portfolio taking the most advantage possible of them and using the most efficient alternative assets.

The final and most important objective of this report is to demonstrate that incorporating the correct alternative assets will add value to any traditional portfolio even if you are Warren Buffett. The capacity that the diversification in different assets has in the risk and the correlation between them shows that a better relation between return and risk is possible and that investing only in traditional assets is not as efficient as doing a greater diversification, even if you are Warren Buffett.

3.2 Methodology

The project starts with the definition and principal differences of alternative assets. Then, the focus is in the United States and in the main alternative assets: real estate, commodities, private equity and venture capital. Another important alternative asset are hedge funds, but the indexes and ETFs available in the market to track their performance are not a full picture of the hedge funds industry in the United States, since is trading in the markets only a couple of hedge funds and few sectors. Therefore, they will not be study in this project since all the other main alternative assets have their indexes reflecting their whole industry.

The methodology will be search for scientific documents and related papers to understand the work done in them and based on this improve their work and make something new and innovative about the study of alternative assets and their application in portfolio allocations.

To find the returns and risks in alternative assets, Thomson Reuters Eikon´s terminal and Bloomberg´s terminal are going to be the most important sources of information. With all the information gathered, all returns and risks associated with these assets are going to be compared to understand the main differences, qualities, advantages and disadvantages of each of them. To compare them, the data since 2003 to 2019 is going to be used while the annual return, the volatility and some additional risk ratios will be exposed. Furthermore, an exhaustive study of the correlation between the traditional assets and between the alternative assets is going to be done to see which asset can complement a specific portfolio in the most efficient way.

The comparison will be done gathering information of Warren Buffett´s fund (Berkshire Hathaway). Once this information is gathered and with the return and the risk of the alternative assets are needed in order to introduce them in a mix portfolio, composed with a 80% of Berkshire Hathaway and a 20% of the alternative asset portfolio and evaluate the results obtained.

This project is based in the information from 2003 to 2019. These are the years selected because of the whole economic cycle that their experienced. From the Internet bubble in 2000 and 2001 to a recovery that was consolidated in 2003 to 2007 until the financial crisis, from 2007 to 2009 United States experienced this crisis and from 2009 to 2019 they lived a strong boom that is believed that is leading to another crisis, making these years a perfect combination of bullish and bearish markets. In consequence, these 15 years explain economic cycles and are a perfect reliable source of data given the recent American economic history.

Furthermore, an explanation of the advantages and disadvantages when adding alternative assets in a portfolio is going to be implemented putting different alternative assets are used and focusing in the performance and efficiency of these assets, with a special mention to the Jensen´s alpha that is going to be the main variable to consider when the results will be analyzed.

The total return is going to be considered, for example in real estate a total return ETF or index is needed otherwise the dividends/rent are going to be excluded of the index or ETF and in consequence from this calculation. That is the reason why the income from dividends and the capital gains from the price appreciation of the shares will be put together year by year to find out the return over all the years.

The risk of the securities and indexes are analyzed by their variance, standard deviation (volatility) and Sharpe´s ratio that they showed year by year while the Jensen´s alpha will be calculated as the main aspect when comparing each asset and each portfolio.

All the return data have been obtained from the first day of trading of each year of each of the stock or indexes selected in this project.

To propose the final portfolio that is expected to be more efficient than Warren Buffett´s, the holding is going to be multiplied by 80% and a 20% will be added that will be the alternative assets. Also, an analysis about the correlation between the assets, and all the results of the new portfolio are going to be showed in detail while the alpha and the Shape´s ratio are going to be calculated in order to find which combination is more efficient and more profitable.

The 10-year United States government bond is the risk free asset that works as a reference in this report. The reason of this selection is because the 10-year period of time is widely used in financial markets as the reference for this type of calculations. All the betas calculated over this project are based in these criteria.

All the currencies and calculations are in USD. All the calculations made where extracted from the prices of indexes, ETFs and stocks and developed in all the calculations explained in this report. The indexes of the alternative assets studied are from the United States since is where Warren Buffet has invested. Although, the commodity index is a world index since the index selected is the reference for the commodity industry and makes a full representation of the investments in this asset.

The following formulas have been used along this report and a further explanation of them appears in the following pages. Here, a brief explanation is provided. These formulas will be use over and over again with each index, ETF or stock analyzed.

Return

The return methodology is going to be based in the calculation of the return year by year by each index or stock and do an average of these returns over the years that covers this report.

Variance

$$\text{variance } \sigma^2 = \frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n}$$

Being Xi the present return, $\bar{x}$ the average of the returns and n the number of years that the return have been analyzed.

Standard Deviation

$$\sigma = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

Is the same procedure as the variance but doing the square root of the variance.

Correlation coefficient

$$r_{xy} = \frac{\text{Cov}(x, y)}{S_x \times S_y}$$

Covariance of the returns of a data set and another one, divided by the multiplications of their standard deviations.

Covariance

$$\text{cov}(X, Y) = E[(X - E[X])(Y - E[Y])]$$

Is the difference between a specific return and the average of all the returns for that asset that is multiplying a specific return minus the average of all the returns for the second asset.

Beta

$$\beta_p = \frac{Cov\left(r_p, r_b\right)}{Var\left(r_b\right)}$$

Covariance of the asset to the market divided by the market´s variance.

Sharpe´s ratio

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p}$$

The return of the portfolio minus the risk-free asset divided by the standard deviation of the portfolio.

Jensen´s alpha

$$Alpha = R(i) - (R(f) + B \times (R(m) - R(f)))$$

The return of the portfolio minus the risk-free asset plus the beta of the portfolio that is multiplying the return of the market minus the risk free asset.

3.3 Literature review

Two are the projects that I am going to mentioned, but I have read a lot more trying to do a something new and innovative, these two projects are the most similar ones to mine.

Ignacio Ruiz González (2015). *"Como mejorar un asset allocation tradicional".* Is one of the projects selected and studied to get a different perspective for the addition of alternative asset in a traditional portfolio. The work done by Ruiz is focus in adding value to traditional portfolios and my work is based in adding value to a specific portfolio, Berkshire Hathaway, to demonstrate that alternative assets can improve traditional portfolios´ results even for Warren Buffett.

Ruiz did an analysis of two different portfolios where one was a traditional portfolio and the other one had included some alternative assets and high yield bonds. He studied the return risk relationship of both portfolios with the conclusion of ending with more return and a more efficient return risk relationship.

My project tries to demonstrate the conclusion that Ruiz ended up his project, investing in alternative assets makes a portfolio more efficient in terms of return risk relationship. The main difference with my project is the more practical approach of mine project and the new portfolio proposed to Warren Buffet that a more efficient portfolio can be achieved adding alternative assets even for him.

The second project studied closely is, Douglas Cumming et al (2010). *"Strategic Asset Allocation and the Role of Alternative Investments"*.

In their project they focus on alternative investments in a more quantitative way, they have analyzed their returns and they elaborated different risk measures to determine some efficient asset allocation related to investor preferences. They have also focused on alpha to determine this efficiency.

Once again, my project is focus on Berkshire Hathaway because of their strong returns and noise generated in the markets, from there the concept of diversification in alternative assets goes to all the traditional portfolios. My results are similar to the last project mentioned since both conclude that adding alternative assets in a traditional portfolio increase their efficiency.

4. Definition and a first approximation to alternative assets

4.1 What is an alternative asset?

Alternative assets are considered those assets out of the three main traditional assets, equities, fixed income and cash. The typically alternative assets are illiquid, is difficult to trade with them. They are non-transparent, the data is scarce, not reliable, the managers are very specialized in them and they are low correlation assets.

The extremely low, and even negative, correlation with other asset classes results in a highly beneficial investment vehicle for an investors' portfolio. A great diversification can be obtained in a portfolio if alternative assets are added like is going to be demonstrated at the end of this project. Nevertheless, only the alternative assets of United States are studied in this project, making the correlation between them and the market higher than investing around the world.

4.2 Different Alternative Assets

4.2.1 Commodities

Commodities usually refers to any good that has the purpose of a transformation during a production process to become an element of consumption. Many of the material goods require a modification or transformation before it can be used by people. They usually need different transformation phases before being ready to be consumed.

The main commodities involve precious metals, energy and agriculture. With a small correlation to other traditional asset and less return than them and a higher volatility.

The supply side is mainly modified by how difficult is to get that commodity. The demand side is mainly modified by the GDP Growth rate.

To get exposed to these alternative assets, it can be done through companies that directly produce, operate, commercialize or have a direct exposure to them. Investing in futures, is the second option to get access to them. In this case, it is not required to invest 100% of the capital, this derivative operates with leverage normally, the contract will be settled by differences. One disadvantage of these futures is that you need to renew all the contracts when they finish, that normally are in the short term. The third option is to buy ETFs linked to commodities, the ETFs operates like normal shares in the financial markets. The last option to buy commodities is buying them physically, with the requisite of storage them.

4.2.2 Real estate

Alternative asset characterized by a direct investment in houses, apartments, warehouses, buildings, resorts, hotels, malls and similar physical assets that they own.

The type of forms of investing in real estate is in a direct way through debt with a mortgage or through equity buying directly a home, for example. The indirect way can be done through a MBS: mortgage backed securities, buying ETFs and buying REITs that are specialized companies that operates in the real estate business to let small investors get access to this industry.

The profitability comes in the form of income (rent) and a plus for capital appreciation. It is known as an inflation hedged asset with a low correlation with the traditional assets.

To value these assets there are three main systems. The cost approach that quantifies how much is the cost of reform the asset, the income approach that discount the future cash flows taking into account the rent and the residual value and the comparative approach that is comparing similar assets near the asset analyzed.

4.2.3 Private Equity

Special funds that invest in non-listed companies with the purpose of holding their participation, normally 4 or 5 years, and sell it later taking big risks in the process for the purpose of getting a big return.

They also offer knowledge about different industries where they invest considering all the experience that they have earned with their past operations. The normal way of operation is buying a company that is private, restructure the company and sell it in an IPO or in a private deal.

The fund is composed by partners. General partners and limited partners. That ears a management fee based in the committed amount and a performance fee based in the profits generated.

The methods used to value companies are the income approach that takes into consideration the future cash flows and discounts them, the asset value approach that value assets to see if there are undervalued and the multiple approach that makes multiple of the business and their competitors trying to get a good deal.

4.2.4 Venture Capital

It is similar to private equity but focus on smaller companies, most of them start ups. They finance these companies and these companies are not listed on the stock exchange and cannot obtain the desired financing in public stock markets or through other traditional forms of financing of companies, such as banks, or these start ups just do not want the bank debt since they can sell shares of their start up instead of building debt.

They hold a high risk, without a history that endorses their future cash flows (which are usually negative in their first years of life) and that are willing to offer large positions in the capital of the company to those who are offered as venture capital in exchange for growing the business.

As for the temporary period, since it is a fairly illiquid investment, investors must commit and immobilize said capital for at least 5 to 10 years before leaving the capital of the company. At this point, an appropriate exit strategy must be planned to obtain a high value, since normally these shares are issued in a public sale offer (IPO) or to another investment fund.

4.2.5 Hedge Funds

Special funds that invest, normally in listed companies, taking huge risks in the process. They are characterized on making huge returns while taking higher risks as well. These risky investments can vary from buying a big proportion of their portfolio based in a complex analysis of a specific asset or going short on an equity.

They are closed funds with a partnership structure, with flexibility in selecting the assets to invest and in the strategies. The managers are compensated with management fees plus performance fees.

4.2.6 Direct lending

Type of investments done by an investor or group of investors that lend directly to a company a certain amount of capital without the presence of a bank or a similar entity. This type of operation exists because of the requirement that banks have, in some cases companies or individuals cannot access bank funding and they need these types of operation that are, normally, more expensive and could not require endorsements.

4.2.7 Renewable Energies

Investments done in wind, solar, waterfalls, wave farms, or biomass energies. These kinds of investments are normally helped by governments with grants and fiscal benefits because they are the solution to fight against global warming. Normally, without grants or fiscal benefits the investments would not be profitable, but this technology is starting to see that without these grants or fiscal benefits a project can also be profitable.

The more extended renewable energies are the ones that get an advantage from the sun and the wind to create energy. Recently, this technology can be seen offshore, in the water to use a cheaper space and make these projects more profitable.

4.2.8 Crowdfunding

Investment made by a crowd of people that together invest in a project or company to get a return from it. It was created centuries ago but boosted recently with new technologies, three different types of crowdfunding exist:

- Crowdfunding in a project or start-up company where investors expect a return acting as shareholders.
- Crowdlending, where investors act as lenders and expect their investment back plus an interest.
- Real estate crowdfunding, where investors invest with small quantities in real estate assets that are normally flats, apartments, buildings or industrial plants of the principal cities with a return in the form of an income, rent, and a capital appreciation.

4.2.9 Art

The investments in art pieces are characterized by volatility, irrationality and illiquidity of this market, making it hard to compare to the traditional assets. Furthermore, the extremely low (and even negative) correlation with other asset classes results in a highly beneficial investment vehicle for an investors' portfolio because of the great diversification effect that can add to a portfolio.

"Art indices tend to have high volatility whilst not gaining significantly greater gains than the stock market. At first glance it would appear that art is a highly risky investment strategy". (Campbell, 2005).

4.2.10 Cryptocurrencies

Cryptocurrencies are virtual currencies that use digital encryption for their operations (blockchain), and with which economic transactions can be made without the need for intermediaries. These digital currencies use cryptography to create safer economies, with greater privacy and that do not respond to the control of any country or institution, since they are totally decentralized.

These virtual currencies began to emerge in 2009 with the appearance of Bitcoin, as an alternative method to the global financial system. So far, many types of cryptocurrencies have appeared.

The main cryptocurrencies are Bitcoin, Ether with the Ethereum technology, Litcoin, Ripple and Bitcoin Cash each of them with their own advantages and disadvantages.

The biggest difference that has these electronic currencies against conventional money is that it is only on the Internet and we can only have it in digital form.

As its name suggests, cryptocurrencies use cryptographic techniques to safeguard the currency's security, thus ensuring that the currency cannot be falsified in any way. Each person has their cryptographic keys that are necessary to perform any type of operation.

These currencies gave a huge return in their early years and a big volatility in the recent years making to doubt their value as real money or safe haven.

4.2.11 Other alternative assets

Wine, antiques, classic cars and even horses are some of the rest of the alternative assets not mentioned in the first approach to this topic. They share some common characteristics with the main alternative assets like illiquidity, difficult access to information and a low or even negative correlation to the traditional assets.

It is data supporting great returns of these assets always linked to momentum from the investors and a strong specialization to know what piece or product is worth investing.

5. Main alternative assets in detail:

5.1 Commodities

5.1.1 Gold

Gold is the principal precious metal commodity around the world. The gold standard was the core of capitalism for many years leading to the current system that it is established today. Nowadays, money does not have any back up behind. Gold have been widely important and nowadays is used to make luxury products and as an investment. It is widely known as an inflation hedged asset and a storage of value asset.

Historically gold returns are exposed in the following paragraph:

"*From 1836 to 2011, gold's average annual real rate of price change is 1.1%, with a standard deviation of 13.1% and a negligible covariance with consumption growth. Because gold does not serve as a hedge against macroeconomic declines, its expected real rate of return should be close to the risk-free rate of around 1%. These properties fit an asset-pricing model with rare disasters and a high elasticity of substitution between gold services and ordinary consumption. In this scenario, gold's expected rate of return corresponds mostly to the unobserved dividend yield, with a small part comprising expected real price appreciation.*" (Barro and Misra, 2015).

5.1.2 Texas Oil

The history of the Oil Texas has always had a strong volatility in them, the strong volatility is along the history of this commodity. Therefore, a huge return could be made if invested in the right time.

If we take 1861 as a reference, being the price at 16$ per barrel and the price in January of 2019 being set at 50$ per barrel, we would obtain a 212.5% of total return with an annual 1.344% of return. Taking the 1970 as reference with a price of 18$ and 2019 with a price set in 50$ the profitability would have been 177.77% in total return with an annual 3.63%.

Oil price fluctuates sharply when a crisis is forecasted or when the production, supply, is changed. From the demand side, our world needs immense quantities of oil to operate, and when a crisis appear the demand goes strongly down and so on the price.

From the supply point of view, countries that have this resource can decide how much quantity they want to sell, this affects the price. For instance, the OPEC decided many times to reduce the production of oil to increase prices and get more cash flow from their operations. Moreover, they also decided to increase production to make a low oil price and eliminate some companies and countries that cannot compete with low oil prices. For instance, it can be appreciated in the chart the low price in 2008 due to the global financial crisis.

5.1.3 Wheat

This widely consumed commodity has been affected by the free trade and globalization. This has plunged all the world's farmers into a single, borderless, hyper-competitive market. This Increase in competition between farmers means lower prices, but the power of inflation over all these years has pushed prices up.

One of the best illustrations of the power of inflation since 1973 is the price of wheat over the past 200 years. From 1800 to 1972, long-term inflation did not affect too much the price of wheat. Everything changed in 1973 with the beginning of modern inflation as we know it today, and now are considered an inflation hedge asset. There were plenty of price fluctuations, from below $1.00 per bushel of wheat to over $2.00 per bushel, but the typical price range stayed between $1-$2 a bushel most of the time. The average price of wheat in the year 1800 was $1.82 per bushel; the average price of wheat in 1972 was $1.57 per bushel.

In the figures below it is calculated the average wheat price over time on a decade by decade basis.

1st Table: Wheat prices over history.

1813-1822: $1.54	**1913-1922:** $1.64
1823-1832: $1.13	**1923-1932:** $1.14
1833-1842: $1.36	**1933-1942:** $0.96
1843-1852: $1.13	**1943-1952:** $2.08
1853-1862: $1.65	**1953-1962:** $2.14
1863-1872: $2.05	**1963-1972:** $1.47
1873-1882: $1.37	**1973-1982:** $3.44
1883-1892: $0.88	**1983-1992:** $3.18
1893-1902: $0.70	**1993-2002:** $3.36
1903-1912: $0.99	**2003-2012:** $5.36

Source: U. of Illinois.

As it can be seen wheat did not make an impressive change during all these years. The return that this commodity offered is not strong, this can be seen in the index selected to analyze the whole commodity industry. Also, a strong volatility is presence raising a doubt about the profitability of this commodity in the long run.

5.1.3 Corn
1st Chart: The long history of corn prices.
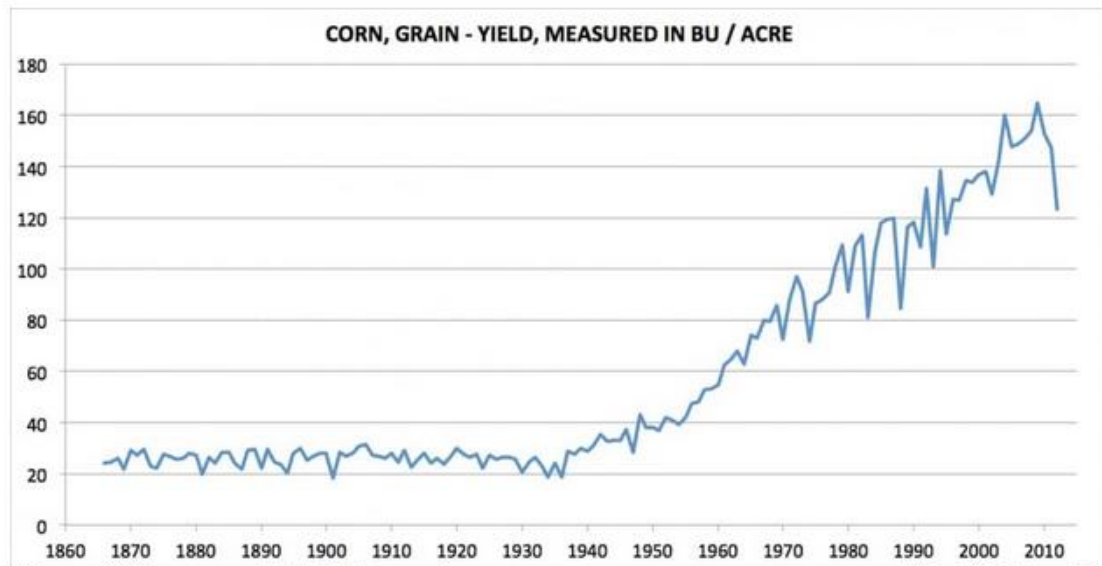
Source: Stuart Staniford

Source: Washington Post, Stuart Staniford.

Corn has had an interesting history in world history. Since the 19th century, farmers started to produce more and more agricultural products because of the technological advances. New industrial fertilizers, tractors and other mechanized tools appeared increasing the production and productivity of this commodity. In 1930 prices began skyrocketing. Corn could now be grown in areas that were once unthinkable. Nevertheless, the agricultural industry is still sensitive to extreme weather events. Droughts and rainfalls cause underproduction and losses to farmers increasing drastically the price of the corn, as well as the tireless inflation.

Furthermore, the following index is proposed to mix all these commodities in just one index to analyze the data provided and make some conclusions about it.

5.1.4 S&P GSCI Total Return Index
The most followed Commodity Index is the S&P GSCI Index, within it I chose the index that takes into consideration the total return to compare the same things along the whole project. This is the S&P GSCI Total Return Index.

It is defined by Bloomberg: "*The S&P GSCI Total Return Index in USD is widely recognized as the leading measure of general commodity price movements and inflation in the world economy. Index is calculated primarily on a world production weighted basis, comprised of the principal physical commodities futures contracts*." (Bloomberg terminal, 2019).

This index is made from physical commodities ETFs that represent different sectors. These sectors are agriculture, precious metals, energy, and livestock. To make a further step over the index, below is a citation over the creator of the index.

 "The S&P GSCI™ is world-production weighted; the quantity of each commodity in the index is determined by the average quantity of production in the last five years of available data. Such weighting provides the S&P GSCI™ with significant advantages, both as an economic indicator and as a measure of investment performance. Together, the diversity of its constituent commodities and their economic weighting allow the S&P GSCI™ to respond in a stable way to world economic growth, even as the composition of global growth changes through time. When world growth is dominated by industrialized economies, the metals sector of the S&P GSCI™ generally responds more than the agricultural components. Similarly, when emerging markets dominate world growth, agricultural and petroleum-based commodities generally respond the most." (Goldman Sachs, 2019).

2nd Chart: S&P GSCI TR Index Distribution

Type ▲	Index ▶	Index
Energy	60.23	
Agriculture	17.05	
Industrial Metals	10.44	
Livestock	7.59	
Precious Metals	4.69	
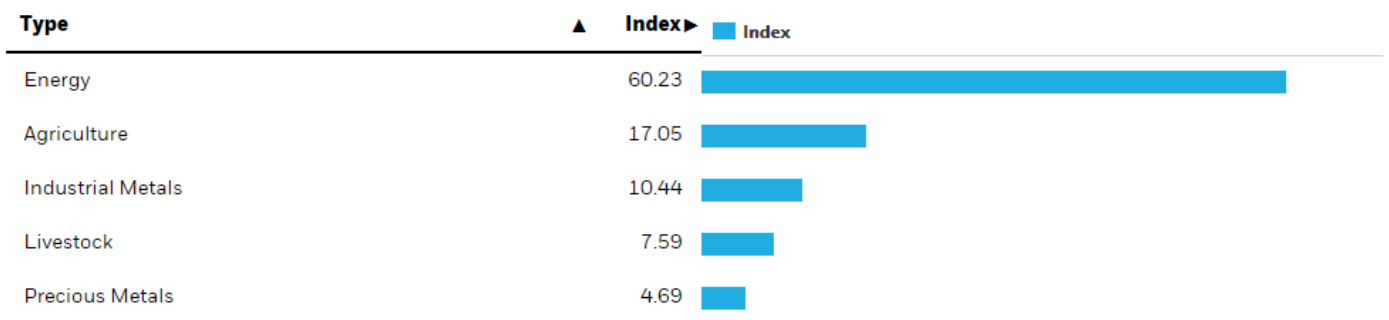
Source: Blackrock.

The reason of the weight of each sector in the index is the world production, as it is explained in the paragraph above. If a commodity is being more produced it will have more weight in the index and vice versa.

In the following tables the analysis of the index is shown:

2nd Table: Returns analysis of the S&P GSCI Total Return Index.

Year	Return
2004	6.31%
2005	16.09%
2006	22.72%
2007	-20.49%
2008	35.76%
2009	-51.26%
2010	14.79%
2011	21.98%
2012	-1.96%
2013	2.16%
2014	-6.90%
2015	-37.05%
2016	-31.17%
2017	15.79%
2018	10.95%
2019	-9.19%
Average	-0.72%

Source: own calculations from the Bloomberg terminal data.

(Annex 1 – 2nd Table for more detailed information over the calculations methodology).

3rd Table: Variance and Standard Deviation analysis of the S&P GSCI Total Return Index.

Year	Variance	Standard Deviation
2004	0.49%	7.02%
2005	2.82%	16.81%
2006	5.49%	23.43%
2007	3.91%	19.77%
2008	13.3%	36.48%
2009	25.54%	50.54%
2010	2.4%	15.51%
2011	5.15%	22.7%
2012	0.02%	1.25%
2013	0.08%	2.88%
2014	0.38%	6.18%
2015	13.20%	36.34%
2016	9.27%	30.45%
2017	2.73%	16.51%
2018	1.36%	11.67%
2019	0.72%	8.47%
Average	5.43%	23.3%

Source: own calculations from the Bloomberg terminal data.

(Annex 1 – 3rd Table for more detailed information over the calculations methodology).

The return offered by the commodities is very weak, they do not even pay for the inflation. Meanwhile, the risk supported is really high, as it can be seen when it is compared with the rest of the alternative assets. I forecast that the Jensen´s alpha of this commodity will not be high and therefore efficient, this will be studied in the following pages.

5.2 Private Equity

Private Equity consists in investing capital through a fund with capital from institutional or individual partners of the fund managed by specialized managers that owns a little share of the fund and earns money by management and success fees. They invest directly in non-listed companies for a long period of time, normally four or five years, and they sell them in IPOs or directly to another company. The capital can be utilized to fund new technology, make acquisitions, expand working capital, and to bolster and solidify a weak balance sheet.

Companies that are bought not only received financial resources but management experience from the private equity fund. Managers of the fund have a lot of experience in certain industries and when them enter in a company their share all this information allowing the company bought to access to an alternative source of finance rather than banks or capital markets and to make an advantage of the industry knowledge of these managers.

The illiquidity, non-transparency and specialization of the managers in private equity it's in consequence of some special points. First, it can be difficult to liquidate holdings in private equity because, unlike public markets, a ready-made order book that matches buyers with sellers is not available. A firm has to undertake a search for a buyer in order to make a sale of its investment or company. Second, pricing of shares for a company in private equity is determined through negotiations between buyers and sellers and not by market forces, as is generally the case for publicly listed companies. Third, the rights of private equity shareholders are generally decided on a case-by-case basis through negotiations instead of a broad governance framework that typically dictates rights for their counterparts in public markets.

5.2.1 Different types of private equity funds:

- Leveraged Buyouts: are the most popular form that works buying out a company improving its business and financial health and reselling it for a profit to an interested party or conducting an IPO.
- Distressed funding: the investments take place in companies with low-performing business units or assets. The intention is to turn them around making the necessary changes in their administration or operations or make a sale of their assets to obtain profits.
- Infrastructure Private Equity: investments made in assets that have a long useful life and that are able to provide stable cash flows over the years. Pension funds, ultra-wealth funds and government funds are typically investing in these types of assets given their low risk and stable cash flows in the long run.

5.2.2 Thomson Reuters Private Equity Buyout Index

To analyze in detail the private equity data the Thomson Reuters Private Equity Buyout Index has been chosen. It is an index that comprises a portfolio of private equity buyout companies that invest in the main sectors where the buyout methodology is normally used.

The overview of the index is provided by Refinitiv (Thomson Reuters): "*The Index is calculated from the performance of six private equity sector portfolios. The Thomson Reuters PE Buyout Index is the first index to allow liquid access to the gross performance of the private equity industry through index-linked investment products. The Thomson Reuters PE Buyout Index (TRPEI) is published daily. The approach of the TR PE Buyout Index is to combine, with appropriate weights, sector portfolio returns, each of which seeks to mimic return characteristics of the private equity firms in each economic sector in the private equity universe and, jointly, to capture the risk/reward characteristics of private equity as an asset class. The sector portfolios hold liquid exchange traded instruments.*" (Refinitiv).

3rd Chart: Thomson Reuters Private Equity Sector Distribution.
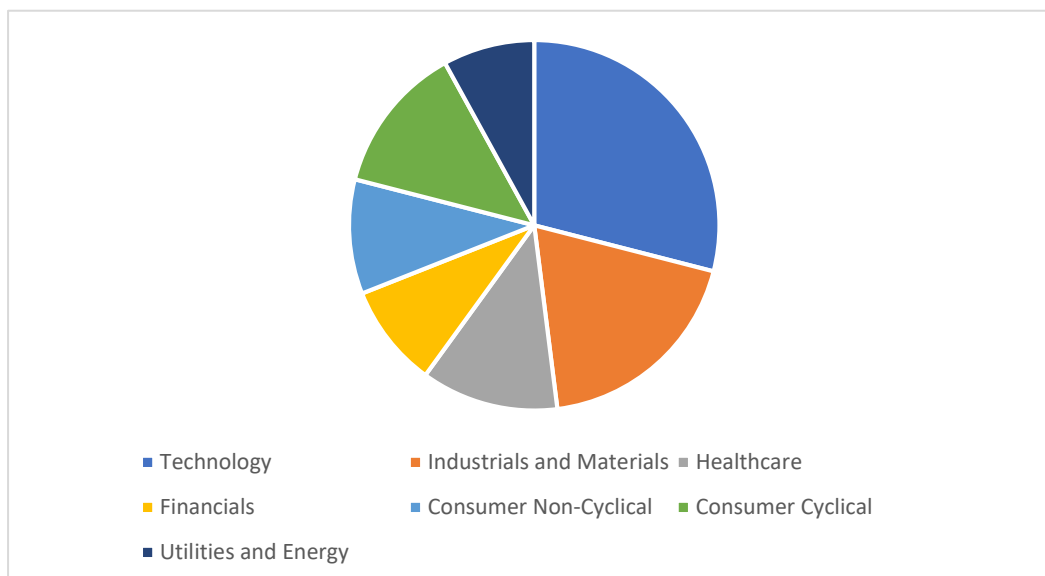
Source: Refinitiv.

The distribution of the portfolio within the index can be appreciate in this chart.

The analysis of the index is provided in the following tables.

4th Table: Return analysis of Thomson Reuters Private Equity Buyout Index.

Year	Return
2004	86.05%
2005	7.5%
2006	16.28%
2007	20%
2008	-4.17%
2009	-33.04%
2010	61.04%
2011	30.65%
2012	11.11%
2013	22.22%
2014	27.73%
2015	26.69%
2016	-3.37%
2017	23.26%
2018	41.04%
2019	-12.37%
Average	20.04%

Source: own calculations from Thomson Reuters Eikon.

(Annex 1 – 4th Table for more details over the calculations methodology).

5th Table: Variance and Standard Deviation analysis of the Thomson Reuters Private Equity Buyout Index.

Year	Variance	Standard Deviation
2004	43.57%	66.01%
2005	1.57%	12.54%
2006	0.14%	3.76%
2007	0.00%	0.04%
2008	5.86%	24.20%
2009	28.18%	53.08%
2010	16.81%	41.00%
2011	1.13%	10.61%
2012	0.80%	8.93%
2013	0.05%	2.18%
2014	0.59%	7.69%
2015	0.44%	6.65%
2016	5.48%	23.41%
2017	0.10%	3.22%
2018	4.41%	21.00%
2019	10.51%	32.41%
Average	7.48%	27.34%

Source: own calculations from Thomson Reuters Eikon.

(Annex 1 – 5th Table for more details over the calculations methodology).

Once this data is analyzed it can be appreciated it the strong returns that Private Equity had in the recent years. The risk held by this asset is very high that, compared with the commodities results, private equity outperforms commodities in returns and in efficiency considering the risk held.

5.3 Venture Capital

There are a lot of similarities and some differences between private equity and venture capital. In similarities, it is the lack of transparency that these companies have, because they are small and private making this difficult to find reliable information outside these companies. Also, the period of permanency in these companies is usually from 4 to 8 years and could finish in an IPO, the resources provided by the buyer is not only financial but in the majority of cases they also provide guidance and experience in the same sector. In differences, the most important one is the size of the firms, in venture capital the investments and companies are much smaller than private equity making this a riskier investment. In venture capital is common to fail a lot of investments given the small information that the investment managers have in the start ups that they fund, but is also common strong returns in those companies that grow quickly compensating the losses in the failed start ups.

5.3.1 Thomson Reuters Venture Capital Index

The Thomson Reuters Venture Capital Index has been selected due to its liquidity, term and underlying assets that are behind. It is a perfect fit with the other indexes analyzed in this project.

Six different sectors are present in this index in a liquid way that is not doing right now the TR VC Research Index. This index selected is much liquid and follow by the investors in the capital markets.
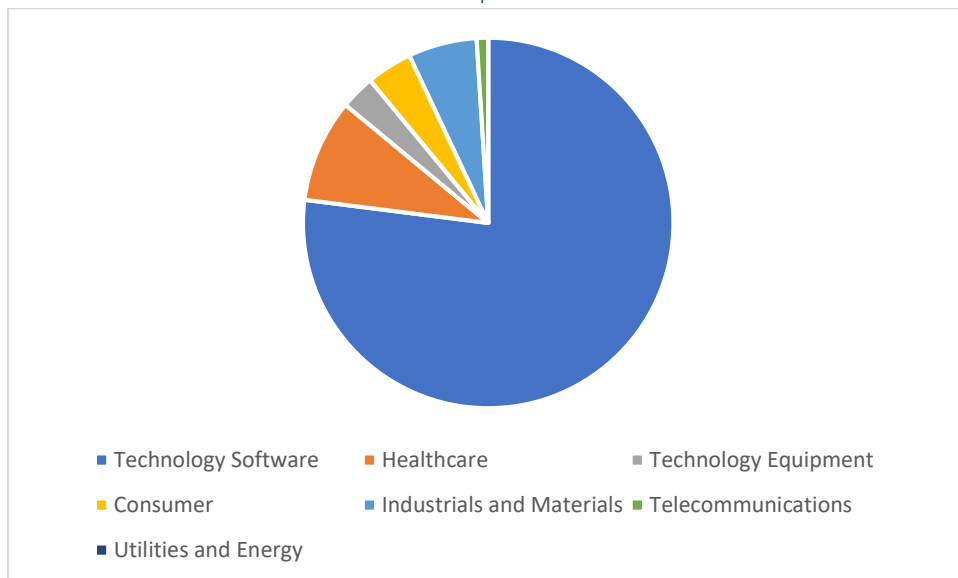
Source: Refinitiv.

This is how Thomson Reuters defines the index:

The TR VC Research Index is constructed from observed valuations of venture-backed firms at discrete points in time, such as during funding rounds, acquisitions, and exits. Aggregating this time-series of firm values, the TR VC Research Index constructs a valueweighted index of the returns to a theoretical fully-diversified portfolio of venture-backed firms capturing a high percentage of all VC-backed companies. Since this portfolio is constructed using observable prices and indicators; its return can be computed in real-time, providing immediate information about movements in the VC universe. Further, since the VC Index portfolio is constructed using liquid securities and is not subject to revision, it is an appropriate benchmark for investable products seeking to achieve venture capital returns in real time." (Refinitiv).

The analysis of this index is exposed below:

6ᵗʰ Table: Thomson Reuters Venture Capital Index.

Year	Points	Return	Variance	Standard Deviation
2003	600			
2004	900	50%	9.59%	30.97%
2005	960	6.67%	1.53%	12.37%
2006	1000	4.17%	2.21%	14.87%
2007	1000	0%	3.62%	19.03%
2008	1090	9%	1.01%	10.03%
2009	905	-16.97%	12.96%	36.00%
2010	1125	24.31%	0.28%	5.28%
2011	1550	37.78%	3.51%	18.75%
2012	1680	8.39%	1.13%	10.64%
2013	1960	16.67%	0.06%	2.37%
2014	2650	35.2%	2.62%	16.17%
2015	3405	28.49%	0.89%	9.46%
2016	3980	16.89%	0.05%	2.15%
2017	4400	10.55%	0.72%	8.48%
2018	7000	59.09%	16.05%	40.06%
2019	8000	14.29%	0.23%	4.75%
Average		19.03%	3.53%	18.78%

Source: Thomson Reuters Eikon and own calculations.

(Annex 1 – 6ᵗʰ Table for more detailed information over the calculations methodology).

5.4 Real Estate

The Benefits when investing in real estate are, income generation, capital appreciation, diversification, and hedging against inflation. The income is generated through the rent of the physical space, being this alternative asset the only one, within the main ones, that can produce this type of income. The capital appreciation corresponds to the increase in price of the real estate asset. The diversification stands for the correlation that historically this asset has with the traditional assets and with the other alternative assets that is going to be exposed in this report. Finally, real estate acts as a hedge against inflation due to their change in price of the rent and in the value of the property while the inflation is increasing. The main investments in real estate are the housing market, offices, industrial plants, buildings, and malls.

To fully understand these concepts, a conclusion of the Credit Suisse Global Investment Returns Yearbook 2018 is shown:

"Long-run returns from housing that said, numerous surveys show that virtually all home buyers view their purchasing decision as an investment. Furthermore, housing is different in that it also provides income. For dwellings that are rented out, there is rental income. For owneroccupiers, there is imputed income in the form of rent saved." (Credit Suisse, 2018).

A report of the housing prices in the United States is shown below to see the evolution of prices and their returns over the years. Now, a first glance of the price appreciation is provided to see the returns offered by this asset.

7th Table: Median home value in the United States between 1940 and 2000.

Year	Value
1940	$2,938
1950	$7,354
1960	$11,900
1970	$17,000
1980	$47,200
1990	$79,100
2000	$119,600

Source: Credit Suisse.

5.4.1 Returns in the international housing industry.

To make a first impression of the powerfulness of these alternative assets some data is provided:

5th Chart: Real price of domestic housing in 11 countries
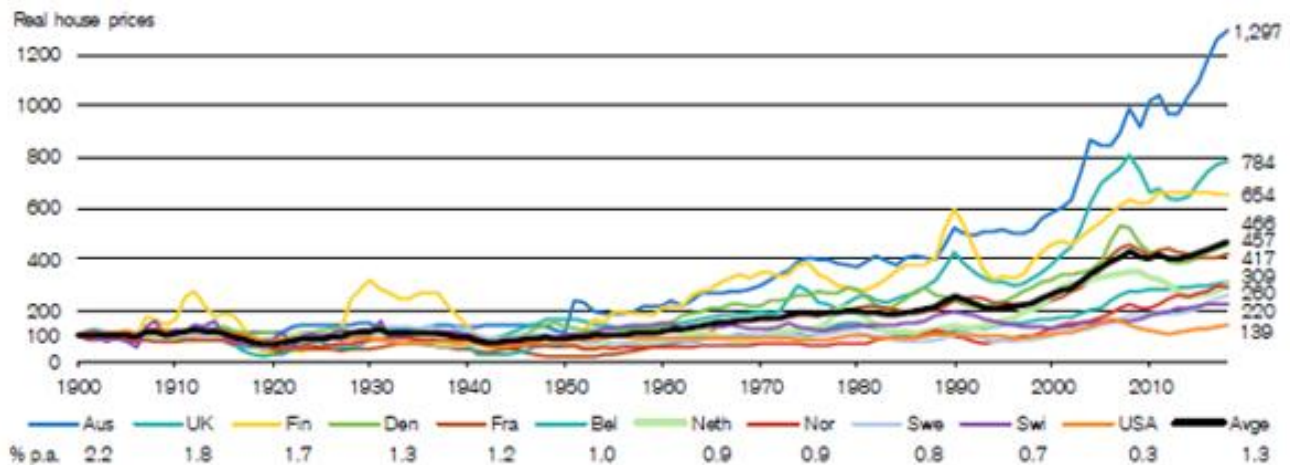
Source: The Economist

As the graph shows in average the housing prices have risen a 457% this is a 3.8% annually only in housing prices without taking into account the rent that would have been earned through all these years. For instance, in Australia, prices have risen an incredible 1297% a 10.99% annually. In the USA the rise was a 139% a 1.17% annually.

This data is for real prices and only taking into account the rise in prices, we should add the income from the rent and a 5% more or less would be obtained in the USA and a 14% in Australia annually.

5.4.2 Vanguard Real Estate ETF Total Return

I have chosen the Vanguard Real Estate ETF total return due to its highly liquidity, transparency, easy access, the required term and the whole picture that can be made over the whole real estate market in the United States.

The description is provided by Vanguard: "*Invests in stocks issued by real estate investment trusts (REITs), companies that purchase office buildings, hotels, and other real property. Vanguard Real Estate ETF seeks to provide a high level of income and moderate long-term capital appreciation by tracking the performance of a benchmark index that measures the performance of publicly traded equity REITs and other real estate-related investments."* (Vanguard).

The different sectors where this ETF is distributed are:

8th Table: Vanguard Real Estate ETF TR Distribution.

Diversified Real Estate Activities	0.2%
Diversified REITs	4.7%
Health Care REITs	9%
Hotel & Resort REITs	4.9%
Industrial REIT	7.7%
Office REITs	10.10%
Real Estate Development	0.4%
Real Estate Operating Companies	0.3%
Real Estate Services	2.7%
Residential REITs	14.1%
Retail REITs	13.6%
Specialized REITs	32.4%

Source: Vanguard.

These are the results obtained by this ETF:

9th Table: Return analysis of the Vanguard Real Estate ETF Total Return.

Years	Return
2004	10.05%
2005	17.02%
2006	12%
2007	35.20%
2008	-16.38%
2009	-36.98%
2010	29.74%
2011	28.47%
2012	8.62%
2013	17.67%
2014	2.42%
2015	30.29%
2016	2.37%
2017	8.53%
2018	4.95%
2019	-5.95%
Average	9.25%

Source: Vanguard.

(Annex 1 – 9th Table for more detailed information over the calculation methodology).

The risk has been calculated and is provided in the following table:

10th Table: Variance and Standard Deviation analysis of the Vanguard Real Estate ETF total return.

Year	Variance	Standard Deviation
2004	0.01%	0.80%
2005	0.60%	7.77%
2006	0.08%	2.75%
2007	6.73%	25.95%
2008	6.57%	25.63%
2009	21.37%	46.23%
2010	4.20%	20.49%
2011	3.69%	19.22%
2012	0.00%	0.63%
2013	0.71%	8.42%
2014	0.47%	6.83%
2015	4.43%	21.04%
2016	0.47%	6.88%
2017	0.01%	0.72%
2018	0.19%	4.30%
2019	2.31%	15.20%
Average	3.24%	18%

Source: own calculations from Vanguard´s data.

(Annex 1 – 10th Table for more detailed information over the calculations methodology).

The results obtained show good returns over a compensated risk making real estate, apparently, an efficient asset to incorporate in any portfolio. The Sharpe´s ratio, and more important, the Jensen´s alpha will be calculated in this report to have a scientific evidence of this opinion.

6. An analysis of the correlation between assets

The correlation between assets in a portfolio is a fundamental aspect that both managers and investors should consider when they decide to invest their money or the money of their clients. Nevertheless, this is not always the case, many investors only consider the return of an asset, portfolio, or fund before investing and they do not consider risk. Correlation between assets is linked to risk because of the different ways that prices can move if their correlation is very low or even negative.

A more detailed explanation is provided by Investopedia, the leading financial information web service:

Tha range for the correlation coefficient goes from -1 to 1. Being 1 perfectly correlated and -1 negative perfectly correlation, when the value is 0 the values move indifferently.

11th Table: Correlations by asset class 1926-2005.

	Small Stocks	Large Stocks	LT Corp. Bonds	LT Gov. Bonds	IT Gov. Bonds	T-Bills
Small Stocks	1	0.79	0.08	-0.02	-0.07	-0.1
Large Stocks	0.79	1	0.19	0.12	0.05	-0.02
LT Corp. Bonds	0.08	0.19	1	0.93	0.9	0.2
LT Gov. Bonds	-0.02	0.12	0.93	1	0.9	0.23
IT Gov. Bonds	-0.07	0.05	0.9	0.9	1	0.48
T-Bills	-0.1	-0.02	0.2	0.23	0.48	1

Source: Ibborson Associates.

In this graph I want to highlight the high correlation between stocks that is widely known. This is the problem when investing in only one market and only with one or a few assets. The correlation between small and large stocks is high, and when the investments are only made in small stocks or high stocks this correlation is higher. But, when the investment changes from one type of asset to another the correlation changes widely, this is the case of the stocks and bonds as it can be seen in the 10th table.

Additionally, the correlation between assets is a very important tool to take into consideration when a fund is created. The less correlation between assets the less downturns the portfolio is going to have in the long run and in period of crises. One of the things that Warren Buffet is not careful about is the diversification and the correlation between the assets that he chooses. This, can be very negative if a general downturn happens to a specific asset. This project will prove that diversifying in alternatives assets adds value to a fund because of the better efficiency that can be developed during the weak performance of the traditional assets and in the case of Warren Buffett, equities.

Below is the table with the specific correlations of the indexes and stocks analyzed in this report:

12th Table: Correlation between the assets analyzed in this report.

	S&P 500	Berkshire Hathaway	US Real Estate	US Private Equity	Commodities	US Venture Capital
S&P 500	1.000	0.828	0.738	0.913	0.512	0.752
Berkshire Hathaway	0.828	1.000	0.567	0.761	0.427	0.612
US Real Estate	0.738	0.567	1.000	0.601	0.212	0.329
US Private Equity	0.913	0.761	0.601	1.000	0.378	0.745
Commodities	0.512	0.427	0.212	0.378	1.000	0.285
US Venture Capital	0.752	0.612	0.329	0.745	0.285	1.000

Source: own calculations.

(Annex 1 – 12th Table for more detailed information over the calculations methodology).

This last table was created with the data obtained from all the indexes linked to each asset. There are some results that it is important to highlight. First of all, the commodities are the less correlated asset to the market and to the rest of the assets analyzed in this project. Secondly, Berkshire Hathaway is less correlated to the market than private equity and more than the rest of the assets. Likewise, it has a low correlation to the rest of the alternative assets. Furthermore, these alternative assets between them have also a low correlation. This fact is a powerful tool because when this asset are combined will provide a lower correlation to the market than Berkshire Hathaway since they have a low correlation between them and less correlation directly to the market with the exception the American private equity.

In addition, in period of crises or when a specific asset suffers a huge downturn this low correlation if combined, can and usually compensate the gains of some assets with the others that suffered this big downturn. Therefore, adding alternative assets in Warren Buffet´s portfolio would strongly diversify his investments given the low correlation between Berkshire Hathaway and the alternative assets.

I forecast that the risk held why Berkshire Hathaway will be higher than the risk held by the portfolio with the alternative assets given their small correlation and volatility of their assets. Moreover, the Sharpe´s ratio and the most common measure of risk and profitability the Jensen´s Alpha will show a lower risk and a more efficient portfolio taking into account the profitability obtained year by year and the risk held when doing these investments.

7. Warren Buffett´s investment vehicle, Berkshire Hathaway analysis.

7.1 Berkshire Hathaway

Berkshire Hathaway, the holding company for all Warren Buffet´s subsidiaries, is going to be analyzed. I decided to treat Berkshire Hathaway as an individual stock because is trading in this condition in the market. The total return is just the price appreciation because Berkshire Hathaway does not pay dividends, they will be used in order to calculate the total return, the variance, the standard deviation (volatility), the Sharpe ratio and the Jensen´s alpha.

The following information is provided by Berkshire Hathaway. In these lines is explained the different stocks that the company has and the characteristics that differentiate them:

"*Comparison of Berkshire Hathaway Inc. Class A and Class B Common Stock Berkshire Hathaway Inc. has two classes of common stock designated Class A and Class B. A share of Class B common stock has the rights of 1/1,500th of a share of Class A common stock except that a Class B share has 1/10,000th of the voting rights of a Class A share (rather than 1/1,500th of the vote). Each share of a Class A common stock is convertible at any time, at the holder's option, into 1,500 shares of Class B common stock. This conversion privilege does not extend in the opposite direction. That is, holders of Class B shares are not able to convert them into Class A shares. The Class B can never sell for anything more than a tiny fraction above 1/1,500th of the price of A. When it rises above 1/1,500th, arbitrage takes place.*" (Buffett, 2010).

Normally, the stocks trades at about 1/1500 times the price of A. Nevertheless, the stock B can trade at a discount, in these cases it is recommended to buy the stock B but when they are at parity the recommendation is buying A because of the rights that this stock holds.

The selected shares are the Berkshire Hathaway B shares because of their liquidity in the stock market and their more commonness between the investors.

The return obtained during all these years by the share ownership is shown in the following table:

13th Table: Return analysis of Berkshire Hathaway.

Year	Return
2004	34.04%
2005	0.44%
2006	-2.07%
2007	25.09%
2008	24.06%
2009	-34.31%
2010	27.85%
2011	6.96%
2012	-4.13%
2013	23.68%
2014	15.13%
2015	28.95%
2016	-9.83%
2017	26.49%
2018	30.61%
2019	-4.12%
Average	11.8%

Source: own calculations from Bloomberg terminal data.

 (Annex 1 – 13th Table for more detailed information over the calculations methodology).

Berkshire Hathaway does not pay dividends, therefore the total return is the same as the increase in the stock price. Warren Buffett considers that he and his team can return a bigger amount than what his investors can by their own, he estimates that their investors can achieve a 7% return per year, but he thinks that with Berkshire they can achieve more return.

14th Table: Variance and Standard Deviation analysis of Berkshire Hathaway.

Year	Variance	Standard Deviation
2004	4.94%	22%
2005	1.29%	11%
2006	1.92%	14%
2007	1.76%	13%
2008	1.50%	12%
2009	21.26%	46%
2010	2.58%	16%
2011	0.23%	5%
2012	2.54%	16%
2013	1.41%	12%
2014	0.11%	3%
2015	2.94%	17%
2016	4.68%	22%
2017	2.16%	15%
2018	3.54%	19%
2019	2.54%	16%
Average	3.46%	18.61%

Source: own calculations from Bloomberg terminal data.

(Annex 1 – 14th Table for more detailed information over the calculations methodology).

Berkshire Hathaway has achieved outstanding results in returns and in the risk held during all these years. They seem that they achieved a strong return risk relationship that will be confirmed in the following pages with the Sharpe´s ratio and Jensen´s Alpha.

S&P 500 Total Return

The market for Berkshire Hathaway is the S&P 500 because is the constant market that Buffett is always referring to while investors think in the same way. The S&P 500 is the widely known index that tracks the price movements for the 500 biggest companies in the United States. The return of this index is the total return where the dividends are also considered:

15th Table: Return analysis of the S&P 500 Total Return.

Year	S&P 500 Total Return
2004	34.57%
2005	6.23%
2006	10.38%
2007	14.51%
2008	-2.31%
2009	-38.63%
2010	33.14%
2011	22.19%
2012	4.22%
2013	16.78%
2014	21.52%
2015	14.22%
2016	-0.67%
2017	20.04%
2018	26.41%
2019	-2.31%
Average	11.27%

Source: own calculations from Bloomberg terminal data.

(Annex 1 – 15th Table for more details over the calculations methodology).

The risk of holding the index is:

16th Table: Variance and Standard Deviation analysis of the S&P 500 Total Return.

Year	Variance	Standard Deviation
2004	5.43%	23.30%
2005	0.25%	5.04%
2006	0.01%	0.89%
2007	0.11%	3.25%
2008	1.84%	13.58%
2009	24.89%	49.89%
2010	4.78%	21.87%
2011	1.19%	10.92%
2012	0.50%	7.05%
2013	0.30%	5.51%
2014	1.05%	10.25%
2015	0.09%	2.96%
2016	1.42%	11.93%
2017	0.77%	8.77%
2018	2.29%	15.14%
2019	1.84%	13.58%
Average	2.92%	17.10%

Source: own calculations from Bloomberg terminal data.

(Annex 1 – 16th Table for more details over the calculations methodology).

Once the data has been analyzed it can be seen that Berkshire Hathaway obtained a return over the S&P 500 slightly greater. Now, the question is if Berkshire Hathaway is also more efficient than the market in terms of the return risk relationship. To clarify this part, the following ratios and calculations are presented.

To compare the efficiency, the Sharpe´s ratio and mostly the Jensen´s alpha is the metric to calculate to answer the question. The Jensen´s alpha is the first one exposed:

The formula is: Jensen's alpha = Portfolio Return – [Risk Free Rate + Portfolio Beta * (Market Return – Risk Free Rate)].

All the variables needed are exposed in the following lines:

Risk-free rate: The 10-year interest rate of the Unites States is going to be the reference for the calculations. The 10-year United States government bond is the risk-free asset that works as a reference in this report. As it was said in the methodology part the reason of this selection is because the 10-year period of time is widely used in financial markets as the reference for this type of calculations. All the betas calculated over this project are based in these criteria.

17th Table: United States 10-year interest rate.

Year	Interest Rate
2004	4.13%
2005	4.13%
2006	4.52%
2007	4.81%
2008	3.60%
2009	2.85%
2010	3.59%
2011	3.37%
2012	1.80%
2013	1.99%
2014	2.64%
2015	1.64%
2016	1.92%
2017	2.47%
2018	2.71%
2019	2.63%
Average	3.05%

Source: Bloomberg terminal.

The beta is the measure of risk. Therefore, is expected for aggressive companies or highly leveraged companies to have high betas, whereas conservative companies whose performance is unrelated to the general market and will have lower betas. If β < 1: the stock price is less risky than the market (fluctuate less). In the other hand, if β > 1: the stock price is riskier than the market (fluctuate more).

$$\beta_p = \frac{Cov\left(r_p, r_b\right)}{Var\left(r_b\right)}$$

Basically, Beta is the covariance between the specific security and the market divided by the variance of the market.

As it was already expressed, in an investment fund not only the return has to be considered but the risk that the investments takes also. The Jensen´s alpha is the main tool of this project to determine this risk and more important the efficiency of the portfolios. When the Jensen´s alpha is positive the portfolio is having excess returns for the risk that the portfolio took, in other words, the portfolio is beating the market. The ratio describes how much excess return you receive for the extra volatility you endure for holding a riskier asset. It is needed a compensation for the additional risk that a investment takes for not holding a risk-free asset.

The beta of the stock is 0.9. That is provided by Bloomberg.

With all this information we can calculate the Jensen´s Alpha for Berkshire Hathaway:

18th Table: Jensen´s alpha of Berkshire Hathaway.

Year	Jensen´s alpha
2004	2.49%
2005	-5.58%
2006	-11.87%
2007	11.53%
2008	25.79%
2009	0.20%
2010	-2.35%
2011	-13.36%
2012	-8.11%
2013	8.37%
2014	-4.51%
2015	15.98%
2016	-9.42%
2017	8.19%
2018	6.55%
2019	-2.30%
Average	1.35%

Source: own calculations.

(Annex 1 – 18th Table for more detailed information over the calculations methodology).

The results reflect a positive Jensen´s alpha, therefore investing in Berkshire Hathaway is more efficient than investing in an ETF over the S&P 500. The risk held by Berkshire Hathaway compensates due to their strong returns obtained.

Another measure of risk is the Sharpe´s ratio that works letting know if the returns obtained are due to good picking skills or to too much risk held.

We will give you a better understanding of how this ratio works, starting with its formula:

$$S(x) = \frac{(r_x - R_f)}{StdDev(r_x)}$$

where:

x = the investment.

Rx = the average rate of return of x.

R f = risk free security.

Standard Deviation (x) = the standard deviation of rx.

The theory states that adding assets to a portfolio that have low correlations can decrease portfolio risk without sacrificing return. That is what this project will try to demonstrate. In conclusion, adding diversification should increase the Sharpe´s ratio compared to similar portfolios with a lower level of diversification.

The Sharpe´s Ratio for Berkshire Hathaway is:

(11.8% - 3.05%) / 18.61% = 0.47

Being, 11.8% = Berkshire´s average return since 2004.

3.05% = risk free asset, Unites States 10-year government bond.

18.61% = Berkshire´s average standard deviation since 2004.

The strong volatility that Berkshire Hathaway experienced makes the Sharpe´s ratio weak. Although, it can be concluded that Warren Buffett beat the market in return and in return risk efficiency as it is shown in the Jensen´s alpha of the 18th table.

With all this information, the alternative assets portfolio is exposed in the following section to incorporate it to Berkshire Hathaway.

8. Alternative Assets portfolio

To propose an alternative asset portfolio, all the returns have been analyzed trying to find out which combination of alternative asset is the most efficient one. In the following table all the returns of the four classes of alternative assets, plus Berkshire Hathaway and the S&P 500 TR (the market) are shown where the asset with the biggest return is the first and the asset with the lowest return is the last one.

19th Table: Best Asset each Year.

2004	2005	2006	2007	2008	2009	2010	2011
PE 86.05%	RE 17.02%	Com. 22.72%	RE 35.2%	Com. 35.76%	VC -16.97	PE 61.04%	VC 37.78%
VC 50%	Com. 16.09%	PE 16.28%	BH 25.09%	BH 24.06%	PE -33.04%	S&P 500 33.14%	PE 30.65%
S&P 500 TR 34.57%	PE 7.5%	RE 12%	PE 20%	VC 9%	BH -34.31%	RE 29.74%	RE 28.47%
BH 34.04%	VC 6.67%	S&P 500 10.38%	S&P 500 14.51%	S&P 500 -2.31%	RE -36.98%	BH 27.85%	S&P 500 22.19%
RE 10.05%	S&P 500 6.23%	VC 4.17%	VC 0%	PE -4.17%	S&P 500 -38.63%	VC 24.31%	Com. 21.98%
Com. 6.31%	BH 0.44%	BH -2.07%	Com. -20.49%	RE -16.38%	Com. -51.26%	Com. 14.79%	BH 6.96%

2012	2013	2014	2015	2016	2017	2018	2019
PE 11.11%	BH 23.68%	VC 35.2%	RE 30.29%	VC 16.89%	BH 26.49%	VC 14.29%	VC 14.29%
RE 8.62%	PE 22.22%	PE 27.73	BH 28.95%	RE 2.37%	PE 23.26%	PE 41.04%	S&P 500 -2.31%
VC 8.39%	RE 17.67%	S&P 500 21.52%	VC 28.49%	S&P 500 -0.67%	S&P 500 20.04%	BH 30.61%	BH -4.12%
S&P 500 4.22%	S&P 500 16.78%	BH 15.13%	PE 26.69%	PE -3.37%	Com. 15.79%	S&P 500 26.41%	RE -5.95%
Com. -1.96%	VC 16.67%	RE 2.42%	S&P 500 14.22%	BH -9.83%	VC 10.55%	Com. 10.95%	Com. -9.19%
BH -4.13%	Com. 2.16%	Com. -6.90%	Com. -37.05%	Com. -3117%	RE 8.53%	RE 4.95%	PE -12.37%

Source: own calculations.

As it can be easily appreciated the S&P 500 TR, the market, is always more or less in the middle. This, can give us a first hint about the risk of the asset studied in this report, they have more risk than the market. Moreover, the commodities are in most of the times in the lowest positions of the ranking, only looking to this table we can have a hint about their low efficiency. The real estate and Berkshire Hathaway appear to be efficient taking into account their returns showed and the volatility supported. Finally, Private Equity and Venture Capital are in average most of the years in the top positions of this ranking.

Nevertheless, only by looking to the return we would only see a part of the picture. It is mandatory to analyze the risk supported by these assets and it is presented in the following pages.

The first alternative asset portfolio proposed is the following:

20ᵗʰ Table: First alternative asset portfolio.

Assets	Proportions	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
Commodities	20%	-0.72%	5.43%	23.30%	-0.16	-9.50%
Real Estate	40%	9.25%	3.24%	18.00%	0.35	-0.18%
Private Equity	40%	20.04%	7.48%	27.34%	0.62	4.98%
Total	100%	11.57%	5.37%	22.80%	0.37	0.02%

Source: own calculations.

Commodities´ beta: 0.697
Real Estate´s beta: 0.776
Private Equity´s beta: 1.46
Whole portfolio beta: 1.03
(Annex 1 – 20ᵗʰ Table for more information over the calculations methodology).

21th Table: Returns year by year of the first alternative asset portfolio.

Year	Returns of AA portfolio
2004	39.70%
2005	13.03%
2006	15.85%
2007	17.98%
2008	-1.07%
2009	-38.26%
2010	39.27%
2011	28.04%
2012	7.50%
2013	16.39%
2014	10.68%
2015	15.38%
2016	-6.63%
2017	15.87%
2018	20.59%
2019	-9.17%
Average	11.57%

Source: own calculations.

(Annex 1 – 21th Table for more details over the calculations methodology).

The covariance of a portfolio is express by the following formula.

$$\sigma_{AB} = \frac{1}{T}\sum_{t=1}^{T}(r_{A,t} - \overline{r}_A)(r_{B,t} - \overline{r}_B)$$

The covariance between the alternative assets portfolio and the market is:

0.03024556
(Annex 1 – 28th Table for more details over the calculations methodology).

The beta of the first alternative asset portfolio is: 1.03

(Annex 1 – 29th Table for more details over the calculations methodology).

Therefore, the Jensen´s Alpha of the first alternative asset portfolio is: 0.02%

11.57% - (3.04% + 1.03 * (11.27% - 3.04%)) = 0.02%

The proportions for the portfolio proposed are undervaluing commodities given their extremely low return over long periods of time but their high-risk relative with the other alternative assets. Private equity and real estate are more efficient investments considering return and risk.

22th Table: Comparison between Berkshire Hathaway and the Alt. assets portfolio.

Assets	Proportions	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
Berkshire Hathaway	80.00%	11.80%	3.46%	18.61%	0.47	1.35%
Alternative Assets portfolio	20.00%	11.57%	5.37%	22.80%	0.37	0.02%

Source: own calculations.

The results show a greater return for Berkshire Hathaway with less risk that ends in more efficient Jensen´s alpha. Now, the two portfolios are combined.

8.1 First Portfolio proposed
Given the 22th table with a 80% of Berkshire Hathaway and a 20% of the first alternative assets portfolio we obtain the following portfolio with the following figures:

23th Table: Berkshire Hathaway + the first alternative assets portfolio.

Assets	Proportions	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
BH + First Alt. Assets portfolio	100%	11.76%	3.85%	19.45%	0.45	1.08%

Source: own calculations.

(Annex 1 – 23th Table for more information over the calculation methodology).

It is observed that adding this first alternative asset portfolio less return is achieved while more risk is added, this last fact can be appreciated in the variance, standard deviation and Sharpe´s ratio figures. In addition, this last portfolio obtained is less efficient in terms of the Jensen´s Alpha. It is not recommended to add this specific alternative asset portfolio with the weights exposed in the 20th table. I will propose a more efficient alternative asset portfolio.

As it can be appreciated in the 20th table the Sharpe´s ratio is negative in consequence of the high risk supported by these commodities but the low return that gave during all these years. As expected, the Jensen´s alpha is also negative, the return of the American risk-free asset and the S&P 500 total return is far greater than the commodities' return. In conclusion, investing in the commodities market is not efficient and should be avoided. Nevertheless, real estate and private equity add value to a portfolio in terms of strong returns, low correlation between other assets and a decent relationship between return and risk for the American real estate and a strongly result for private equity. Once this data has been analyzed I have decided to exclude commodities from the portfolio. The return obtained with the risk supported over the years is far away from an investment that tries to multiplicate the initial amount of money. The relationship between return and risk is very inefficient and proves that is not worth it investing in this specific combination of commodities.

In consequence, one or more alternative assets should be included in the new portfolio in exchange of the exclusion of commodities. Hedge funds are considered one of the biggest alternative assets, even though their lack of transparency and the difficulty and sometimes impossibility to find reliable information have been the reasons why I decided to not include them in this project. Some indexes can be found, but they are not considering a big part of the hedge funds market and the holdings of this index are not reflecting the whole industry like the other alternative assets do, it would be comparing different things.

Another important alternative asset is venture capital. As it was showed in the 6th table, venture capital presents good results and seems efficient. To find out with facts this perception, the Sharpe´s ratio and the Jensen´s alpha have been calculated.

Once the focus is over the Unites States Venture Capital:

24th Table: Venture Capital´s analysis.

Asset	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
Venture Capital	19.03%	3.53%	18.78%	0.85	9.19%

Source: own calculations.

Venture Capital´s beta: 0.826

With this data we can conclude that the United States Venture Capital is an outstanding asset that can boost the figures of almost any portfolio. Venture capital is near the greatest return analyzed in this report (it is 19% near the 20% achieved by private equity) but, with the difference that the risk is much lower. This fact is reflected in the Sharpe´s ratio and in the Jensen´s alpha achieved figures that are better than Berkshire Hathaway and all the alternatives assets analyzed. It is very important to add them in our final portfolio.

8.2 Final Portfolio proposed

As it was demonstrated investing in commodities is not efficient in terms of return/risk, therefore in the final portfolio they are excluded. Venture Capital is included given their great return/risk relationship showed in the United States in the last years and because is one of the biggest alternative asset of the United States.

This is the final portfolio proposed:

25th Table: Final alternative asset portfolio.

Assets	Proportions	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
Real Estate	33.33%	9.25%	3.24%	18.00%	0.35	-0.18%
Private Equity	33.33%	20.04%	7.48%	27.34%	0.62	4.98%
Venture Capital	33.33%	19.03%	3.53%	18.78%	0.85	9.19%
Total	100%	16.11%	4.75%	21.38%	0.61	4.66%

Source: own calculations.

(Annex 1 – 25th Table for detailed information over the calculations methodology).

Portfolio beta: 1.02

The returns year by year are expressed in the following table:

26th Table: Returns year by year of the final alternative asset portfolio.

Year	Returns
2004	48.70%
2005	10.40%
2006	10.82%
2007	18.40%
2008	-3.85%
2009	-29.00%
2010	38.36%
2011	32.30%
2012	9.37%
2013	18.85%
2014	21.78%
2015	28.49%
2016	5.30%
2017	14.11%
2018	35.03%
2019	-1.35%
Average	16.11%

Source: own calculations.

The final portfolio is the sum of Berkshire Hathaway + the Final Alternative Asset portfolio:

27ᵗʰ Table: Berkshire Hathaway with the Final Alternative Asset portfolio.

	Proportions	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
Berkshire Hathaway	80%	11.80%	3.46%	18.61%	0.47	1.35%
Final Alternative Assets portfolio	20%	16.11%	4.75%	21.38%	0.61	4.66%
Total	100%	12.66%	3.72%	19.16%	0.50	2.01%

Source: own calculations.

(Annex 1 – 27ᵗʰ Table for detailed information over the calculations methodology).

In this alternative asset portfolio, it is obtained more return, more risk, but a better return/risk relationship than Berkshire Hathaway, adding in this way value to Warren Buffett´s portfolio. The efficiency is measured with the Jensen´s Alpha that has pushed Warren Buffett new portfolio Jensen´s ratio higher. Furthermore, the strong return given by the alternative assets is incorporated to this portfolio while the bigger risk is also increasing the final risk of the combined portfolio. This is the reason why the variance, standard deviation and the Sharpe´s ratio have increased.

The final alternative asset portfolio is more efficient than the first alternative asset portfolio analyzed, the exchange between the commodities for the venture capital was a successful decision. Moreover, it is achieved enough results to say that incorporating alternative assets to a traditional asset portfolio is a more efficient way of investing even if you are Warren Buffett.

9. <u>Conclusions</u>

To conclude, this project has demonstrated several things with a very real and practical approach. Every traditional asset portfolio could be improved if efficient alternative assets are added, this will diversify and make an advantage of the low correlation between them. Even for Warren Buffett it is possible to boost the return and get a better return/risk relationship if the alternative assets are added to a portfolio, this was demonstrated in the 27th table. Their low correlation are key in case that a general downturn happen, the alternative assets would increase the performance in this scenario. Moreover, as it was showed with the Jensen´s alpha, the efficiency of the investments in alternative assets is greater than Warren Buffet´s investments in equities. Therefore, adding the right alternative asset will increase the relationship between return and risk that is easily measure with the Jensen´s alpha.

The Commodities index analyzed is not efficient and is not worth it investing in them. As it was explained, the relationship between return and risk make commodities an alternative asset that does not pay for the risk that the investments hold. A lot of volatility is always involved in the commodities industry, as it has been analyzed in the commodities in detail section, the commodities industry has experienced a lot of volatility in the recent years where the returns are not good, and they cannot even beat inflation. The new technologies that make the supply of these commodities cheaper, the globalization that created somehow a single global market where the hyper competition is reflected in the prices and the new products that can substitute the commodities used in the present are the main causes of these volatility in the prices and the reason why the prices are not increasing and increasing year by year.

Additionally, there is not reliable public information about the return history of hedge funds, since there is not an index that shows a reliable picture of the whole hedge fund industry of the United States as it happens with the real estate, commodities, private equity and venture capital. They were not included in this project since it would be comparing different things.

Adding a 20% of alternative assets cloud be seen as too much, but given their efficiency and powerful returns, I decided to include them in that percentage, but at least a 10% is recommended for any traditional portfolio to make an advantage of their low correlation to the other assets and their great return risk relationship that was demonstrated in this project, even for Warren Buffett.

9.1 Limitations

Only the main four alternative assets were selected to conduct this analysis when there are many of them. For example, hedge funds were excluded from this report since their information is not transparent and there is not a similar index trading in the markets like the other four alternative assets. Furthermore, the returns were calculated year by year and then doing an average of all the years to reach the final return. There are different ways to calculate returns and in this project only the one mentioned was performed.

More risks measures could be added, like the Treynor ratio, for example. In this report the main ones were done trying to synthesize the calculations.

Finally, one ETF and three indexes were selected to reflect the alternative assets calculations. It could be completed with, for example, three indexes per alternative asset to reach more sectors within each alternative asset. This limitation is also an improvement that can be performed to this project.

9.2 Improvements

It was performed two different portfolios in this project once the efficiency of commodities was extremely low, a further step would be taking away real estate since its efficiency is lower than Berkshire Hathaway in terms of the Jensen´s alpha.

A further step in the limitation of the analysis of the four alterative assets is analyzing more alternative assets finding those that are efficient and add them in Berkshire Hathaway. Also, the project can be developed in more countries and not only in the Unites States.

An econometric analysis can be done trying to see if the calculations performed are reliable or not, specially the calculations over the Jensen´s alpha.

Moreover, a more theoretical approach can be developed to back the practical part with more deep theory.

Finally, as it was explained in the limitations section the incorporation of more indexes per each alternative asset studied in this project, would be something that would make this report more reliable since more sectors could be analyzed to set and classify the most efficient sectors of each alternative asset.

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11. __Annex 1__

All the formulas and calculations showed in the annex have been calculated in Microsoft Excel.

S&P GSCI Commodity Total Return calculations (2nd and 3rd Table):

A1	B	C	D	E	F
2	Year	S&P GSCI Commodity TR	S&P GSCI Commodity TR Return	Variance	Standard Deviation
3		4566			
4	2004	4854	=+ (C4 - C3)/ C3	=+ (D4 - $D$21) ^2	=+ SQRT (E4)
5	2005	5635	=+ (C5 - C4)/ C4	=+ (D5 - $D$21) ^2	=+ SQRT (E5)
6	2006	6915	=+ (C6 - C5)/ C5	=+ (D6 - $D$21) ^2	=+ SQRT (E6)
7	2007	5498	=+ (C7 - C6)/ C6	=+ (D7 - $D$21) ^2	=+ SQRT (E7)
8	2008	7464	=+ (C8 - C7)/ C7	=+ (D8 - $D$21) ^2	=+ SQRT (E8)
9	2009	3638	=+ (C9 - C8)/ C8	=+ (D9 - $D$21) ^2	=+ SQRT (E9)
10	2010	4176	=+ (C10 - C9)/ C9	=+ (D10 - $D$21) ^2	=+ SQRT (E10)
11	2011	5094	=+ (C11 - C10)/ C10	=+ (D11 - $D$21) ^2	=+ SQRT (E11)
12	2012	4994	=+ (C12 - C11)/ C11	=+ (D12 - $D$21) ^2	=+ SQRT (E12)
13	2013	5102	=+ (C13 - C12)/ C12	=+ (D13 - $D$21) ^2	=+ SQRT (E13)
14	2014	4750	=+ (C14 - C13)/ C13	=+ (D14 - $D$21) ^2	=+ SQRT (E14)
15	2015	2990	=+ (C15 - C14)/ C14	=+ (D15 - $D$21) ^2	=+ SQRT (E15)
16	2016	2058	=+ (C16 - C15)/ C15	=+ (D16 - $D$21) ^2	=+ SQRT (E16)
17	2017	2383	=+ (C17 - C16)/ C16	=+ (D17 - $D$21) ^2	=+ SQRT (E17)
18	2018	2644	=+ (C18 - C17)/ C17	=+ (D18 - $D$21) ^2	=+ SQRT (E18)
19	2019	2401	=+ (C19 – C18)/ C18	=+ (D19 - $D$21) ^2	=+ SQRT (E19)
20					
21		Mean	=+ AVERAGE(D4:D19)	=+ AVERAGE(E4:E19)	=+ SQRT (E21)

Thomson Reuters Private Equity Buyout Index calculations (4ᵗʰ and 5ᵗʰ Table):

A1	B	C	D	E	F
2	Year	Points	Return	Variance	Standard Deviation
3	2003	215			
4	2004	400	=+ (C4 - C3)/ C3	=+ (D4 - $D$21) ^2	=+ SQRT (E4)
5	2005	430	=+ (C5 - C4)/ C4	=+ (D5 - $D$21) ^2	=+ SQRT (E5)
6	2006	500	=+ (C6 - C5)/ C5	=+ (D6 - $D$21) ^2	=+ SQRT (E6)
7	2007	600	=+ (C7 - C6)/ C6	=+ (D7 - $D$21) ^2	=+ SQRT (E7)
8	2008	575	=+ (C8 - C7)/ C7	=+ (D8 - $D$21) ^2	=+ SQRT (E8)
9	2009	385	=+ (C9 - C8)/ C8	=+ (D9 - $D$21) ^2	=+ SQRT (E9)
10	2010	620	=+ (C10 - C9)/ C9	=+ (D10 - $D$21) ^2	=+ SQRT (E10)
11	2011	810	=+ (C11 - C10)/ C10	=+ (D11 - $D$21) ^2	=+ SQRT (E11)
12	2012	900	=+ (C12 - C11)/ C11	=+ (D12 - $D$21) ^2	=+ SQRT (E12)
13	2013	1100	=+ (C13 - C12)/ C12	=+ (D13 - $D$21) ^2	=+ SQRT (E13)
14	2014	1405	=+ (C14 - C13)/ C13	=+ (D14 - $D$21) ^2	=+ SQRT (E14)
15	2015	1780	=+ (C15 - C14)/ C14	=+ (D15 - $D$21) ^2	=+ SQRT (E15)
16	2016	1720	=+ (C16 - C15)/ C15	=+ (D16 - $D$21) ^2	=+ SQRT (E16)
17	2017	2120	=+ (C17 - C16)/ C16	=+ (D17 - $D$21) ^2	=+ SQRT (E17)
18	2018	2990	=+ (C18 - C17)/ C17	=+ (D18 - $D$21) ^2	=+ SQRT (E18)
19	2019	2620	=+ (C19 - C18)/ C18	=+ (D19 - $D$21) ^2	=+ SQRT (E19)
20					
21	Mean		=+ AVERAGE(D4:D19)	=+ AVERAGE(E4:E19)	=+ SQRT(E21)

Thomson Reuters Venture Capital Index (6th Table):

A1	B	C	D	E	F
2	Year	Points	Return	Variance	Standard Deviation
3	2003	600			
4	2004	900	=+ (C4 - C3)/ C3	=+ (D4 - $AD$20) ^2	=+ SQRT(E4)
5	2005	960	=+ (C5 - C4)/ C4	=+ (D5 - $AD$20) ^2	=+ SQRT(E5)
6	2006	1000	=+ (C6 - C5)/ C5	=+ (D6 - $AD$20) ^2	=+ SQRT(E6)
7	2007	1000	=+ (C7 - C6)/ C6	=+ (D7 - $AD$20) ^2	=+ SQRT(E7)
8	2008	1090	=+ (C8 - C7)/ C7	=+ (D8 - $AD$20) ^2	=+ SQRT(E8)
9	2009	905	=+ (C9 - C8)/ C8	=+ (D9 - $AD$20) ^2	=+ SQRT(E9)
10	2010	1125	=+ (C10 - C9)/ C9	=+ (D10 - $AD$20) ^2	=+ SQRT(E10)
11	2011	1550	=+ (C11 - C10)/ C10	=+ (D11 - $AD$20) ^2	=+ SQRT(E11)
12	2012	1680	=+ (C12 - C11)/ C11	=+ (D12 - $AD$20) ^2	=+ SQRT(E12)
13	2013	1960	=+ (C13 - C12)/ C12	=+ (D13 - $AD$20) ^2	=+ SQRT(E13)
14	2014	2650	=+ (C14 - C13)/ C13	=+ (D14 - $AD$20) ^2	=+ SQRT(E14)
15	2015	3405	=+ (C15 - C14)/ C14	=+ (D15 - $AD$20) ^2	=+ SQRT(E15)
16	2016	3980	=+ (C16 - C15)/ C15	=+ (D16 - $AD$20) ^2	=+ SQRT(E16)
17	2017	4400	=+ (C17 - C16)/ C16	=+ (D17 - $AD$20) ^2	=+ SQRT(E17)
18	2018	7000	=+ (C18 - C17)/ C17	=+ (D18 - $AD$20) ^2	=+ SQRT(E18)
19	2019	8000	=+ (C19 - C18)/ C18	=+ (D19 - $AD$20) ^2	=+ SQRT(E19)
20					
21		Mean	=+ AVERAGE(D4:D19)	=+ AVERAGE(E4:E19)	=+ SQRT(E21)

Vanguard Real Estate ETF Total Return Calculations (9ᵗʰ and 10ᵗʰ Table):

A1	B	C	D	E
2	Year	Vanguard Real Estate ETF total return	Variance	standard deviation
3	2004	0.1005	=+ (C3 - $C$20) ^2	=+ SQRT (D3)
4	2005	0.1702	=+ (C4 - $C$20) ^2	=+ SQRT (D4)
5	2006	0.12	=+ (C5 - $C$20) ^2	=+ SQRT (D5)
6	2007	0.352	=+ (C6 - $C$20) ^2	=+ SQRT (D6)
7	2008	-0.1638	=+ (C7 - $C$20) ^2	=+ SQRT (D7)
8	2009	-0.3698	=+ (C8 - $C$20) ^2	=+ SQRT (D8)
9	2010	0.2974	=+ (C9 - $C$20) ^2	=+ SQRT (D9)
10	2011	0.2847	=+ (C10 - $C$20) ^2	=+ SQRT (D10)
11	2012	0.0862	=+ (C11 - $C$20) ^2	=+ SQRT (D11)
12	2013	0.1767	=+ (C12 - $C$20) ^2	=+ SQRT (D12)
13	2014	0.0242	=+ (C13 - $C$20) ^2	=+ SQRT (D13)
14	2015	0.3029	=+ (C14 - $C$20) ^2	=+ SQRT (D14)
15	2016	0.0237	=+ (C15 - $C$20) ^2	=+ SQRT (D15)
16	2017	0.0853	=+ (C16 - $C$20) ^2	=+ SQRT (D16)
17	2018	0.0495	=+ (C17 - $C$20) ^2	=+ SQRT (D17)
18	2019	-0.0595	=+ (C18 - $C$20) ^2	=+ SQRT (D18)
19				
20	Mean	=+ AVERAGE(C3:C18)	=+ AVERAGE(D3:D18)	=+ SQRT (D20)

Correlation Table (12ᵗʰ Table):

A1	B	C	D	E
2		S&P 500	Berkshire Hathaway	US Real Estate
3	S&P 500	=+CORREL(Main!N3:N18,Main!N3:N18)	=+CORREL(Main!N3:N18,Main!J3:J18)	=+CORREL(Main!N3:N18,Main!B3:B18)
4	Berkshire Hathaway	=+D3	1	=+D5
5	US Real Estate	=+E3	=+CORREL(Main!B3:B18,Main!J3:J18)	1
6	US Private Equity	=+F3	=+CORREL(Main!Z3:Z18,Main!J3:J18)	=+CORREL(Main!Z3:Z18,Main!B3:B18)
7	Commodities	=+G3	=+CORREL(Main!F3:F18,Main!J3:J18)	=+CORREL(Main!F3:F18,Main!B3:B18)
8	US Venture Capital	=+H3	=+CORREL(Main!AE3:AE18,Main!J3:J18)	=+CORREL(Main!AE3:AE18,Main!B3:B18)

Berkshire Hathaway Inc. B Calculations (13th and 14th Table):

A1	B	C	D	E	F
2	Year	Stock price	Returns	Variance	Standard Deviation
3	2003	44.48			
4	2004	59.62	=+ (C4 - C3)/ C3	=+ (D4 - $D$21) ^2	=+ SQRT (E4)
5	2005	59.88	=+ (C5 - C4)/ C4	=+ (D5 - $D$21) ^2	=+ SQRT (E5)
6	2006	58.64	=+ (C6 - C5)/ C5	=+ (D6 - $D$21) ^2	=+ SQRT (E6)
7	2007	73.35	=+ (C7 - C6)/ C6	=+ (D7 - $D$21) ^2	=+ SQRT (E7)
8	2008	91	=+ (C8 - C7)/ C7	=+ (D8 - $D$21) ^2	=+ SQRT (E8)
9	2009	59.78	=+ (C9 - C8)/ C8	=+ (D9 - $D$21) ^2	=+ SQRT (E9)
10	2010	76.43	=+ (C10 - C9)/ C9	=+ (D10 - $D$21) ^2	=+ SQRT (E10)
11	2011	81.75	=+ (C11 - C10)/ C10	=+ (D11 - $D$21) ^2	=+ SQRT (E11)
12	2012	78.37	=+ (C12 - C11)/ C11	=+ (D12 - $D$21) ^2	=+ SQRT (E12)
13	2013	96.93	=+ (C13 - C12)/ C12	=+ (D13 - $D$21) ^2	=+ SQRT (E13)
14	2014	111.6	=+ (C14 - C13)/ C13	=+ (D14 - $D$21) ^2	=+ SQRT (E14)
15	2015	143.91	=+ (C15 - C14)/ C14	=+ (D15 - $D$21) ^2	=+ SQRT (E15)
16	2016	129.77	=+ (C16 - C15)/ C15	=+ (D16 - $D$21) ^2	=+ SQRT (E16)
17	2017	164.14	=+ (C17 - C16)/ C16	=+ (D17 - $D$21) ^2	=+ SQRT (E17)
18	2018	214.38	=+ (C18 - C17)/ C17	=+ (D18 - $D$21) ^2	=+ SQRT (E18)
19	2019	205.54	=+ (C19 – C18)/ C18	=+ (D19 - $D$21) ^2	=+ SQRT (E19)
20					
21		Mean	=+ AVERAGE(D4:D19)	=+ AVERAGE(E4:E19)	=+ SQRT (E21)

S&P 500 Total Return Calculations (15th and 16th Table):

A1	B		C	D	E
2	Year		S&P 500 Total Return	Variance	Standard Deviation
3	2003	1228.14			
4	2004	1652.73	=+ (M4 - M3)/M3	=+ (C4 - $C$21) ^2	=+ SQRT (D4)
5	2005	1755.68	=+ (M5 - M4)/M4	=+ (C5 - $C$21) ^2	=+ SQRT (D5)
6	2006	1937.93	=+ (M6 - M5)/M5	=+ (C6 - $C$21) ^2	=+ SQRT (D6)
7	2007	2219.19	=+ (M7 - M6)/M6	=+ (C7 - $C$21) ^2	=+ SQRT (D7)
8	2008	2167.90	=+ (M8 - M7)/M7	=+ (C8 - $C$21) ^2	=+ SQRT (D8)
9	2009	1330.51	=+ (M9 - M8)/M8	=+ (C9 - $C$21) ^2	=+ SQRT (D9)
10	2010	1771.40	=+ (M10 - M9)/M9	=+ (C10 - $C$21) ^2	=+ SQRT (D10)
11	2011	2164.40	=+ (M11 - M10)/M10	=+ (C11 - $C$21) ^2	=+ SQRT (D11)
12	2012	2255.69	=+ (M12 - M11)/M11	=+ (C12 - $C$21) ^2	=+ SQRT (D12)
13	2013	2634.16	=+ (M13 - M12)/M12	=+ (C13 - $C$21) ^2	=+ SQRT (D13)
14	2014	3200.95	=+ (M14 - M13)/M13	=+ (C14 - $C$21) ^2	=+ SQRT (D14)
15	2015	3656.28	=+ (M15 - M14)/M14	=+ (C15 - $C$21) ^2	=+ SQRT (D15)
16	2016	3631.96	=+ (M16 - M15)/M15	=+ (C16 - $C$21) ^2	=+ SQRT (D16)
17	2017	4359.81	=+ (M17 - M16)/M16	=+ (C17 - $C$21) ^2	=+ SQRT (D17)
18	2018	5511.21	=+ (M18 - M17)/M17	=+ (C18 - $C$21) ^2	=+ SQRT (D18)
19	2019	5383.63	=+ (M19 - M18)/M18	=+ (C19 - $C$21) ^2	=+ SQRT (D19)
20					
21	Mean		=+ AVERAGE(C4:C19)	=+ AVERAGE(D4:D19)	=+ SQRT(D21)

Jensen´s Alpha Calculations (18th Table):

J1	K	L	O	R	U
2	Year	Berkshire´s Return	S&P 500 TR	US 10y Interest rate	Jensen´s Alpha
3					
4	2004	0.3404	0.3457	0.04134	= +L4-(R4 + 0.9 * (O4-R4))
5	2005	0.0044	0.0623	0.04132	= +L5-(R5 + 0.9 * (O5-R5))
6	2006	-0.0207	0.1038	0.04519	= +L6-(R6 + 0.9 * (O6-R6))
7	2007	0.2509	0.1451	0.04814	= +L7-(R7 + 0.9 * (O7-R7))
8	2008	0.2406	-0.0231	0.03597	= +L8-(R8 + 0.9 * (O8-R8))
9	2009	-0.3431	-0.3863	0.02851	= +L9-(R9 + 0.9 * (O9-R9))
10	2010	0.2785	0.3314	0.03588	= +L10-(R10 + 0.9 * (O10-R10))
11	2011	0.0696	0.2219	0.03374	= +L11-(R11 + 0.9 * (O11-R11))
12	2012	-0.0413	0.0422	0.01795	= +L12-(R12 + 0.9 * (O12-R12))
13	2013	0.2368	0.1678	0.01985	= +L13-(R13 + 0.9 * (O13-R13))
14	2014	0.1513	0.2152	0.02644	= +L14-(R14 + 0.9 * (O14-R14))
15	2015	0.2895	0.1422	0.01639	= +L15-(R15 + 0.9 * (O15-R15))
16	2016	-0.0983	-0.0067	0.0192	= +L16-(R16 + 0.9 * (O16-R16))
17	2017	0.2649	0.2004	0.02466	= +L17-(R17 + 0.9 * (O17-R17))
18	2018	0.3061	0.2641	0.02712	= +L18-(R18 + 0.9 * (O18-R18))
19	2019	-0.0412	-0.0231	0.02633	= +L19-(R19 + 0.9 * (O19 – R19))
20					
21	Mean	=+ AVERAGE(L4:L19)	=+ AVERAGE(O4:O19)	=+ AVERAGE(R4:R19)	=+ AVERAGE(U4:U19)

Sharpe´s ratio and Jensen´s alpha for the first alternative asset (20th Table):

A1	B	C	D	F	G	H
2	Assets	%	Return	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
3	Commodities	0.2	=+ Main!F20	=+ Main!H20	=+ (D3-$C$8)/ F3	=+ D3-($C$8 + C9*(Main!$N$20-$C$8))
4	Real Estate	0.4	=+ Main!B20	=+ Main!D20	=+ (D4-$C$8)/ F4	=+ D4-($C$8 + C10*(Main!$N$20-$C$8))
5	Private Equity	0.4	=+ Main!Z20	=+ Main!AB20	=+ (D5-$C$8)/ F5	=+ D5-($C$8 + C11*(Main!$N$20-$C$8))
6	Total		=+ $C$3*D3+$C$4*D4+$C$5*D5	=+ $C$3*F3+$C$4*F4+$C$5*F5	=+ (D6-C8)/F6	=+ D6-($C$8 + O4*(Main!$N$20-$C$8))
7						
8	Rf	=+Main!Q20				
9	Commodities´Beta	0.697				
10	Real Estate Beta	0.77				
11	Private equity Beta	1.46				

Both the Sharpe´s ratio and the Jensen´s alpha were calculated using the same formulas than in the annex 1 - 18th table methodology, The formula for calculating is: Jensen's alpha = Portfolio Return – [Risk Free Rate + Portfolio Beta * (Market Return – Risk Free Rate)].

The return, variance and standard deviations were previously showed in their respective index calculations.

First Alternative Assets portfolio return year by year calculations (21th Table):

A1	B	C	D	E	F	G	H
2		Vang RE ETF TR	S&P Com TR	PE Return	Assets	Proportions	Return of the portfolio
3	2003						
4	2004	10.05%	6.31%	86.05%	Com	0.2	=+ $G$4*D4 + $G$5*C4 + $G$6*E4
5	2005	17.02%	16.09%	7.50%	RE	0.4	=+ $G$4*D5 + $G$5*C5 + $G$6*E5
6	2006	12%	22.72%	16.28%	PE	0.4	=+ $G$4*D6 + $G$5*C6 + $G$6*E6
7	2007	35.20%	-20.49%	20.00%	Total	=+ SUM(G4:G6)	=+ $G$4*D7 + $G$5*C7 + $G$6*E7
8	2008	-16.38%	35.76%	-4.17%			=+ $G$4*D8 + $G$5*C8 + $G$6*E8
9	2009	-36.98%	-51.26%	-33.04%			=+ $G$4*D9 + $G$5*C9 + $G$6*E9
10	2010	29.74%	14.79%	61.04%			=+ $G$4*D10 + $G$5*C10 + $G$6*E10
11	2011	28.47%	21.98%	30.65%			=+ $G$4*D11 + $G$5*C11 + $G$6*E11
12	2012	8.62%	-1.96%	11.11%			=+ $G$4*D12 + $G$5*C12 + $G$6*E12
13	2013	17.67%	2.16%	22.22%			=+ $G$4*D13 + $G$5*C13 + $G$6*E13
14	2014	2.42%	-6.90%	27.73%			=+ $G$4*D14 + $G$5*C14 + $G$6*E14
15	2015	30.29%	-37.05%	26.69%			=+ $G$4*D15 + $G$5*C15 + $G$6*E15
16	2016	2.37%	-31.17%	-3.37%			=+ $G$4*D16 + $G$5*C16 + $G$6*E16
17	2017	8.53%	15.79%	23.26%			=+ $G$4*D17 + $G$5*C17 + $G$6*E17
18	2018	4.95%	10.95%	41.04%			=+ $G$4*D18 + $G$5*C18 + $G$6*E18
19	2019	-5.95%	-9.19%	-12.37%			=+ $G$4*D19 + $G$5*C19 + $G$6*E19

First portfolio proposed (Berkshire Hathaway + Alternative Assets portfolio) (23th Table):

A1	B	C	D	E	F	G	H
2	Assets	Proportions	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
3	Berkshire Hathaway	0.8	0.1	0.025	0.158	0.72	0.0168
4	Alt. Assets portfolio	0.2	0.115	0.053	0.227	0.37	0.0437
5	Total	=+ C3+C4	=+ $C$3*D3+$C$4*D4	=+$C$3*E3+$C$4*E4	=+ $C$3*F3+$C$4*F4	=+ $C$3*G3+$C$4*G4	=+$C$3*H3+$C$4*H4

Final portfolio proposed (Final Alternative Assets portfolio) (25ᵗʰ Table):

A1	B	C	D	E	F	G	H
2	Assets	Proportions	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s Alpha
3	RE	0.33	0.0925	0.032	0.179		
4	PE	0.33	0.2	0.0747	0.27		
5	VC	0.33	0.19	0.035	0.187		
6	Total	=+ SUM(C3:C5)	=+ $C$3*D3+$C$4*D4+$C$5*D5	=+$C$3*E3+$C$4*E4+$C$5*E5	=+$C$3*F3+$C$4*F4+$C$5*F5	=+ (D6-C8) / F6	=+D6-(C8+I6*(Main!N20-C8))
7							
8	Rf	=+ Main!R20					

Berkshire Hathaway + Final Alternative assets portfolio (27ᵗʰ Table):

A1	B	C	D	E	F	G	H
2		Proportions	Return	Variance	Standard Deviation	Sharpe´s Ratio	Jensen´s alpha
3	Berkshire Hathaway	0.8	0.104	0.0255	0.158	0.72	0.0168
4	Alt. Assets portfolio	0.2	0.16	0.047	0.21	0.61	0.079
5	Total	=+ C3 + C4	=+ $C$3 * D3 + $C$4 * D4	=+ $C$3 * E3 + $C$4 * E4	=+ $C$3 * F3 + $C$4 * F4	=+ $C$3 * G3 + $C$4 * G4	=+$C$3*H3+$C$4*H4

Covariance between the alternative asset portfolio and the market (28th Table):

I1	J	L	M	N
2	Year	Returns of AA portfolio	S&P 500 returns	Covariance AA and Market
3				
4	2004	39.70%	34.57%	=+ COVAR(K4:K19, M4:M19)
5	2005	13.03%	6.23%	
6	2006	15.85%	10.38%	
7	2007	17.98%	14.51%	
8	2008	-1.07%	-2.31%	
9	2009	-38.26%	-38.63%	
10	2010	39.27%	33.14%	
11	2011	28.04%	22.19%	
12	2012	7.50%	4.22%	
13	2013	16.39%	16.78%	
14	2014	10.68%	21.52%	
15	2015	15.38%	14.22%	
16	2016	-6.63%	-0.67%	
17	2017	15.87%	20.04%	
18	2018	20.59%	26.41%	
19	2019	-9.17%	-2.31%	

Beta of the alternative assets portfolio (29th Table):

A1	B	C	D
2	Covariance - AA and Market	Variance of the market	Beta
3	0.03024	0.0292	=+ B3/C3