# COMPARISON OF PORTFOLIOS: RESEARCH ON FUNDAMENTAL INDICES AND RECURRENT INDICES

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## ABSTRACT

Portfolios constructed on the basis of fundamental metrics have been the subject of research over the years and are an area of great interest in portfolio investment.They have been constructed according to the Market capitalization and the naïve portfolio. Moreover, They have been studied and analyzed by different economists as well as compared by investors with the recurrent and most used portfolios.

Since there has been a growing interest in this topic in recent years, this research presents different studies by researchers who have conducted empirical studies in which it is compared constructed portfolios by fundamental metrics with the most recurrent portfolios that got different results and therefore different conclusions.

So far, there are still disagreements about which of these strategies performs best. That is why the main objective of this project is to find out which portfolio has the best results among all of them that have been analyzed. Hence this project focuses on portfolios based on fundamental factors and compares them with the portfolios used by investors or analysts.
The portfolios based on fundamental metrics that have been studied in this work are: portfolio based on Return on Assets, portfolio based on Return on Equity and portfolio based on the fundamental metric Debt to Equity

The portfolio is constructed with 35 companies that have been part of the Ibex 35 during the period from 2018 to 2020.



**Keywords:** Return on Assets, Return on Equity, Debt to Equity, Market Capitalization, naïve portfolio, Sharpe Ratio, fundamental metrics.

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## 1. INTRODUCTION

Nowadays, decisions surround our daily lives in one way or another, and making a decision involves risk. In financial markets, this risk could be not obtaining the expected results from investments. However, the main objective is to increase the maximum return at minimum level of risk.

Over the years, there have been different portfolio selection models. Let is to start with Harry Markowitz's mean-variance portfolio selection model.
Harry Markowitz's model was presented in 1952 and since then it has become the world's theoretical reference for portfolio selection.
His study has been justified with empirical evidence and criticized by different economists who have defended the investment in other specific portfolios that have been analyzed after this one. As a result this has given rise to improvements and models based on his work. (Mendizábal et al., 2022).

Currently, one of the improvements of his model, that has being studied, is the investment in fundamentally weighted indices. Empirical evidence from other researchers proves that this new way of investing is more optimal and yields better evidence.
In empirical studies, this evidence is often compared to the investment in two types of portfolios: the market capitalization-based portfolio and the naïve portfolio.

For this reason, the main objective of this project is to find out which of the analyzed portfolios have got the best result. In order to find an answer this project has been focused on portfolios based on fundamental factors and they have been compared with the investors or analysts recurrent portfolios, which have been both, market capitalization and the naïve portfolio.

Although the empirical evidence of this project has not been the expected due to the high volatility of evidence among different years, it has been possible to draw some conclusions about the investment in these portfolios.

Section 3 of this project presents the empirical evidence of different economists who have analyzed, explained or criticized these three types of portfolios: one portfolio based on fundamental metrics and two of the most recurrent portfolios for investors: the portfolio based on market capitalization and the naïve portfolio. Therefore, in the theoretical framework of this research there are examples of different experts who argue, with empirical

evidence, the investment in this type of portfolios, since according to their studies, they are the most efficient. Also the opposite perspective of those who criticize the positive view appears as well.

Next, section 4 explains how the empirical part of the work was carried out, from where data were collected, why and how the different portfolios were constructed.
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Throughout section 5 of this research it will be shown and explained the empirical evidence of the different portfolios constructed separately and they will be analyzed with the help of the Sharpe Ratio. After that, a general analyze of the evidence of the different portfolios will appear and in order to give an end to this research the reached conclusions can be found in the empirical part.

The different portfolios are constructed from 35 companies that have formed part of the Ibex 35. The companies that have changed from one year to another have been modified year by year and the study has been analyzed in the period time between 2018 and 2020. It has been used data of the previous years to be able to construct the portfolio of the following year.
Finally, there are the conclusions of the study, the bibliography and an appendix with the companies that have been used to construct the portfolio in all the years that are mentioned on the project.

## 2. CONTEXTUALISATION

Over the years, there have been different models of portfolio selection, starting with Markowitz's mean-variance portfolio selection model. Markowitz's idea can be summarized in this way: instead of investing in individual assets, a rational investor should choose the portfolio with the lowest risk to rate of return and vice versa, the portfolio with the highest return should be chosen as well for the same risk, and these two portfolios are called efficient portfolios. (Adame et al., 2016).

In fact, Tu and Zhou (2011) noted that the Markowitz (1952) procedure is the most widely used method for portfolio selection. (Carnero and Leal, 2013)

Other economists have developed their own theories following Markowitz's idea, leading to the development of the Capital Asset Pricing Model by Sharpe (1964), Linter (1964) and Mossin (1966).

However, in the 1990s, many economists had criticized the initial theory owing to the fact that there are cases that the Capital Asset Pricing Model (CAPM) cannot explain. Also its practical implementation is difficult due to the low returns shown in its sample. It should be noted that these expected returns are calculated only with sample data. (Adame et al., 2016). Moreover, it is criticized that the aforementioned economists have not found the ideal market structure suggested by its early models yet.

For example, Tu and Zhou (2011) argue that there are problems in the practical application of the Markowitz model because the real values of its unknown parameters are often estimated from historical data, and its optimal (tangible) portfolios have errors that may be very different from real values (Chen and Yuan, 2016; Tu and Zhou, 2011; Michaud, 1998). Demigel et al. (2009) stand that there are so many estimation errors that eliminate the benefits of optimal diversification strategies (Carnero and Leal, 2013).

After the Markowitz's model and the CAPM, researchers and economists have modified the CAPM into multi-factor models. In the 1980s, Fama and French used their Three-Factor Model (FF3F) to explain stock market irregularities. The CAPM became the main model to explain the changes in returns of different assets, which have been experimenting modifications from that moment onwards. (Doğan et al., 2022).

Arnott, Hsu and Moore (2005) suggest in their research a different approach to investing, which they call "Fundamentally weighted index". The idea of their new theory is, as Blitz and Swinkels (2008) explain, "to create indices in which stocks are weighted by economic fundamentals, such as revenue, dividend rates, earnings, or book value rather than by price". Arnott, Hsu and Moore (2005) believe that investment based on fundamental indexing is more optimal than other investments such as market capitalisation-weighted indices. However, this is analyzed as well by Perold (2007), who stands that capitalisation weighting itself has no effect on efficiency. (Blitz and Swinkels, 2008).

In fact, as Kasic (2019) states, it is usual to invest in market index, with the main market stock indices such as the OMXS30 and the S&P 500 weighted by market capitalisation. According to CAPM (Bodie, Kane & Marcus, 2014, p. 291-299), this type of market index is the most efficient in terms of average variance. In addition, passive strategies such as this

one have the advantage of not requiring any adjustment and therefore have low transaction costs. (Hsu, 2006).

Today, still exists the debate for and against this new form of investing in fundamental indexing and in the market capitalisation weighted index. Even it is compared with the traditional forms of investing, the 1/N Portfolio Strategy.

## 3. THEORETICAL FRAMEWORK: Comparison of indices based on fundamental metrics and typical indices

### 3.1.1 Market capitalisation

Over the years, it has been speculated that market capitalisation-based portfolios are usually the most efficient in terms of variance.

As Hsu states (2004): using portfolio strategies based on market capitalization is the most common strategy for the following reasons:

1. Capitalisation weighting is a passive strategy that requires almost no active management, so active management fees are significantly lower.

2. If the price of values changes, the market capitalisation-weighted portfolio is automatically rebalanced. Apart from replacing the constituent values in the portfolio, there is no rebalancing related to the strategy. Thus, if an investor wants to replicate an index, he will not have to make extra calculations to adjust the weight of each value in the portfolio, because it will be adjusted automatically (Agüero et Pernía, 2012)

3. The capitalisation weighting is allocated in such a way that the highest weights are related to the largest companies.

The majority of stock indices are based on market capitalisation. Since market capitalisation is highly correlated with liquidity, equal weight ensures that the portfolio is invested mainly in high liquid values, which reduces the expected transaction costs of the portfolio (Hsu, 2004).

In spite of these facts, market capitalisation-weighted indices are no longer the most efficient investment in terms of variance according to the following studies.

For example, Hsu (2006) argues that market-weighted indices are inappropriate due to pricing inefficiencies (Kasic, 2019). He also explains that there is a reduction of the return in portfolios created by this method. This theory is also supported by the study of Hsu and Campollo in the same year.

According to these researchers, overvalued companies have an additional weight in the index at the expense of undervalued companies.
A passive index investor should allocate more of the portfolio to overvalued stocks and less to undervalued stocks (Hsu and Campollo, 2006). This is explained by the Inefficiency Market (Hsu, 2006).
The assertion that weighting stocks by the market capitalisation of firms would lead to more investment in overvalued stocks and less in undervalued stocks is called the *Noisy market hypothesis* (Perold, 2007) and Its author proves that noisy market prices do not lead to higher returns, as Hsu (2006) states (Kasic, 2019).

This is considered to be another of the disadvantages of portfolio construction with this method: *Market noise.* Economists such as professor of the Wharton School of the University of Pennsylvania, Jeremy Siegel argues that "stock prices often fluctuate due to transitory factors that have nothing to do with the actual value of the stock", because investors often use the *Momentum investing* and this causes the demand for this strategy to drive up the stock price. This strategy is used because it exists, not because of the impact of the fundamental values of the company. This *Market noise* may be causing the so-called *Economic bubbles* (Agüero et Pernía, 2012).

In one of the economist Hsu's empirical researches, he explains that market capitalisation weighted portfolios are not profitable because they do not fully reflect company fundamentals and concludes in this study that the returns extracted by a market capitalisation weighted portfolio are lower than those of a portfolio that has not been market capitalisation weighted and this occurs when according to Jason C. Hsu (2004) "prices are noisy and do not fully reflect the fundamentals of the companies" (Hsu, 2004).

### 3.1.2 Fundamental Factor

Empirical evidence from other researchers explains that there are other more optimal ways of investing with better results. This is fundamentally weighted indices.
Arnott, Hsu and Moore (2005) suggest a new form of investment, based on fundamental indexing. As mentioned above, this method consists of “allocating weights to stocks according to fundamental values of companies. As a result, market indices are weighted by fundamentals such as book value, cash flow, gross dividends, sales and the total use of companies" (Arnott, Hsu and Moore (2005) (Kasic, 2019).

The major indices compare stocks with key indicators of their economy. Therefore, the differences in weights depend completely on the differences in valuation levels, that is to say, the relationship between the initial value and the market value. For example, if the main index is created firstly with book values, there will be differences in the market weight of the securities included in the index. Given that, the differences in weight between the underlying index and the traditional index are completely caused by differences in valuation levels. The difference between the performance of the underlying index and the traditional index is owing to the difference in value and growth of the securities.

Supporters of fundamental metrics investment argue that equity weighting itself detracts from performance because overvalued stocks in a market capitalization-weighted index tend to be underrepresented by overvalued and undervalued stocks.
It is said that a weighted index by fundamental metrics is better to avoid this disadvantage.
However, Perold (2007) correctly notes that this reasoning is largely based on the assumption that stock performance is somewhat predictable due to the difference between its market price and its fundamentals.
In other words, supporters of fundamental indexing accept that stocks with high valuation ratios are more likely to be overvalued than stocks with low valuation ratios (Blitz and Swinkels, 2008).

According to empirical evidence, the capitalisation-weighted indices are worse constructed than the fundamentals-weighted index.
However, it is probably better to say that the proportions of cap-weighted indices are worse because of their construction. The capitalization weight causes the delay of the performance when prices are noisy (highly volatile). On the one hand, in this situation, the underlying weight is clearly the correct index structure. On the other hand, with high prices of efficiency, investors should be indifferent to holding a well-diversified portfolio with similar risk factors.

This means that, when the market is efficient, fundamentals are only as good as the capitalization measures (Hsu and Campollo, 2006).

Therefore, Arnot, Hsu and Moore (2005) studied whether fundamentally weighted indices have good evidence and outperform market capitalisation weighted indices.

The evidence of their research confirmed what they believed, that is to say, fundamentally-weighted indices outperform the market capitalization-weighted index with a 2.15% more per annum due to the portfolio on the basis of fundamentals, which means that they outperform the average with two percentage points. This way they prove that their theory is more efficient and has a higher return compared with market capitalisation investment.

A more in-depth analysis of the price risk of major indices Arnott et al. (2005) suggests that indices based on fundamental metrics are no riskier than market capitalisation-weighted indices (Stotz et al., 2010).

Tamura and Shimizu (2005) have also researched this investment method with the Arnott et al. method (2005) (Kasic, 2019).

The difference with Arnott's study is that Tamura and Shimizu focused their research on the global market instead of Arnott who did a research of the US market.

Similar to the study of Arnott et al. (2005), the evidence show that fundamentals-weighted indices significantly outperform market capitalisation-based indices (Kasic, 2019).

The evidence of the aforementioned studies are also consistent with the analysis conducted by Hemminki and Puttonen (2008), which explain the advantages of fundamental indexation using European data. They found out that fundamental indexation can lead to higher risk-adjusted returns.

Estrada (2008) presents a broader version of the issue of fundamental indexation related to international diversification (Stotz et al., 2010).

In order to evaluate a fundamental strategy based on the aforementioned international diversification, he considered 16 benchmark countries, which cover the 93% of the total world of market capitalisation over the time period of 1974-2005.

The evidence of their study show that the dividend-weighted fundamental index significantly outperforms the capital-weighted index by 1.9% per year. At the same time, a simple value strategy that weights all benchmark indices with the same value in only one country and uses on that purpose the dividend yield, outperforms the underlying dividend-weighted index by 1.7% per year over the same period. Furthermore, they argue that core indices are more similar to active investment strategies than classic passive indices (Stotz et al., 2010).

The sample of securities included in Estrada's research adds all the securities of the DJ sTOXX 600 index from the interval between July 1993 and April 2007.

**Table 2** Annualized mean returns, standard deviations, and Sharpe ratios of fundamentally-weighted indexes (in percentage points)

| Weighting scheme | Mean return | Standard deviation | Sharpe ratio |
|---|---|---|---|
| Panel A: Market capitalization | | | |
| MV | 11.566 | 17.462 | 55.0 |
| Panel B: Fundamental data of latest fiscal year (single-year data) | | | |
| BV | 13.278 | 17.418 | 64.9* |
| CF | 13.797 | 17.723 | 66.7* |
| DIV | 13.340 | 16.549 | 68.7* |
| SAL | 13.389 | 18.018 | 63.4* |
| COMP | 13.473 | 17.337 | 66.3* |
| Panel C: Average of fundamental data over 10 years (multi-year data) | | | |
| AVG(*CF*) | 13.873 | 17.755 | 67.0* |
| AVG(*DIV*) | 14.554 | 15.980 | 78.7* |
| AVG(*SAL*) | 13.341 | 17.925 | 63.4* |

Table 1: Annualized mean return, standard deviations, and Sharpe ratios of fundamentally weighted indices (in percentage points). Source: Stotz et al. (2010).

Table 1 summarizes Estrada's evidence for the market capitalisation-weighted index return and the fundamental-weighted index return. One of the studies shows the evidence of only one year (single-year data) whereas the other one shows the evidence of exactly 10 years (multi-year data).

It can be seen in the columns the annualized rate of return, the annualized standard deviation, defined as the square root of the variance, and finally the Sharpe Ratio as a performance indicator of comparison of the two different strategies.

As it can be seen Panel A of the table shows the MV, that is to say, the market value of equity, and the evidence obtained from the market capitalisation-weighted index.
This index has an average annual return of 11.6%, a standard deviation of 17.5% and a positive Sharpe ratio.

Panel B shows the evidence of the index weighted by different fundamental metrics in a single year.

The empirical evidence of this portfolio fluctuates between 13.3% and 13.8% annual returns, that is to say, a return two percentage points higher the one of the market capitalization weighted index. It also has a higher Sharpe ratio than the previous portfolio.

Regarding the annualized standard deviation, a similar behavior can be seen for the market capitalisation weighted index and the index weighted by fundamental metrics.
It is also important to highlight the standard deviation of the dividend-weighted index, which is one percentage point lower than the market capitalisation index in terms of standard deviation. The same situation happens in the rest of the metrics.

The empirical evidence in this table supports the conclusions of Arnott et al. (2005), Tamura, Shimizu (2005) and Puttonen (2008) that underlying indices do not represent a higher level of risk than market capitalisation-weighted indices. Thus, this accounting information that takes in consideration risk factors (such as cash flow volatility) does not significantly reduce the performance of characteristics of the underlying indices (Stotz et al., 2010).

### 3.1.3 Naïve Portfolio (1/N)

In contrast to the above mentioned, although there are diverse researches which prove that fundamental index-weighted portfolios have better returns and outperform market capitalisation-weighted indices, other researchers consider this theory to be flawed.

For example, Perold (2007) criticizes fundamental indexing, and like others, he dismisses the idea of fundamental metric-weighted indices outperforming market capitalization-weighted indices because they invest more in overvalued stocks and less in undervalued stocks (Stotz et al., 2010).

Swensen (2009) argues that its active portfolio management is expensive and leads to failure for those who do not implement it (Carnero and Leal, 2013).

This means that, despite the plethora of theoretical models developed over the last decade and the research that has been done to affirm or test these theories, researchers continue to use simple rules for allocating their wealth across assets. Taking this into account, It has been tried to find another approach to portfolio and index construction which, according to other researchers, surpasses the two forms of investment that have been previously mentioned. This is the 1/N-weighted strategy or also called the naïve strategy.

Equally weighted portfolios have been proved to outperform market portfolios (Plyakha, Uppal and Vilkov, 2012) (Kasic, 2019). Unlike previous strategies, the naïve portfolio-based index (1/N), which invests uniformly in N assets of interest, is not based on any theory or data.
The Talmud has been known for about 1500 years and is very relatable to the Duchin and Levy rule (2009) since It corresponds to a portfolio of almost equal weight (Tu and Zhou, 2011).

Brown (1976) is credited with the first empirical study of this theory and it is Jobson and Korbie in 1980 who claim, according to the evidence, that the naïve portfolio performs better than, for example, a market capitalisation-based index and also that it can outperform, at the same time, the Markowitz rule.

V. DeMiguel, L. Garlappi and R. Uppal also conducted an empirical study in 2009 with the aim of comparing the naïve strategy with 14 other different portfolio models. In their study they used the Sharpe ratio and It helped them to conclude that none of them can outperform the balanced or naïve portfolio. This happens because in general this 1/N portfolio has better evidence and dominates the rest of the portfolios.

Michaud (2008) notes that "an equally weighted portfolio can often be substantially closer to true optimisation than an optimized portfolio" (Tu and Zhou, 2011).

Therefore, it is often a recurrent strategy to compare the indices seen above with the naïve 1/N portfolio, as this strategy, according to different economists, is a difficult strategy to surpass. The study concludes that an equally weighted portfolio produces both a higher Sharpe ratio and a higher equivalent additional return. However, they also showed that this

portfolio actually has a higher standard deviation and kurtosis, characteristics that are considered less favorable (Kasic, 2019)

Another example of this type of investment is provided by (Víctor M. Adame a , Fernando Fernández-Rodríguez and Simon Sosvilla-Rivero). They compare the evidence obtained from different portfolio strategies. To do so, they present the evidence of five measures of the statistical comparison of different portfolio strategies. The evidence of these evaluated portfolio strategies are compared with the Ibex 35 index strategy and the naive 1/N strategy.
Portfolios are constructed with daily return series for period Nt and analyzed for the next period, Ntþ1, for t ¼ 2000; 2001; .... ; 2013.
This way, these economists construct 14 portfolios for the methodological framework, although the evidence is added by time period: 2001-2014, 2001-2007 y 2008-2014 (Blitz and Swinkels, 2008).

Table 3. Summary of main results, 2001–2014 time period.

| Portfolio | Total Return | Annual Return | VaR 95% 1 day | CVaR 95% 1 day | Annualized Sharpe ratio (*p*-value) | Diversification ratio | Concentration ratio |
|---|---|---|---|---|---|---|---|
| Ibex 35 | 13.21% | 0.89% | 2.525 | 3.170 | 0.0365 (1.000) | – | – |
| 1/N | 46.80% | 2.78% | 2.165 | 2.720 | 0.1321 (0.493) | 1.5648 | **0.0400** |
| M-V | **276.37%** | **9.93%** | **1.778** | **2.240** | **0.5663** (0.005)*** | 1.5989 | 0.1551 |
| GMV | **244.31%** | **9.23%** | **1.689** | **2.129** | **0.5544** (0.009)*** | 1.6102 | 0.1513 |
| MDP | 179.21% | 7.61% | **1.742** | **2.194** | **0.4440** (0.038)** | **1.7153** | 0.1113 |
| ERC | 81.18% | 4.34% | 1.988 | 2.499 | 0.2239 (0.182) | **1.6164** | **0.0391** |
| MTD | 117.47% | 5.71% | 1.836 | 2.310 | 0.3176 (0.092)* | **1.6326** | **0.0973** |
| CVaR | 154.00% | 6.88% | **1.786** | **2.248** | 0.3896 (0.096)* | 1.5100 | 0.2059 |
| MaxDD | 159.24% | 7.04% | 2.383 | 2.997 | 0.3041 (0.261) | 1.3464 | 0.3830 |
| AvDD | 193.39% | 7.99% | 3.170 | 3.988 | 0.2585 (0.338) | 1.0788 | 0.8401 |
| CDaR95 | 167.64% | 7.29% | 2.437 | 3.066 | 0.3067 (0.251) | 1.2765 | 0.4879 |
| MinCDaR95 | **291.71%** | **10.24%** | 1.937 | 2.441 | **0.5375** (0.030)** | 1.4157 | 0.2901 |
| R-Minimax | 105.82% | 5.29% | 2.006 | 2.523 | 0.2707 (0.239) | 1.4725 | 0.2141 |
| O-Minimax | **247.09%** | **9.3%** | 2.188 | 2.754 | 0.4317 (0.096)* | 1.2563 | 0.5223 |
| Clayton (MTD) | 184.78% | 7.76% | 1.852 | 2.332 | 0.4257 (0.041)** | **1.6932** | **0.0954** |
| Beta | **246.43%** | **9.28%** | **1.705** | **2.148** | **0.5515** (0.008)*** | **1.6783** | **0.1008** |

Table 2. Summary of main evidence, 2001-2014 time period.Source: Blitz and Swinkels (2008).

There are few equity funds that outperform naïve 1/N portfolios according to the stock selection criteria of past performance and price-to-book ratios.
However, equity funds have lower volatility than the 1/N portfolios. This result reinforces the advantage of the 1/N portfolio for individual investors whose main investment opportunity would be active and passive equity funds professionally managed. However, an individual investor should prefer an equity fund if he/she is too sensitive to volatility in the 1/N portfolios because of the impact of transaction costs. Naïve portfolios may be poorly diversified and may be subjected to additional risk factors such as size, value and *momentum*. Therefore, their historical performance differences may simply be due to this additional risk (Carnero and Leal, 2013)

As Kasic (2019) reports, although previous researches have affirmed that equal-weighted portfolios outperform market-cap portfolios, there is evidence that this is not happening in this specific case (Kritzman, Page and Turkington, 2010). The authors explain that creating an equal-weighted portfolio does not require investment knowledge. In their study they verify that equally weighted portfolios do not outperform market capitalisation portfolios. It is clear then that there are different opinions and arguments about the different indexing methods, but the evidence has proved that portfolios based on market capitalisation can outperform portfolios based on fundamental metrics and portfolios based on simple equal weighting. However, this evidence was also mixed which means it is necessary further research on the subject (Kasic, 2019).

## 4. METHODOLOGY

Throughout this section it is going to be tested whether the investment in a factor-weighted portfolio has outperformed the equal-weighted portfolio and the portfolio based on market capitalisation. To this effect, there are constructed factor-weighted indices and their evidence is compared with equal-weighted and market capitalisation-weighted indices. A sample of some Spanish companies has been used for this comparison.

This sample includes stocks that have been part of the Ibex 35 from 2017 to 2020.

The Ibex 35 index is the official index of the Spanish continuous market. The index consists of the 35 most liquid stocks traded on a continuous market (Blitz and Swinkels, 2008).

As the evaluation of a fund cannot be measured only through performance, but also by risk-adjusted return, this evaluation will be carried out through the Sharpe ratio in order to know the return that is got each of the portfolios for each unit of risk.

The time period used for this analysis is 4 years. This period runs from January 2017 to December 2020. It should be taken into account that the following years portfolio is constructed with the data of previous years

### 4.1 Identification of the Benchmark

Firstly, it is necessary to identify these 35 companies that have belonged to the Ibex 35 in different years. They vary from year to year, since the Ibex 35 includes them on the SIBE (the Spanish Stock Market's Electronic System) with the most liquid securities found in it. For this reason, some of them may change from one year to another, but the same have been used for the construction of 5 portfolios: The balanced portfolio, the market capitalisation portfolio and 3 portfolios based on fundamentals: Return on Assets (ROA), Return on Equity (ROE) and Debt to Equity (D/E).

The companies that have been part of the ibex 35 each year of the research can be seen in Annex I of this project.

### 4.2 Construction of the different indices

the following data was got from the different companies that have contributed in the ibex 35 each different year:

- ➔ Total Assets
- ➔ Equity
- ➔ Total Debt
- ➔ Net Profit
- ➔ Number of shares in circulation
- ➔ Stock price

These data, with the exception of stock price, have been provided from the annual accounts of these different companies, while the annual accounts have been downloaded from the Comisión Nacional del Mercado de Valores (CNMV) (s.f).

The stock price has been extracted from the monthly closing price of the Yahoo Finance platform. Thanks to these collected data, the following ratios can be calculated in order to be able to follow the strategies of the next portfolios:

$$ROA = \frac{NET\ INCOME}{TOTAL\ ASSETS}$$

$$ROE = \frac{NET\ INCOME}{NET\ EQUITY}$$

$$DEBT\ TO\ EQUITY = \frac{TOTAL\ DEBT}{NET\ EQUITY}$$

$$MARKET\ CAPITALIZATION = SHARE\ PRICE \times SHARES\ OUTSTANDING$$

Then, for each year, the average monthly return and volatility of each company is calculated based on the monthly closing prices.

If these closing prices are used, the monthly return will be calculated using the following formula:

$$LN = \frac{CLOSE\ PRICE\ T}{CLOSE\ PRICE\ T-1}$$

Furthermore, the average volatility is calculated through the variance. This variance measures the dispersion of the data related to its average and is calculated with this formula::

$$Var\ (x) = \frac{\Sigma_1^n (x_i - \bar{x})^2}{n}$$

Finally, the standard deviation is calculated like the square root of the variance.

On the one hand, the data extracted are monthly, as well as the closing prices. Therefore, we multiply the monthly average return data and the monthly standard deviation by 12 in order to annualize the information.

This means that, on the other hand, in order to form a portfolio, weights are assigned proportionally each year. For example, in case of forming a portfolio according to the Return on Assets ratio, companies with the highest Roa are assigned a higher weight and the process is repeated each year, as the portfolio is rebalanced during the same period of time.

It should be always borne in mind that the portfolio for year n is formed with the evidence extracted in year n-1.

Finally, with that data, the portfolio return is calculated with the sum-product of the weights given to each company with the annualized return. Apart from that, the standard deviation of the portfolio is calculated with the sum-product of different weights that have been calculated for each company with the annualized standard deviation. Once both data have been provided, the Sharpe ratio can be calculated.

## 5. EMPIRICAL EVIDENCE

The evidence of different fundamental investment strategies are analyzed below. Each different strategy is first analyzed separately and then the evidence will be analyzed together.

The performance of each strategy is compared with both, the equal-weighted strategy and the market capitalisation strategy. The indicator used to contrast the different strategies is the Sharpe Ratio.

The Sharpe ratio was created by William Sharpe and it compares the return of an investment with its risk.
This ratio is calculated like this:

$$SHARPE\ RATIO = \frac{R_p - R_f}{\sigma_p}$$

These abbreviations correspond to:

- ➔ Rp Return of the portfolio
- ➔ Rf risk-free rate
- ➔ σp the standard deviation of the portfolio's excess return.

The standard deviation explains the dispersion that surrounds the mean and it can be calculated from the square root of the variance (systematic or market risk + unsystematic or diversifiable risk).

The Sharpe ratio is important when evaluating a fund, since the objective of some investors or managers is to get the maximum return regardless of the amount of risk being assumed in the investment. However, a fund ratio should be compared to the ratio of another fund with the same investment objective, because the fund is not informative enough without comparison.

The higher the Sharpe ratio, the better the return compared to the risk of the investor. Therefore, a Sharpe ratio of less than one indicates that a low return has been reached compared with the risk assumed when investing in the asset or fund.

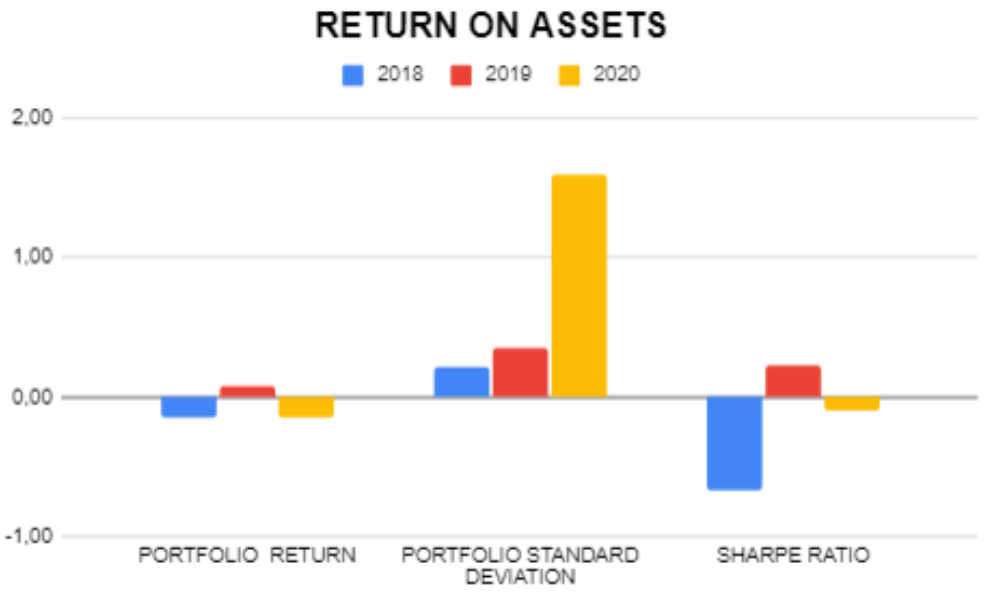
### 5.1 Return on assets

Return on assets (ROA) is a financial performance ratio that measures the earnings power, that is to say, the return a company receives for every dollar invested in its assets. It is a way of measuring whether the company or companies are using the assets they have appropriately and efficiently (Westreicher, 2022).

During the years in which the portfolio has been constructed, the empirical evidence, based on fundamental Return on Assets metric, has been as follows:

| | | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| ROA | | | | |
| | PORTFOLIO RETURN | -0,14 | 0,08 | -0,15 |
| | PORTFOLIO STANDARD DEVIATION | 0,22 | 0,35 | 1,59 |
| | SHARPE RATIO | -0,67 | 0,23 | -0,10 |

Table 3. Index performance based on the fundamental metric Return on assets. Source: Own elaboration.




Graph 1. Index performance based on the fundamental Return on assets metric. Source: Prepared by the authors.

Table 3 summarizes the evidence extracted on the risk-adjusted index return weighted by the fundamental "Return on assets" index over the period 2017 to 2020, since the data to construct the 2018 index is based on the evidence of last year, which was, 2017.

The fluctuation of evidence between those different years is perfectly shown and it can make clear the main differences in the empirical evidence.

The Sharpe ratio stands out that the worst result that has been in the first year. If it there had been an investment in 2018 with the 2017 evidence, a Sharpe ratio of -0.67 would have been got. Hence that would have been negative, a very low return compared to risk. This means that the return is lower than the risk-free return.

Chart 1 clearly shows the evolution of different years and has a better result in 2019 and the only positive result compared to the rest of the years, considering that the Sharpe ratio is negative in 2018 and 2020.

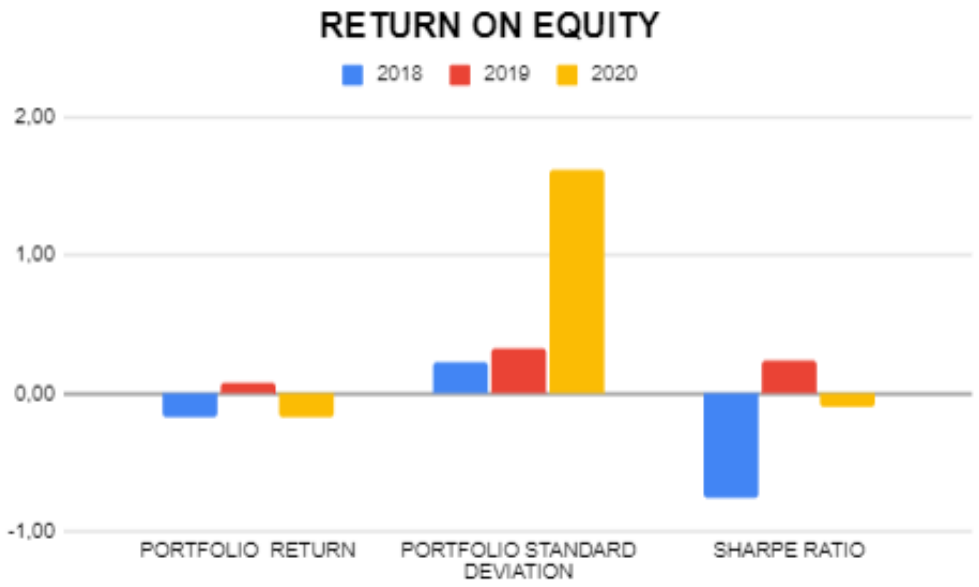
### 5.2 Return on equity

The return on equity (ROE) ratio defines the capacity of companies to generate profits for its stockholders. The higher is the ratio, the higher the profitability that the company will produce in relation to the equity it uses to finance itself. (Antón, 2020).

During the years in which the portfolio has been constructed, the empirical evidence, based on fundamental Return on Equity metric, has been as follows:

| | | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| ROE | | | | |
| | PORTFOLIO RETURN | -0,17 | 0,08 | -0,17 |
| | PORTFOLIO STANDARD DEVIATION | 0,22 | 0,33 | 1,62 |
| | SHARPE RATIO | -0,75 | 0,23 | -0,10 |

Table 4. Index evidence based on the fundamental metric Return on equity. Source: Own elaboration.




Graph 2. Index performance based on fundamental Return on equity metric. Source: Prepared by the authors.

Table 4 summarizes the evidence extracted on the risk-adjusted index return weighted by the fundamental Return on equity index over the period 2017 to 2020, since the data to construct the 2018 index are based on the evidence of last year, this is, 2017.

The evidence of this strategy outperform in a negative way the previous strategy in the first year, owing to the fact that this strategy has a more negative Sharpe Ratio than in the Return on Assets fundamental strategy, which reaches a value of -0.75. Thus it has a higher volatility and worse evidence than any of the remaining strategies and years.

In this strategy, it can be noticed, like the previous one, the great difference in evidence between different years, since there are jumps from negative to positive evidence from one year to another. This can be clearly seen in the Sharpe Ratio part 2 of the Graph.

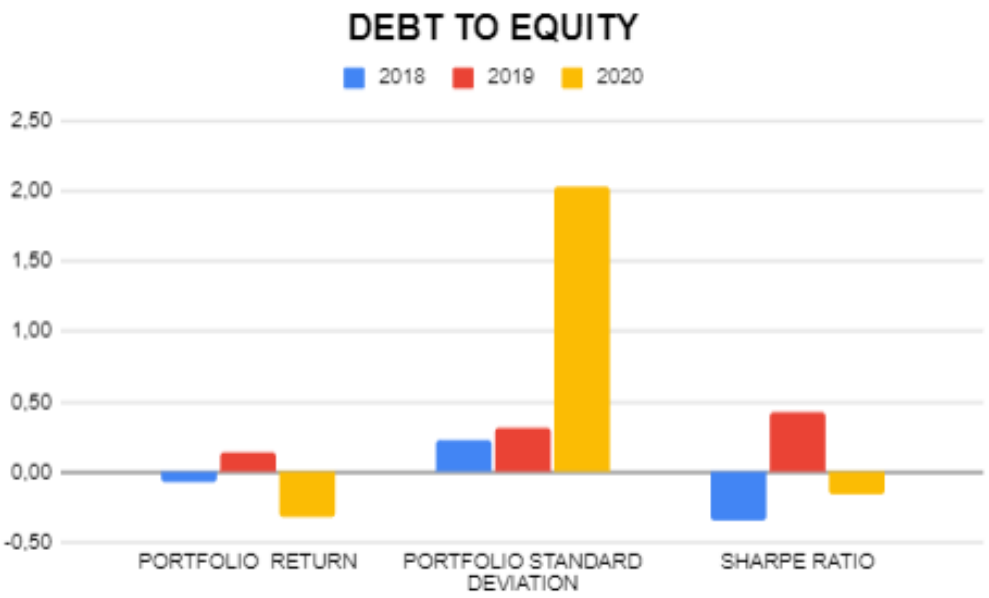
### 5.3 Debt to Equity

The Debt to Equity ratio measures how many assets are financed by debt rather than equity. In other words, it relates the debt of companies to equity, since higher the ratio is, higher the debt the company uses like a form of leverage to finance its assets .

During the years in which the portfolio has been constructed, the empirical evidence, based on the fundamental Debt on Equity metric, has been as follows:

| | | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| DEBT TO EQUITY | | | | |
| | PORTFOLIO RETURN | -0,08 | 0,13 | -0,32 |
| | PORTFOLIO STANDARD DEVIATION | 0,22 | 0,32 | 2,03 |
| | SHARPE RATIO | -0,34 | 0,43 | -0,16 |

Table 5. Evidence of the index based on the Debt to Equity fundamental metric. Source: Own elaboration.




Graph 3. Index performance based on Debt to Equity fundamental metric. Source: Own elaboration.

This table summarizes the evidence extracted on the risk-adjusted index return weighted by the "Debt to equity" fundamental index over the period 2017 to 2020, since the data to construct the 2018 index is based on last year evidence, that is to say, 2017.

In this strategy, like in the other two previous strategies, the first year evidence has a high and a negative Sharpe Ratio.

This fundamental strategy stands out an increase in the Sharpe Ratio during 2019 compared to the other two fundamental strategies. However, there is still a big difference in the evidence from one year to the next in the study.

It has a negative Sharpe Ratio in 2018 of -0.34, a positive Sharpe Ratio in 2019 of 0.43 and finally, just like the previous two metrics, a negative Sharpe Ratio of -0.16.

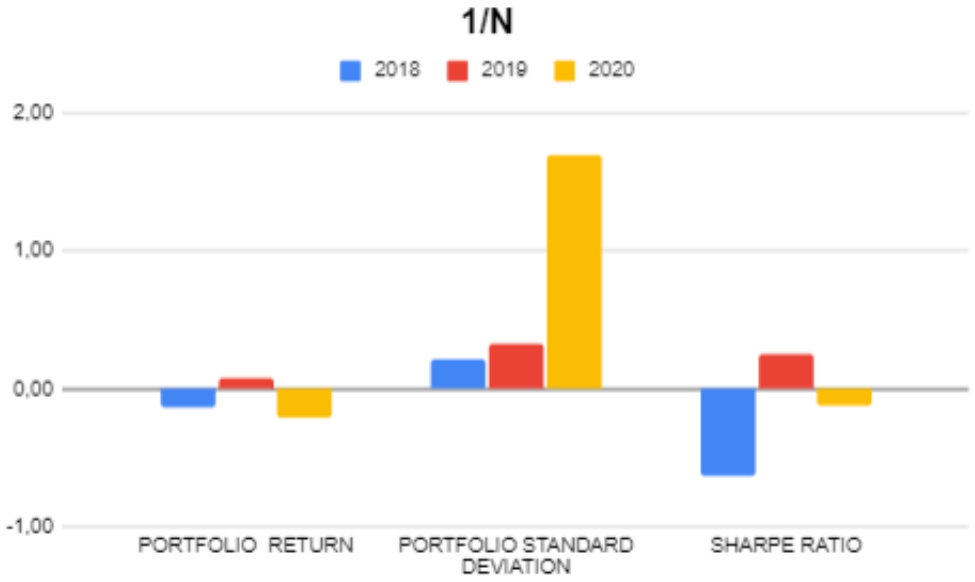
### 5.4 Recurrent strategies

#### 5.4.1 Naïve portfolio (1/N)

The next strategy to be analyzed is the portfolio based on the 1/N strategy, one of the strategies most frequently used by investors.
During the years in which the portfolio has been constructed, the empirical evidence based on the naïve portfolio (1/N) has been as follows:

| | | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| ESTRAETGIA 1/N | | | | |
| | PORTFOLIO RETURN | -0,14 | 0,08 | -0,20 |
| | PORTFOLIO STANDARD DEVIATION | 0,22 | 0,32 | 1,69 |
| | SHARPE RATIO | -0,63 | 0,25 | -0,12 |

Table 6. Evidence of the naïve portfolio weighted index (1/N). Source: Own elaboration.




Graph 4. Evidence of the naïve portfolio weighted index (1/N). Source: Own elaboration.

This table summarizes the evidence obtained on the risk-adjusted index return weighted by the 1/N' strategy over the period 2017 to 2020, since the data to construct the 2018 index is based on the evidence of last year, which is 2017.

In Table 6 we can notice a negative Sharpe Ratio in 2018 of -0.63. This ratio has similar values to those found in the Return on Equity strategy and changes in 2019 to a positive Sharpe ratio of 0.25. Finally, just as in the previous indices, it ends with a negative Sharpe Ratio of -0.12.

This index, that is no longer based on a fundamental metrics but on a recurring index of investors, follows the same pattern of behavior like the previous three and even it is very similar to the fundamental strategy Return on Assets or Return on Equity. This happens because the evidence is practically the same. These indices in which a high and negative Sharpe Ratio is obtained in the first year, follow with a positive Sharpe Ratio and fall again during last year. Unfortunately there is not a clear pattern of behavior in the evidence.

### 5.4.2 Market capitalisation

Last portfolio that is constructed and analyzed is the portfolio based on the market capitalisation strategy. The second most frequently used portfolio by investors.
During the time in which the portfolio has been constructed, the empirical evidence, based on the market capitalisation weighted index, has been as follows:

| | | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| CAPITALIZACIÓN BURSÁTIL | | | | |
| | PORTFOLIO RETURN | -0,20 | 0,14 | -0,09 |
| | PORTFOLIO STANDARD DEVIATION | 1,69 | 0,24 | 1,53 |
| | SHARPE RATIO | -0,12 | 0,58 | -0,06 |

Table 7. Index performance based on market capitalisation. Source: Own elaboration.


Graph 5. Index performance based on market capitalisation. Source: Prepared by the authors.

Table 7 summarizes the evidence extracted on the market capitalisation-weighted risk-adjusted performance of the index over the period 2017 to 2020. Since the data is constructed in 2018, this index is based on the evidence of last year, that is to say, 2017.

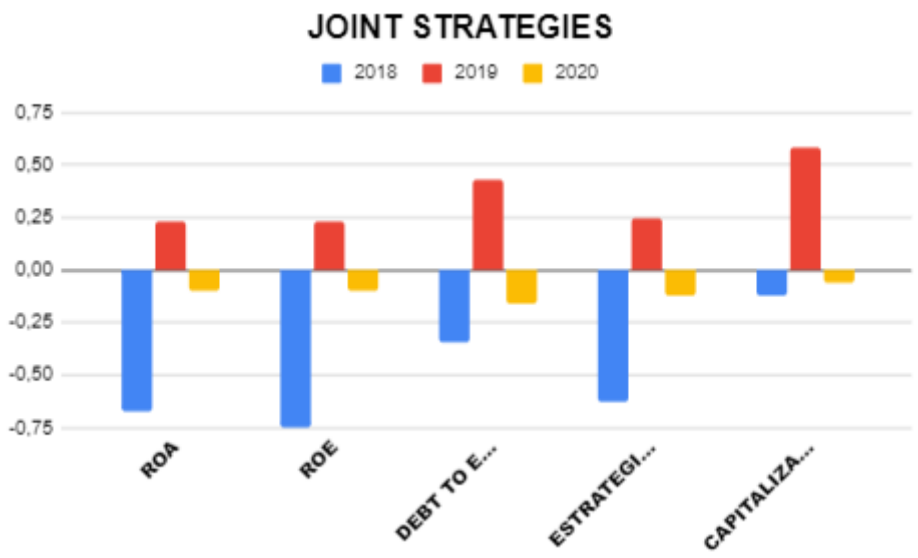
The market capitalisation weighted index has got a low or even negative Sharpe ratio during different periods. This portfolio, unlike the rest, has in 2018 the highest standard deviation value compared to the rest of the portfolios.

It also stands out the highest Sharpe ratio in 2019. It reaches a value of 0.58 which is low compared to other investment strategies. However this is the highest Sharpe ratio of all the strategies evaluated in this project.

It can be clearly noticed in graph 5 that there is a big difference in the evidence from year to year.
In this strategy, like the previous, a volatility in the evidence appears throughout different years.

### 5.5 Joint Strategies.

Finally, we put each and every one of the strategies together in a single chart so that it can be seen the evidence of each one of them in terms of Sharpe ratio as well as to have the possibility of making a better comparison.




Graph 6: Joint strategies. Source: Own elaboration.

Above it can be shown in a more clear way, everything that has been mentioned before. There is an evident tendency in all strategies because they follow the same pattern of evolution over the years.

The same happens with the negative Sharpe Ratio evidence during years 2018 and 2020, although there is a higher and a negative evidence in 2018 as well. Among them, the Return on Equity strategy is the one that in 2018 had the worst performance in terms of Sharpe Ratio. It is followed later by the Return on Assets strategy. Moreover, it is important to remember that both of them are based on fundamental metrics.

In contrast, 2019 was a year in which positive Sharpe Ratio evidence was obtained for each and every one of the strategies studied.

The Market Capitalisation strategy highlights especially, since, according to the aforementioned analyze, is the only one that had a better evidence among all strategies during that specific year.

Therefore, as it can be clearly seen, there is a high volatility in each and every strategy from year to year, so it could be said that there are other factors that explain the evolution of these strategies, such as the *economic momentum* or other specific factors that may affect the evolution of the investment in these strategies.

## 6. CONCLUSION

The aim of this work is to find out whether the fundamental metric weighted indices outperform the market capitalisation weighted indices and the naïve portfolio (1/N), since they are the most recurrent when investing.
The research constructed 3 portfolios based on fundamental metrics, which were Return on Assets, Return on Equity and Debt to equity and it also constructed the naïve portfolio and a market capitalisation portfolio for comparison.
Although there has been perhaps a paucity of data in this study which has prevented to look into the evolution of these portfolios over a longer period of time than it has been really shown, it is possible to draw some conclusions.

The evidence may not be the expected and the sample is small, but as we have seen, each year, the portfolios have the same behavior, since in two of the three years the Sharpe Ratio is negative and in 2019, the empirical evidence had a positive return and even it can be appreciated a somewhat high Sharpe Ratio compared to other years. For example in the market capitalisation strategy.
If one of the evaluated strategies had to be chosen, the strategy based on market capitalisation has been the one that has achieved the best empirical evidence because it has got a higher return compared to the others. Plus, on the one hand, it is the one whose Sharpe ratio is higher in 2019, since it has a positive value of 0.58. On the other hand it is the one that has achieved the best evidence among the negative Sharpe Ratios of years 2018 and 2020.

In the empirical evidence of this project, all strategies have 2 things in common:

Firstly, the optimal evidence that have been extracted in 2019, since in each and in every one of the strategies the Sharpe ratio is positive, so we can say that it was a good year in investment.
On the other hand, It is highlighted the high volatility in the evidence from year to year, so it would not be advisable to invest in any of them. Especially in terms of risk-averse investment or even risk-neutral investment. It would be better to opt to invest in other types of safer or less volatile strategies.

Therefore, on the one hand, Hsu is right when he mentions that market capitalisation weighted indices are not efficient. This could be true because most of the portfolio has been

invested in overvalued stocks and the other part of the portfolio has been invested in undervalued stocks. However, in this case, neither of them are fundamental indices nor the equal-weighted strategy. This means that it cannot be possible to strictly choose any of the aforementioned. In addition, as it was said before, these strategies are affected by other external factors that cause high volatility throughout years and this involves each and every strategies.

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## 8. ANNEXES

### 8.1 ANNEX I: IBEX 35 composition

| | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| 1 | ABERTIS INFRAESTRUCTURAS, S.A | ACCIONA S.A | ACCIONA S.A | ACCIONA S.A |
| 2 | ACCIONA S.A | ACERINOX S.A | ACERINOX S.A | ACERINOX S.A |
| 3 | ACERINOX S.A | ACTIVIDADES DE CONSTRUCCIÓN Y SERVICIOS (ACS) | ACTIVIDADES DE CONSTRUCCIÓN Y SERVICIOS (ACS) | ACTIVIDADES DE CONSTRUCCIÓN Y SERVICIOS (ACS) |
| 4 | ACTIVIDADES DE CONSTRUCCIÓN Y SERVICIOS (ACS) | AENA SME S.A | AENA SME S.A | AENA SME S.A |
| 5 | AENA SME S.A | AMADEUS IT GROUP S.A | AMADEUS IT GROUP S.A | AMADEUS IT GROUP S.A |
| 6 | AMADEUS IT GROUP S.A | ARCELORMITTAL S.A | ARCELORMITTAL S.A | ARCELORMITTAL S.A |
| 7 | ARCELORMITTAL S.A | BANCO DE BILBAO VIZCAYA ARGENTINA (BBVA) | BANCO DE BILBAO VIZCAYA ARGENTINA (BBVA) | BANCO DE BILBAO VIZCAYA ARGENTINA (BBVA) |

| | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| 8 | BANCO DE BILBAO VIZCAYA ARGENTINA (BBVA) | BANCO SABADELL S.A | BANCO SABADELL S.A | BANCO SABADELL S.A |
| 9 | BANCO SABADELL S.A | BANCO SANTANDER S.A | BANCO SANTANDER S.A | BANCO SANTANDER S.A |
| 10 | BANCO SANTANDER | BANKIA S.A | BANKIA S.A | BANKIA S.A |
| 11 | BANKIA S.A | BANKINTER S.A | BANKINTER S.A | BANKINTER S.A |
| 12 | BANKINTER S.A | CAIXABANK S.A | CAIXABANK S.A | CAIXABANK S.A |
| 13 | CAIXABANK S.A | CELLNEX TELECOM S.A | CELLNEX TELECOM S.A | CELLNEX TELECOM S.A |
| 14 | CELLNEX TELECOM S.A | CIE AUTOMOTIVE S.A | CIE AUTOMOTIVE S.A | CIE AUTOMOTIVE S.A |
| 15 | DISTRIBUIDORA INT. DE ALIMENT. (DIA) | ENAGAS S.A | ENAGAS S.A | ENAGAS S.A |
| 16 | ENAGAS S.A | ENCE ENERGÍA Y CELULOSA S.A | ENCE ENERGÍA Y CELULOSA S.A | ENCE ENERGÍA Y CELULOSA S.A |
| 17 | ENDESA S.A | ENDESA S.A | ENDESA S.A | ENDESA S.A |

| | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| 18 | FERROVIAL CONSTRUCCIÓN S.A | FERROVIAL CONSTRUCCIÓN S.A | FERROVIAL CONSTRUCCIÓN S.A | FERROVIAL CONSTRUCCIÓN S.A |
| 19 | GRIFOLS S.A | GRIFOLS S.A | GRIFOLS S.A | GRIFOLS S.A |
| 20 | INTERNATIONAL AIRLINE GROUP S.A | INTERNATIONAL AIRLINE GROUP S.A | INTERNATIONAL AIRLINE GROUP S.A | INTERNATIONAL AIRLINE GROUP S.A |
| 21 | IBERDROLA | IBERDROLA | IBERDROLA | IBERDROLA |
| 22 | INDRA SISTEMAS S.A | INDRA SISTEMAS S.A | INDRA SISTEMAS S.A | INDUSTRIA DE DISEÑO TEXTIL |
| 23 | INDUSTRIA DE DISEÑO TEXTIL | INDUSTRIA DE DISEÑO TEXTIL | INDUSTRIA DE DISEÑO TEXTIL | INDRA SISTEMAS S.A |
| 24 | INMOBILIARIA COLONIAL SOCIMI | INMOBILIARIA COLONIAL SOCIMI | INMOBILIARIA COLONIAL SOCIMI | INMOBILIARIA COLONIAL S.A |
| 25 | MAPFRE | MAPFRE | MAPFRE | MAPFRE |
| 26 | MEDIASET ESPAÑA S.A | MEDIASET ESPAÑA S.A | MASMOVIL S.A | MASMOVIL S.A |

| | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| 27 | MELIA HOTELS S.A | MELIA HOTELS S.A | MEDIASET ESPAÑA S.A | MEDIASET ESPAÑA S.A |
| 28 | MERLIN PROPERTIES S.A | MERLIN PROPERTIES S.A | MELIA HOTELS S.A | MELIA HOTELS S.A |
| 29 | NATURGY ENERGY GROUP S.A | NATURGY ENERGY GROUP S.A | MERLIN PROPERTIES S.A | MERLIN PROPERTIES S.A |
| 30 | RED ELÉCTRICA DE ESPAÑA | RED ELÉCTRICA DE ESPAÑA | NATURGY ENERGY GROUP S.A | NATURGY ENERGY GROUP S.A |
| 31 | REPSOL | REPSOL | RED ELÉCTRICA DE ESPAÑA S.A | RED ELÉCTRICA DE ESPAÑA S.A |
| 32 | SIEMENS S.A | SIEMENS S.A | REPSOL | REPSOL |
| 33 | TÉCNICAS REUNIDAS S.A | TÉCNICAS REUNIDAS S.A | SIEMENS | SIEMENS |
| 34 | TELEFÓNICA S.A | TELEFÓNICA S.A | TELEFÓNICA S.A | TELEFÓNICA S.A |
| 35 | VISCOFAN S.A | VISCOFAN S.A | VISCOFAN S.A | VISCOFAN S.A |

TABLE 8. Composition of the Ibex 35. Source: Prepared by the authors.