THE PERFORMANCE OF EMERGING MARKETS IN A MARKET PORTFOLIO

This study focusses on the role of emerging markets in a European based global portfolio. Specifically the TICKS countries have been used as an index for the emerging markets. Previous research has failed to address the possibility of emerging markets as safe haven during the recent decades and focussed mainly on pre-crisis data. Using a Mean Variance Analysis in combination with a Monte Carlo Simulation this paper has shine new light on the role of emerging markets in a portfolio during times of prosperity and turmoil. Emerging markets seem to have an overall positive effect on the performance ratios used and there is clear evidence emerging markets can be used as diversifier. The role of emerging markets changes in different market circumstances and the exact role of emerging markets as safe haven remains unclear requiring further research.

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1. INTRODUCTION

In the current financial world many players are participating in the equity market ranging from simple retail investors to large institutional investors. All parties make an optimal investment decision with all information that is available to them. Their investment decision is based on their perceived value of a certain stock and since the world we live in is not a perfect world, predictions about future prices or profits are educated guesses based on the information that is available. An optimal investment portfolio would be a portfolio that generates high returns for an as low as possible risk. According to Markowitz (1952) a good portfolio is more than a long list of stocks and bonds. It should be a balanced whole, providing the investor with protections and opportunities with respect to a wide range of contingencies. In other words, *diversification* had been introduced to the world of finance. Diversification makes use of differences in correlations among security returns to reduce risk (Levy & Sarnat, 1970), potentially transforming a portfolio with a certain amount of return to a portfolio with a similar return but lower risk. Now one could look at a country and diversify amongst companies within the country, but quickly that would create a country specific risk. This could be reason enough to opt for international diversification, spreading risk not only in one stock exchange but spreading risk into several stock exchanges.

International diversification has been a topic of research for years. As early as 1976, Alan Rugman studied international diversification. Diversifying into several countries should intuitively lower risk for anything that happens in the home country does not necessarily occur in foreign countries. However, as could be seen in the financial crisis of 2008, the world we live in today is more globally orientated than ever. During this crisis, the initial housing bubble of the United States (U.S.) caused global damage to financial institutions (Simkovic, 2013). Damage to global financial institutions due to an issue in one country leading to a worldwide recession would imply that the correlation between several stock exchanges could be higher than expected. Several studies have investigated the impact of risk and return from global market/regional market to domestic market and vice versa (Eun and Shim, 1989; Mulyadi and Anwar, 2010). Their conclusion is that there is an impact from dominant markets to other (smaller) markets and vice versa. Arghyrou and Kontikas (2012) also find evidence that a crisis has contagious qualities and may spread cross-border with relative ease. So not only do markets feel impact from other markets, crises seem to spread across borders as well. Reason for international spreading could be because markets are quite similar, their correlation is high. The western world shares much amongst one another, but another group of interesting countries are the emerging markets.

The emerging markets are countries that are, as the name suggests, emerging and developing towards a market equal to one of a developed country. The definition of an emerging

market or country is rather complex, because not everyone agrees entirely on which countries are emerging markets. The general consensus though is that these countries do not (yet) have the level of market efficiency and strict standards in accounting and securities regulation to be on par with advanced economies. Nevertheless they do typically have a physical financial infrastructure, including banks, a stock exchange and a unified currency. For investors emerging markets are interesting because in general they experience faster economic growth, as measured by GDP. This of course does not come without penalty, where investing in emerging markets comes with greater risks and therefore volatility due to for instance political instability, domestic infrastructure problems, currency volatility and limited equity opportunities. Taking the risks into account, the emerging markets could have good diversification possibilities. One of the problems of a financial crisis is that stock markets become higher correlated, causing contagion (Moldovan, 2011; Sandaval Junior and De Paula Franca, 2012; Kenourgious et al., 2011; Sylljgnakis and Kouretas 2011). When stock markets become correlated, the diversification properties having several markets in your portfolio are diminished. Emerging markets however have shown to co-move with the global stock market in bullish markets, while they are independent when the market is bearish (Mensi, Hammoudeh, Reboredo & Nguyen, 2014). This is especially interesting for times of turmoil, where emerging markets could turn out to be a good hedge or even a safe haven.

2. THEORETICAL FRAMEWORK

This chapter will describe the theoretical framework used for this study. It will start by explaining portfolio optimization and explaining diversification possibilities. Next the diversification possibilities will be further elaborated with emerging markets as special subject. Having this background information, previous studies focussed on similar subjects will be shown resulting in hypotheses for this study.

2.1. PORTFOLIO OPTIMIZATION

For an investor it is amazing to see an asset skyrocket when having invested in this particular asset. In February 2011 for example, the share price of Gateway Industries rose from about 2 cents per share to nearly $3,- in one day. In 2018 Turtle Beach had a yearly gain of 780% due to the sudden popularity of the game *Fortnite*. Extraordinary growths like these occur occasionally, however similar losses are also a possibility. Facebook, now one of the largest companies in the world, fell from $38 to $17,55 in just 3 months after its IPO. Intel saw its stock price drop from about $73 to $32 in less than 6 months in the year 2000, albeit not as much as a 780% gain this is still a spectacular loss. Since investing in solely one stock has the risk of losing much of the investment, many investors nowadays opt to spread their risk by means of diversification.

2.1.1. DIVERSIFICATION

When talking about risk in the investing sector there are two main groups: systematic risk and unsystematic risk. Systematic risk, also known as market risk or un-diversifiable risk, is the uncertainty inherent to the entire market or market segment (Beja, 1972). Unsystematic risk, also known as specific risk, diversifiable risk or residual risk, is the type of uncertainty that comes with the company or industry you invest in (Beja, 1972). Investors always want as much return as possible for the risk they are taking. Thus investors will always like to diversify their unsystematic risk. However, since there is always a systematic risk, diversification can only reduce risk so far and never completely eliminate all variance (Markowitz, 1952). Together the works of Markowitz (1952) and Tobin (1958) laid base to a theoretical framework that provided an explanation and normative rules for the diversification of risky assets, but the degree to which diversification can reduce risk depends on the correlations among security returns (Levy & Sarnat, 1970). Their work has been the standard for efficient portfolio construction for finance ever since and still modern finance is based on some form of this theory. Markowitz showed that variance can be reduced while maintaining the return with the use of diversification and thus investing in multiple securities rather than focussing on one security individually, also known as the mean-variance

analysis. By maximizing the risk versus return ratio, thus the most optimal diversified portfolio can be constructed.

By distributing weights to several assets in a portfolio a certain return combined with a variance can be plotted. When repeating this process any possible asset combination can be computed and plotted resulting in one of the most important concepts of the modern portfolio theory: the efficiency frontier. Any portfolio positioned below the efficiency frontier is per definition sub-optimal, as it is possible to obtain a higher return given that variance. Even though it is possible to be closer to the efficiency frontier, thus obtaining a higher return or decreasing the variance, investors can have their reasons to deviate from the efficiency frontier. For example, for an investor a reason could be that they dislike certain operations from a company and thus are reluctant to invest in a company alike. As for the efficiency frontier, there is no other distribution of weights possible to obtain a higher return given a standard deviation so the efficiency frontier is deemed the most optimal portfolio. However it is impossible to pinpoint the best choice among portfolios on the efficiency frontier, as this choice is dependent on the individual risk attitude of investors (Chen, Chung, Ho & Hsu, 2010).

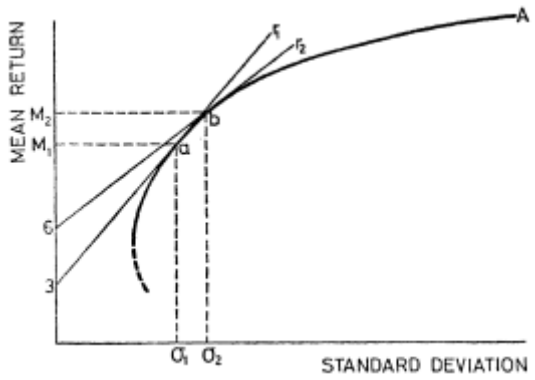

FIGURE 1-EFFICIENCY FRONTIER (LEVY & SARNAT, 1970)

Sharpe (1966) applied the idea suggested by Roy (1952) to apply risk-reward in evaluating a portfolio, resulting in the well-known Sharpe ratio. The Sharpe ratio has been the most used measure for performance evaluation ever since. The Sharpe ratio measures the mean excess return per unit of overall risk, with the portfolio with the higher Sharpe ratio being regarded to as the superior portfolio (Scholz, 2007).

$$S = \frac{r_p - r_f}{\sigma_i} \quad (1)$$

However the Sharpe ratio has implied assumptions that can hide substantial downward risk (De Prado & Peijan, 2004). The assumptions being: returns are independent and normally distributed. For hedge funds it seems that their strategies and high frequency strategies in

particular lead to inflated Sharpe ratios (Bailey & Lopez de Prado, 2012). However, by sampling returns more frequently the inflationary effect is reduced (Goetzmann, Ingersoll, Spiegel & Welch, 2007). For bear markets the Sharpe ratio has often been challenged (Israelsen, 2003, 2005; Jobson & Korkie, 1981; Scholz, 2007). A negative Sharpe ratio could lead to choosing a sub-optimal portfolio because a portfolio with a higher variance will have a higher Sharpe ratio, given the same return. If a portfolio return is 10%, the risk free rate is 20% and for A the standard deviation is 25% and for B the standard deviation is 50%. In this example the Sharpe ratio for A would be -0.40 and -0.20 for B. Thus one should choose portfolio B based on the Sharpe ratio, but intuitively portfolio A should perform better since it has a lower risk for equal return. An argument has been made by McLeod and van Vuuren (2004) that the fund with the highest Sharpe ratio is the fund most likely to outperform the risk-free asset, thus that the Sharpe ratio is still viable for funds in a bearish market. Due to its simplicity the Sharpe ratio remains one of the most used measure for performance evaluation, but there are some alternatives in this field of research.

Among others Expected Shortfall (ES) or conditional variance at risk is a variation on the variance at risk (VaR) variable. VaR is a measurement of risk of loss in investments by estimating for a given probability an investment might lose over a certain time period, given normal market conditions. The conditional variance at risk plays in on this by focussing on the less profitable outcomes and make a rather conservative estimation of potential losses. Instead of simply looking at the possible losses, the ES calculates the losses when things go bad for instance during a crisis. Another interesting variable is the semivariance (SV). Instead of looking at the total variance of the asset SV looks at the downside risk by averaging the squared deviations of values that are less than the mean. Hereby it measures the dispersion of all observations that fall below the mean (Reboredo & Rivera-Castro, 2014).

2.1.2. HEDGE OR SAFE HAVEN

By diversifying a portfolio the correlations between several assets are important. Since correlation is measured by values of $\rho = -1$ to $\rho = 1$ an asset can be perfectly (negatively) correlated, uncorrelated or (negatively) correlated. Assets with perfect correlation ($\rho = -1$ or $\rho = 1$) will have no real use in diversification. Positively perfect correlated assets will have the same percentage change in price, whereas negatively perfect correlation will completely offset any change resulting in a net change of 0. Uncorrelated assets ($\rho = 0$) however do prove to help in portfolio diversification, as their movements have no effect on the price of one another. Whenever assets are imperfect correlated, they can be used. Still then there is a distinction made between assets that are positively and negatively correlated. A definition has been made by Baur and Lucey (2010) that positively correlated stocks are *diversifiers* and negatively or uncorrelated assets are *hedges*. The distinction between these two is that diversifiers reduce risk to protect the

investor from being affected by any individual event in an investment. Hedges on the other hand reduce risk or losses by taking an offsetting position, thus if an assets price falls the hedge asset will rise in price or remain the same.

A problem however is that empirical evidence shows that even hedges with a negative correlation coefficient are positively correlated during times of market stress. The subprime crisis of 2007 is a clear example where Asian financial markets have suffered severe losses, sometimes even sharper than the major developed markets. Despite banks in the region being relatively less affected by the subprime problem compared to those in the United States or Europe (Yiu, Alex Ho & Choi, 2010). In general, times of turmoil result in complete bear markets or even a worldwide downward trend. This is where a *safe haven* comes into play. A safe haven is defined as an asset that is uncorrelated or negatively correlated with another asset in times of market stress or financial turbulence (Baur & Lucey, 2010). The specific property is the non-positive correlation with a portfolio in extreme market conditions. This property does not force the correlation to be positive or negative during normal times, only to be zero or negative in specific periods. Since a safe haven can also act as a diversifier or hedge when there are no extreme market conditions, finding the right safe haven is essential for good portfolio diversification.

2.2. INTERNATIONAL DIVERSIFICATION

For many years international diversification has been a topic of research. Levy and Sarnat (1970) were one of the first to explore this field, where many have followed (Solnik, 1974, 1982; Black & Litterman, 1992; Heathcote & Perri, 2007), demonstrating that international diversified portfolios dominate domestic diversified portfolios. Intuitively it makes sense, when looking at diversification within one market, one can also assume that diversifying further between several markets should also result in a better balanced portfolio. When talking about international diversification most literature focusses on US-based portfolios and therefore the perspective of the US is by far the most analysed. Also notably is that many (early) studies use the US, several European countries and Japan indices (Shawky, Kuenzel & Mikhail, 1997). Not only the studies have focussed on those countries, traditionally investors have considered developed markets in their international diversification strategy. Since then, research shows that markets of industrialized countries are more interdependent than once thought, which causes the diversification potential to diminish (Errunza, 1983). A clear example of this interdependency is seen in the financial crisis of 2008, where the initial housing bubble of the US caused global damage to financial institutions (Simkovic, 2013). Several studies have investigated the impact of contagion and concluded that a crisis has contagious qualities and may spread cross-border with relative ease (Eun & Shim, 1989; Mulyadi & Anwar, 2010; Arghyrou & Kontikas, 2012). Reason for

international spreading could be because markets are quite similar, their correlation is high. The western world shares much amongst one another, but another group of interesting countries are the emerging markets.

2.2.1. PROPERTIES OF EMERGING MARKETS

Emerging markets are emerging and developing towards a market equal or similar to a one of a developed country. The definition of an emerging market or country is rather complex, because not everyone agrees entirely on which countries are emerging markets. The general consensus though is that these countries do not (yet) have the level of market efficiency and strict standards in accounting and securities regulation to be on par with advanced economies. Nevertheless they do typically have a physical financial infrastructure, including banks, a stock exchange and a unified currency. For investors emerging markets are interesting because in general they experience faster economic growth, as measured by GDP and therefore in stock price. This of course does not come without penalty, where investing in emerging markets comes with greater risks and therefore volatility due to for instance political instability, domestic infrastructure problems, currency volatility and limited equity opportunities. Like any international investment there are certain barriers or common obstacles like taxation or currency controls (Lessard, 1976). For emerging markets however there come certain risks that make investors reluctant to invest in these kind of assets.

A risk that immediately pops to mind when investing in a foreign country is the currency risk. For western countries the risk is relatively low as the markets are correlated as are the currencies. For emerging markets however it is more likely for potential investors to perceive currency risk as a major obstacle (Errunza, 1983). Investors could see the limited hedging opportunities or expectations that international parity theorems do not hold as a problem. In the long run the purchasing power parity holds and the impact of exchange rate changes on the realized returns reported did not increase volatility or reduce returns to unacceptable levels (Errunza, 1983). Phylaktis and Ravazzolo (2004) further explore the topic of currency risk in emerging markets and conclude that currency risk is an important component in international capital asset-pricing models. Investors should not be discouraged though, because they are compensated for bearing such a risk since currency risk is priced.

Given that these markets are still developing, it is logical to question the efficiency of the markets. One could question the fairness of the prices and whether or not they reflect all information available. Even though many factors have helped to improve the availability, quality and timeliness of information on markets and firms, it is still nowhere near the developed markets standards (Errunza, 1983; Stiglitz, 2000). The operational and informational efficiency in less

developed or emerging markets is not yet maximised and therefore the markets are not yet fully efficient, albeit they are efficient to some extent (Mobarek, Mollah, & Bhuyan, 2008).

Emerging markets might also endure some form of political instability and therefore have a political risk. Although this is not unique to emerging markets, the probability of expropriations, nationalizations or capital controls is generally perceived much greater in these markets (Errunza, 1983). These political risks stem partly from a big difference between developed and emerging, the differences in their institutions. These institutions have been defined by North (1991, p. 87) as "humanly devised constraints that structure political, economic and social interaction" and as "regulative, normative and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life" by Scott (2013, p. 56). As these definitions indicate, it is rather difficult to pinpoint and quantify these institutional differences. Whether or not the legal system has an English or non-English origin could for instance play a role, or the corruption within a country, but adjusting for these differences is out of the scope of this study. Therefore the risks connected to the institutional differences will be assumed to be included in the prices similar to the currency risk. One thing is certain though, these countries often have relatively weak institutions (Henry, 2000; Bekaert, Harvey & Lundblad, 2001, 2005; Leuz, Lins & Warnock, 2008).

Taking the risks into account, the emerging markets could have good diversification possibilities. For they in general have a higher volatility, but this higher volatility goes hand in hand with higher extreme market returns (Errunza, 1983; Diamonte, Liew & Stevens, 1996). One could go as far as saying the emerging markets have safe haven potential. One of the problems of a financial crisis is that stock markets become higher correlated, causing contagion (Moldovan, 2011; Sylljgnakis & Kouretas 2011). When stock markets become correlated, the diversification properties having several markets in your portfolio are diminished. Emerging markets however have shown to co-move with the global stock market in bullish markets, while they are independent when the market is bearish (Mensi, Hammoudeh, Reboredo & Nguyen, 2014).

2.2.2. EMERGING MARKETS AS SAFE HAVEN

The BRICS countries are a group of countries considered to be emerging markets and amongst the largest gold producing or exporting countries. Among the top 10 gold mining countries in 2017 China and Russia are first and third respectively according to the GFMS Gold Survey of 2018. Also noteworthy is South Africa, as being the largest gold exporter from Africa (Bekiros, Boubaker, Nguyen & Uddin. 2017). As safe havens go, one of the most studied and acknowledged safe havens is gold (Baur & Lucey, 2010; Baur & McDermott, 2010; Hood & Malik; 2013). Since gold as a safe haven has been given quite the attention, most studies conclude that for a developed market gold

could function as a safe haven, but for emerging markets this appears not to be the case (Baur & McDermott, 2010; Gürgün & Ünalmış, 2014). There seems to be a correlation between emerging markets and gold in times of market stress. Thus when emerging markets are correlated to gold, this could give rise to the idea that emerging markets could be used as a safe haven.

The question whether or not emerging markets are a safe haven is still one that needs further exploration. Not many studies have been eager to examine this subject. Lai and Tseng (2010) did study the role of the Chinese stock market in a global portfolio from 1993 to 2009 and concluded that the Chinese market has potential to be a hedge and a safe haven. Their definition of safe haven slightly differs in that they define a safe haven as a market that is less dependent with the other market and generates low probability of joint crash, given the other collapses. Several studies have been focussing on interdependence and contagion during the global financial crisis of 2008. Their empirical evidence shows the question for emerging markets is not so easily answered as their mixed results provide no clear answer (Ahmad, Mishra & Daly, 2018).

There are several studies that have found evidence for contagion between US or Eurozone markets and the emerging markets during crises (Celık, 2012; Jin & An, 2016; Bhuyan, Robbani, Talukdar & Jain, 2016). Mostly those studies focussed on the BRICS countries rather than emerging markets as a whole. Another finding that has been prevalent is that there is some form of contagion, but the interdependencies between emerging market countries are significantly more important (Baur & Fry, 2009; Ahmad, Sehgal & Bhanumurthy, 2013). The distinction between interdependencies and contagion is that interdependencies are co-movements between markets in times of normal market interaction, whereas contagion is during times of financial stress. Samarakoon (2011) on the other hand found there to be no contagion effects from the US to emerging markets, but rather from the emerging markets to the US. Several other studies have also found there is no contagion between the US and emerging markets during crises (Dimitriou, Kenourgios & Simos, 2013; Baur, 2012; Kenourgios, Christopoulos & Dimitriou, 2013; Bekaert, Ehrmann, Fratzscher & Mehl, 2014). Not only have Mensi, Hammoudeh and Kang (2017) found that BRICS stocks have significant time-varying correlations with developed markets, but are sought after during downturns, indicating the ability of BRICS to offer positive returns during stress and thus the role of a safe haven. Overall, the findings are inconclusive and therefore the role of emerging markets with a global market portfolio still requires more research.

2.3. HYPOTHESES

The study contributes to the literature in the following manner. Firstly it complements the literature by examining the stock movements of several markets during recent times. Furthermore a Europe based global market portfolio will be made to assess the role of emerging markets as an asset. The aim is to see whether or not the emerging markets are used in an optimal portfolio and to see if they have safe haven properties. These goals are reflected in the research question:

What is the role of emerging markets within a Europe based global market portfolio and does this differ in times of distress?

The hypotheses to answer said research question are set according to the underlying theory. The first hypothesis stems from the portfolio optimization theory. When minimizing the variance of a portfolio given a return the inclusion of emerging markets in a portfolio should become visible. This should be best visible when comparing the different portfolios with the base portfolio with their corresponding efficiency frontiers.

H1: Emerging markets have diversification potential in a Europe based global market portfolio

As an extension of the first hypothesis we will take a look at performance ratios of the portfolios. The addition of emerging markets to a portfolio should result in a better diversified portfolio and therefore supplement the performance ratios. Even though the Sharpe ratio has many shortcomings, the ratio still is used as the best option for a risk-to-reward ratio. Amongst others the Sharpe ratio shall be used as performance ratio.

H2: The inclusion of emerging markets leads to better performance ratios

Not only do we expect the emerging markets to have diversification potential. Emerging markets seem to be disconnected enough from the developed world to have potential as safe haven during crises.

H3: Emerging markets can be used as a safe haven during crises

3. CREATING THE PORTFOLIOS

This chapter will describe the dataset and methodology used in this paper. First the data selection process will be elaborated, followed by the methodology. In the methodology the Mean Variance Analysis and Monte Carlo Simulation will be explained and the reasoning of the different portfolios.

3.1. THE DATA

The data will consist of weekly data from 1-1-2008 to 31-12-2017 retrieved from Thomson Reuters' Datastream. The perspective will be that of a western investor based in Europe. An investor alike will have some form of home bias, investing more in countries and companies that are close to home. The European based global market portfolio will consist of the following assets shown in Table 1.

Indices	Others
S&P Europe 350	MSCI World Real Estate Index
FTSE EuroMid index	S&P GSCI Commodity Index
MSCI Europe	
FTSE 100 index	
S&P 500 index	
Nikkei 225 index	
MSCI World Index	

TABLE 1-ASSET OVERVIEW

The stock indices are chosen to represent the most important developed stock markets while including more European indices, for the purpose of simulating a portfolio from a European point of view. To ensure the global perspective also the MSCI World Index will be added to the portfolio. Normally an investor doesn't solely invest in stocks, but creates a diverse portfolio[1]. Therefore to complement the portfolio the MSCI World Real Estate Index and S&P GSCI Commodity index will be added. Combined this will be denoted as the Base Portfolio. The returns from the indices will

[1] Bonds of Europe, the U.S. and Japan were used to further diversify the portfolio but the MVA could not cope with these variables. Therefore they are left out of the study.

be total returns[2], which should give a better view of relative performance instead of price indices given it includes dividend and coupon payments.

As addition to the Base Portfolio and main subject of this study the emerging markets will be added to see if they make a difference. Since emerging markets are diverse a selection will be made of several emerging market's market. In 2001 Jim O'Neill published a paper first referring to the four countries that were at a similar stage of newly advanced economic development (O'Neill, 2001). These most common emerging markets are the countries known as the BRIC: Brasil, Russia, India and China. The countries have their differences, but have similar territorial extension, size of population and economic potential (Wilson & Purushothaman, 2003). As of 2003 the investment report of Goldman Sachs pointed out not only the importance of South Africa as the biggest economy in the African continent, but also as an emerging economy in the world (Vijayakumar, Sridharan & Rao, 2010). Since 2010 South Africa joined the BRIC countries, resulting in the acronym BRICS, compassing the 5 largest emerging markets. However since 2001 much has changed and Goldman Sachs has even closed the BRIC fund in 2015, signalling an end of an era (McLannahan, 2015). Interest appears to have shifted to technology heavy industries, like Taiwan and South Korea, replacing the commodity heavy industries of Brazil and Russia. Large institutions like Copley Fund Research, Baillie Gifford, JP Morgan, Nordea, Swedbank have all indicated to have high exposure to these tech heavy industries, signalling their potential as emerging economies (Johnson, 2016). To include these emerging markets to the Base Portfolio an index will be made to combine the markets. Their market capitalization will be converted to one currency, given the exchange rate, and added up to create one EM Index. Since the Base Portfolio is based on being an European investor, the foreign markets will be converted to Euro's with their corresponding exchange rates.

	Full period		Bear period		Bull period	
	Return	Standard Deviation	Return	Standard Deviation	Return	Standard Deviation
Brazil	-2,31%	33,44%	-31,68%	53,45%	2,87%	29,43%
Russia	-5,14%	36,81%	-54,45%	69,48%	5,42%	29,18%
India	3,86%	28,90%	-49,18%	53,54%	15,11%	23,25%
China	6,26%	33,22%	-26,72%	52,85%	12,12%	29,29%
South-Africa	5,96%	26,31%	-31,38%	44,95%	12,81%	22,35%
Taiwan	8,62%	20,70%	-20,85%	34,88%	13,70%	17,72%
South Korea	3,14%	25,78%	-37,75%	50,70%	10,93%	19,71%

TABLE 2-EMERGING MARKETS OVERVIEW

[2] Russia, China and South Korea did not have total returns available. The price indices are used and could cause the correlations to be slightly different than they appear.

Table 2 shows the countries and their corresponding returns and standard deviation given the time period. Visible is that the countries discussed earlier, Brazil and Russia, perform the poorest over all time periods, except for Brazil in the bear period where it has the 4th lowest return. Not only do these countries have a low return, they also have very high standard deviation. If put in an portfolio optimizer as discussed below, the results show that for portfolios with a high standard deviation and low return the two countries are used, but not for the low risk-high return portfolios. Looking at their efficiency frontiers below is clearly visible that the countries Brazil and Russia do not provide much diversification potential. Therefore this study will focus on the TICKS countries and use those 5 as an Emerging Market index. This is also in line with the theory that Brazil and Russia are less viable and Taiwan and South-Korea are more viable as emerging market (Chychkalo-Kondratska, Bezrukova & Svichkar, 2017).

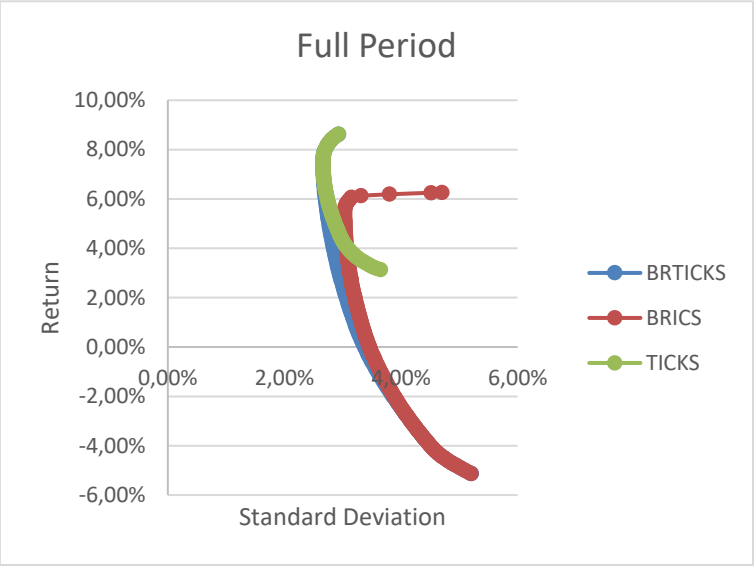

FIGURE 2-EFFICIENCY FRONTIER EMERGING MARKETS OF THE FULL PERIOD

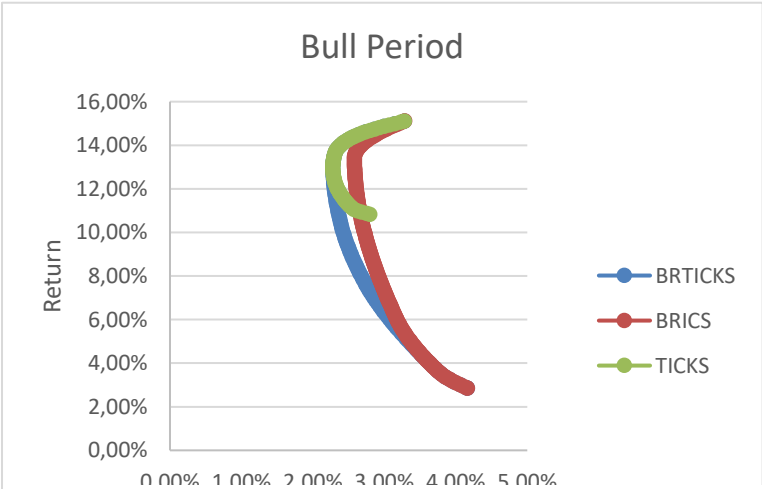

FIGURE 3-EFFICIENCY FRONTIER EMERGING MARKETS OF THE BULL PERIOD

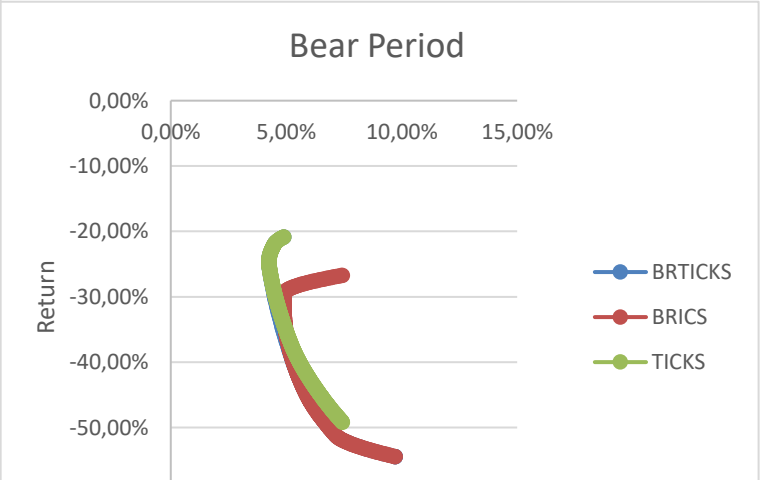

FIGURE 4-EFFICIENCY FRONTIER EMERGING MARKETS OF THE BEAR PERIOD

3.2. METHODOLOGY

Firstly the traditional mean-variance analysis (MVA) is used as portfolio optimization model to examine differences between the global portfolio and the portfolio with emerging markets in it. To examine the effect of a bullish or bearish market different time periods should provide different results on the diversification potential of emerging markets. Finally a Monte Carlo Simulation (MCS) will be performed with the generated data to answer the research question and test the hypotheses.

3.2.1. MEAN VARIANCE ANALYSIS

The MVA is a process where returns are used to in the end determine the most optimal portfolio with the least variance. Cuthebertson and Nitzsche (2005) wrote a book about stocks, bonds and foreign exchange, in which they gave an in depth explanation of the MVA and the formulas used. Since the collected data consists of historical closing prices, the first step is these prices to returns. As geometric returns are often more useful and commonly used in the field of finance, the natural logarithm of returns will be used:

$$r_t = \ln\left(\frac{p_t}{p_{t-1}}\right) \tag{2}$$

Since the time period between t and $t + 1$ is one week, the calculated rates of return over the period still have to be annualized. Annualizing the data should allow for better comparison over a commonly used period of one year. The variance – covariance matrix is then derived from the returns using the following formulas.

$$\sigma = \sqrt{\frac{\sum(\mu - \bar{\mu})^2}{N}} \tag{3}$$

σ being the standard deviation, μ the return and $\bar{\mu}$ the mean return together resulting in the excess return for that time period and N being the number of observations.

$$\sigma_{x,y} = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) \tag{4}$$

$\sigma_{x,y}$ is the covariance between asset x and y and lastly the correlation matrix is calculated given the calculated standard deviation and covariance.

$$\rho_{x,y} = \frac{\sigma_{x,y}}{\sigma_x \sigma_y} \tag{5}$$

To optimize the portfolio the return of the entire portfolio is calculated given weights to the assets in the portfolio. These weights are calculated for the least amount of variance given a return. The variance of the portfolio is calculated with the following formula:

$$\sigma_p^2 = \sum_{i=1}^{N} w_i^2 \sigma_i^2 + \sum_{i=1}^{N} \sum_{\substack{j=1 \\ i \neq j}}^{N} w_i w_j \rho_{ij} \sigma_i \sigma_j \tag{6}$$

This will result in a return of the portfolio of:

$$E(r)_p = \sum_{i=1}^{n} w_i E(r_i) \tag{7}$$

This basic MVA will give the best possible solution, but not constraining the analysis will give surrealistic results. In the real world an investor does not have unlimited resources to invest, or at least has an self-imposed constraint. The basic MVA does leave room for unlimited short-selling, which is highly unlikely for an investor. Therefore a constraint shall be that there is no short-selling allowed. As a robustness check this will still be conducted, but not as main focus of research. Another assumption for this study will be that the portfolio is always fully invested. Using this assumption, the study should answer the question best where to invest in, when investing, rather than if one should invest in the first place.

3.2.2. MONTE CARLO SIMULATION

One of the limitations of the MVA is that the estimation risk can play an important role (Jorion, 1992). Expected returns, risks and correlations are measured from historical data and fed into an optimizer as if they were known perfectly. However, these data could be measured with substantial errors. Therefore the optimized portfolio can only approximate a true optimal portfolio. This limitation can partially be solved by conducting a MCS. The historical data will be used and a random sample will be drawn from the distribution to perform portfolio optimization. This process can be repeated resulting in a scatterplot of several portfolio's. Following this

scatterplot of portfolio's the efficiency frontier can be seen and one's optimal portfolio can be found.

Similar like Jorion (1992) the steps required for the simulation are:

1. Using the optimization process compute the returns and covariance matrix. Define T as the number of weeks and N as the number of assets. Assume the returns and covariance matrix to be true values.
2. Draw N random samples simulating one period of return.
3. Repeat step 3 for T periods.
4. Estimate a new set of returns and the corresponding variance-covariance matrix.
5. Perform the optimization process to ascertain the optimal portfolio.
6. Repeat steps 2 to 5 a thousand fold to approximate the distribution of the optimal portfolio with enough precision.

A scatterplot can be made to determine the efficiency frontier and therefore the most optimal portfolios can be determined. As discussed in the theoretical framework the Sharpe ratio has its limitations, therefore two other performance ratios will be used to ascertain the best portfolio. The semivariance (SV) and expected shortfall (ES) are calculated with the following formulas:

$$SV = E\left[\min\left(0, r_p - \bar{r}_p\right)\right]^2 \quad (8)$$

$$ES = E[r_t | r_t \leq -VaR_t(r_p)] \quad (9)$$

3.2.3. PORTFOLIOS

The portfolios simulated have several constraints and characteristics. Since the emerging market index used is one created by ourselves, it could be interesting to take a look at different weights of the indices used in the created EM index. The EM indices created will be based on market capitalization, equally weights and the highest Sharpe ratio based on the given period and further denoted as Base + Market Cap, Base + Equal Weights and Base + Sharpe respectively . The EM index based on market capitalization will be similar to buying one of each indices to combine them into one index. The EM index based on the highest Sharpe ratio should as explained in the previous chapter result in the EM index that has the highest risk-to-return ratio, therefore possibly obtaining the highest amount of returns. An upcoming theory however is that due to the estimation error when using historical data, feeding your optimizer with sub-optimal inputs could result in superior portfolios (DeMiguel, Garlappi, Nogales & Uppal,2009). This will be tested with the equally weighted EM index.

4. ANALYSIS

This chapter will present the results of the study. First an overview of the Base Portfolio will be given for the three time periods, the full period overview, the bearish period and the bullish period. Thereafter follow the paragraphs for the different time periods adding the different created Emerging Market index to the Base Portfolio. The time periods will first show the MVA and their corresponding efficiency frontiers to partly answer the first hypothesis. To answer the other hypotheses and finally the research question the paragraphs will be divided into further sub paragraphs for the MCS of the different portfolios. The third hypothesis can only be answered when the market is a bear period so will be dealt with in paragraph 4.3 accordingly.

The created EM index had the following weights corresponding to the full time period sharpe ratio, shown in Table 3. The indices created for the equally weighted and market capitalization were generated through weighting the returns equally and calculating the returns through combining the country specific indices respectively. The weights shown in Table 3 were used to create the EM Sharpe index for the corresponding time periods. Noteworthy is that for every period the best Sharpe ratio has a weight of 0 contributing for South Korea.

	Full period	Bear period	Bull period
India	0,0000	0,0000	0,2253
China	0,1139	0,0000	0,1263
South-Africa	0,0000	0,0000	0,0806
Taiwan	0,8861	1,0000	0,5677
South Korea	0,0000	0,0000	0,0000
Return	8,35%	-20,85%	13,75%
Standard Deviation	19,71%	34,59%	16,42%

TABLE 3-EM INDEX BASED ON MAX SHARPE RATIO

4.1. BASE PORTFOLIO

The Base Portfolio exists of all asset indices except for the Emerging Market index. Table 4 gives an overview of the assets' annualized return, standard deviation and median with respect to their time periods.

	Full period			Bear period			Bull period		
	Return	Standard Deviation	Median	Return	Standard Deviation	Median	Return	Standard Deviation	Median
S&P Euro 350	2,78%	21,19%	13,92%	-40,35%	31,45%	-23,29%	11,16%	18,99%	17,99%
EuroMid	6,57%	22,52%	13,51%	-38,70%	38,20%	-33,92%	15,41%	18,94%	17,27%
Europe Small	8,18%	20,91%	24,77%	-40,25%	34,18%	-30,22%	17,84%	17,88%	28,35%
London	3,42%	19,95%	6,75%	-38,73%	32,37%	-24,73%	11,52%	17,17%	11,80%
S&P 500	10,34%	17,18%	22,31%	-29,46%	27,42%	-24,88%	17,70%	14,92%	25,60%
Japan 225	7,78%	19,98%	19,07%	-21,53%	28,67%	-36,48%	12,83%	18,28%	22,48%
World index	7,50%	16,16%	18,55%	-32,18%	25,16%	-21,73%	14,89%	14,14%	23,32%
Real Estate	5,90%	19,54%	18,16%	-42,19%	35,69%	-40,81%	15,55%	15,50%	26,44%
Commodities	-8,06%	22,47%	-0,37%	-38,27%	35,91%	-36,34%	-2,62%	19,64%	3,12%

TABLE 4-BASE PORTFOLIO OVERVIEW

Table 5 and 6 show the correlations of the Base Portfolio where in Table 6 the table is split according to the diagonal. Below the diagonal is the Bearish period and above the diagonal is the Bullish period. To be expected the correlations of the European indices are high and close to 1, as is the London index. The world index is also fairly high correlated to all other indices but less so for Japan. Compared to the other indices Japan is less correlated to the rest of the world it seems, maybe partly because of its geographical location compared to the other western countries.

	S&P Euro 350	EuroMid	Europe Small	London	S&P 500	Japan 225	World index	Real Estate	Commodities
S&P Euro 350	1								
EuroMid	0,93226	1							
Europe Small	0,90519	0,97631	1						
London	0,86808	0,90676	0,89293	1					
S&P 500	0,63660	0,66500	0,66059	0,72271	1				
Japan 225	0,48205	0,49985	0,53481	0,55033	0,53714	1			
World index	0,82176	0,84443	0,84253	0,88041	0,93911	0,66980	1		
Real Estate	0,67350	0,74897	0,74705	0,75323	0,79880	0,66711	0,87021	1	
Commodities	0,40214	0,45204	0,47490	0,53621	0,47339	0,33481	0,53730	0,45685	1

TABLE 5- CORRELATIONS BASE PORTFOLIO FULL PERIOD

	S&P Euro 350	EuroMid	Europe Small	London	S&P 500	Japan 225	World index	Real Estate	Commodities
S&P Euro 350		0,93284	0,89879	0,84413	0,63251	0,41365	0,79533	0,60106	0,38535
EuroMid	0,93946		0,97872	0,90082	0,67632	0,43985	0,83166	0,67918	0,45701
Europe Small	0,91937	0,97212		0,89179	0,68724	0,47428	0,83526	0,69367	0,47186
London	0,91765	0,91401	0,88854		0,74170	0,52289	0,87534	0,72731	0,53151
S&P 500	0,62495	0,62786	0,58690	0,66845		0,58370	0,95386	0,80827	0,52525
Japan 225	0,64405	0,62502	0,66504	0,60540	0,41428		0,67080	0,65545	0,37691
World index	0,87259	0,86453	0,84736	0,88401	0,90449	0,66137		0,85313	0,56583
Real Estate	0,80720	0,84373	0,82188	0,78895	0,78405	0,71418	0,90822		0,49309
Commodities	0,41698	0,42509	0,46066	0,52865	0,34684	0,21785	0,45856	0,38508	

TABLE 6- CORRELATIONS BASE PORTFOLIO BEAR AND BULL PERIOD

Figure 5 shows the three efficiency frontiers created using the MVA on the Base Portfolio per time period. As expected the Bull period has the highest returns whereas the Bear period has the least returns, with respect to the standard deviation.

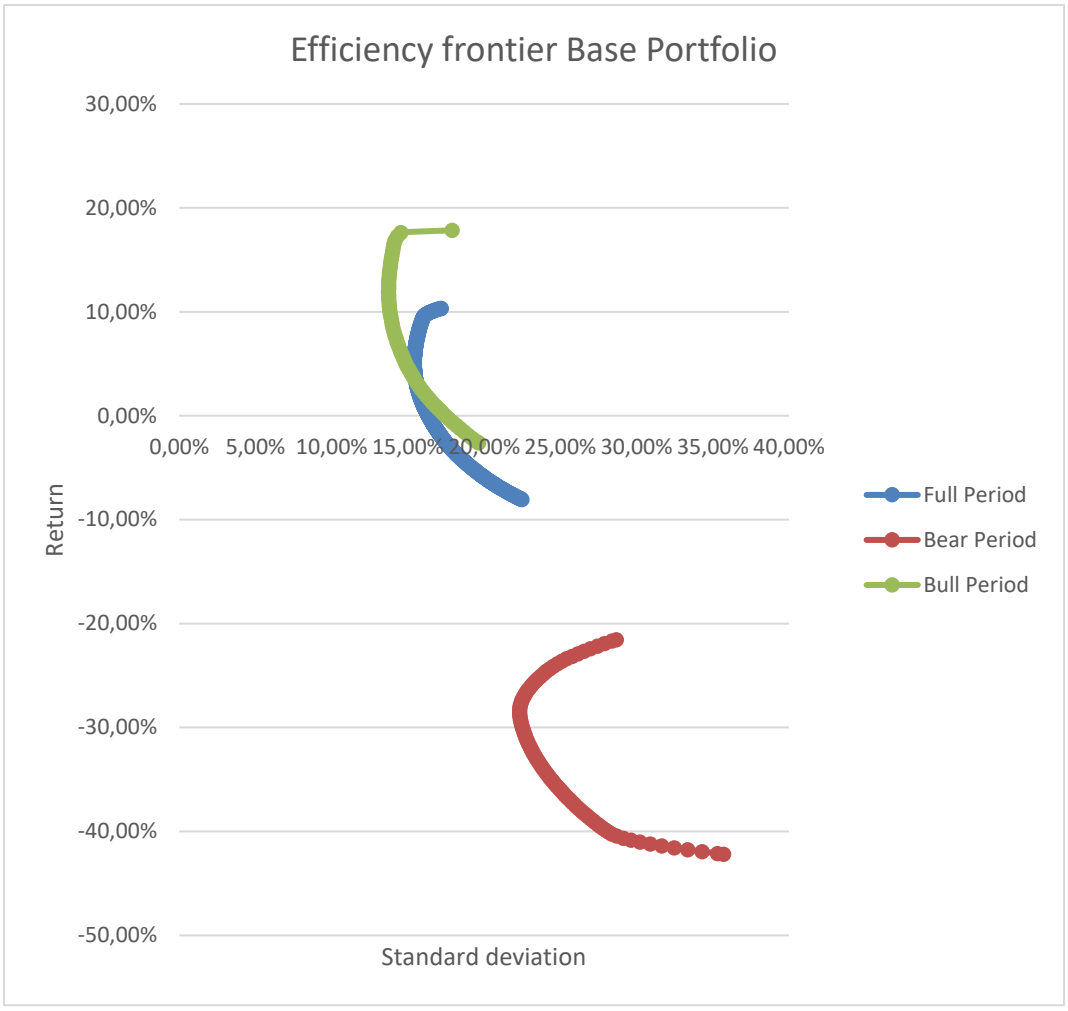

FIGURE 5-EFFICIENCY FRONTIERS BASE PORTFOLIO

Figure 6 shows the returns of the Base Portfolio over the full period of time. The first peak of volatility is clearly visible on pretty much all assets, albeit not all equally high. The peaks and troughs are visible in the stacked line overview of figure 7 explaining much of the volatility.

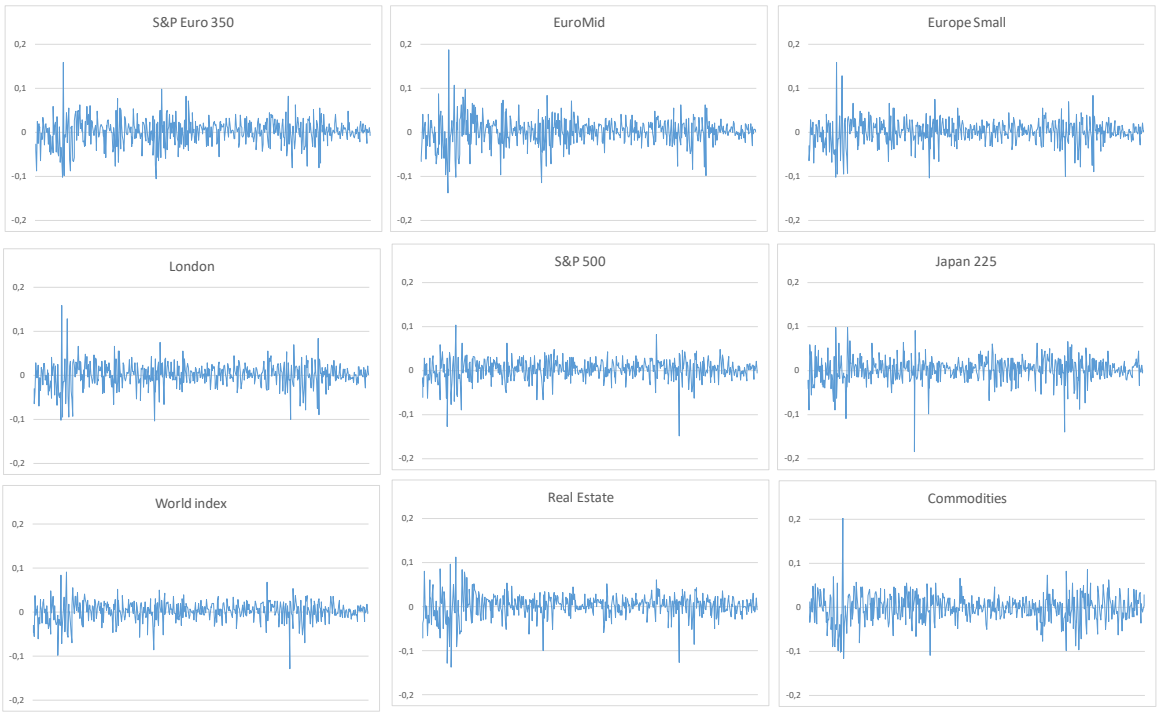

FIGURE 6-BASE PORTFOLIO RETURN OVERVIEW PER ASSET

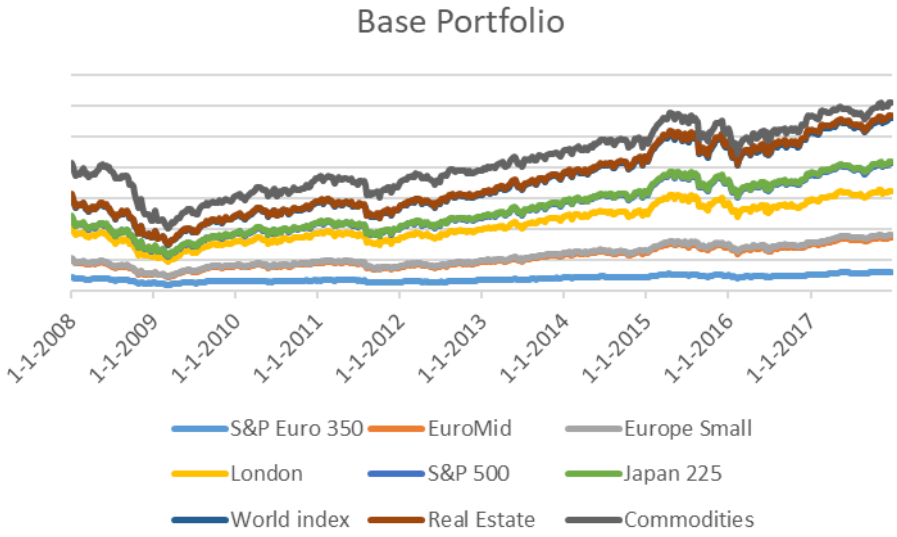

FIGURE 7-BASE PORTFOLIO STACKED LINE OVERVIEW

4.2. GENERAL PERIOD OVERVIEW

When looking at the combined efficiency frontiers created with the MVA shown in figure 8, we can see the blue line of the Base portfolio being the rightmost efficiency frontier. The difference is small, but the efficiency frontier of the Base + Sharpe portfolio is the leftmost efficiency frontier.

Followed by the Base + Market Cap and the Base + Equal Weights respectively. This supports the first hypothesis that for all EM indices there is a diversification potential.

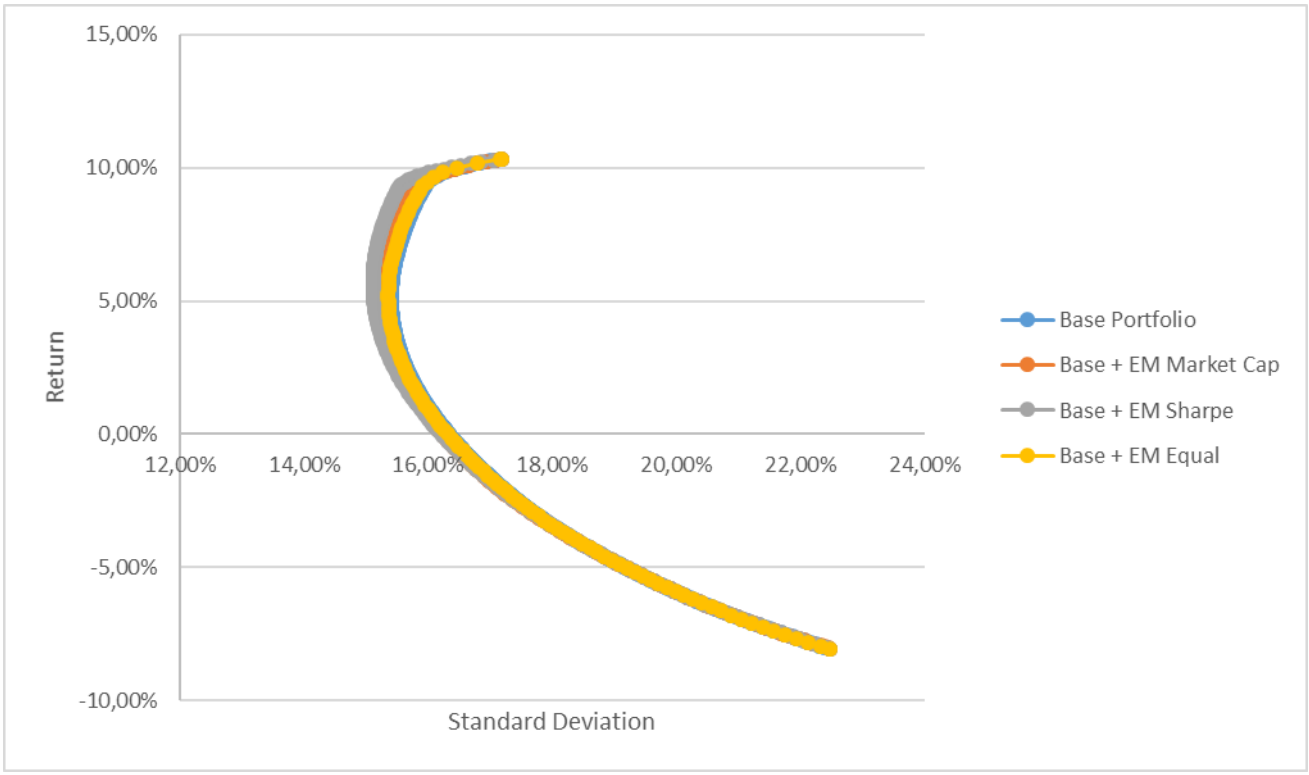

FIGURE 8-COMBINED EFFICIENCY FRONTIERS FULL PERIOD

4.2.1. BASE + EM MARKET CAP

When looking at the simulated portfolios shown in figure 9, it becomes clear that the estimation error is quite evident as all of the simulated portfolios are left of the efficiency frontier created by the MVA. The dispersion of the portfolios seems to be more to the left compared to the Base Portfolio thus offering lower standard deviations given the return. When looking at the weights of the EM index in the simulated portfolios shown in figure 10, it is clear that for the optimal portfolios simulated the EM index plays a fairly big part ranging up to about 0.66 with a mean of about 0.21 contribution of the EM index. This also shows evidence for the first hypothesis as the optimal portfolios include the EM index.

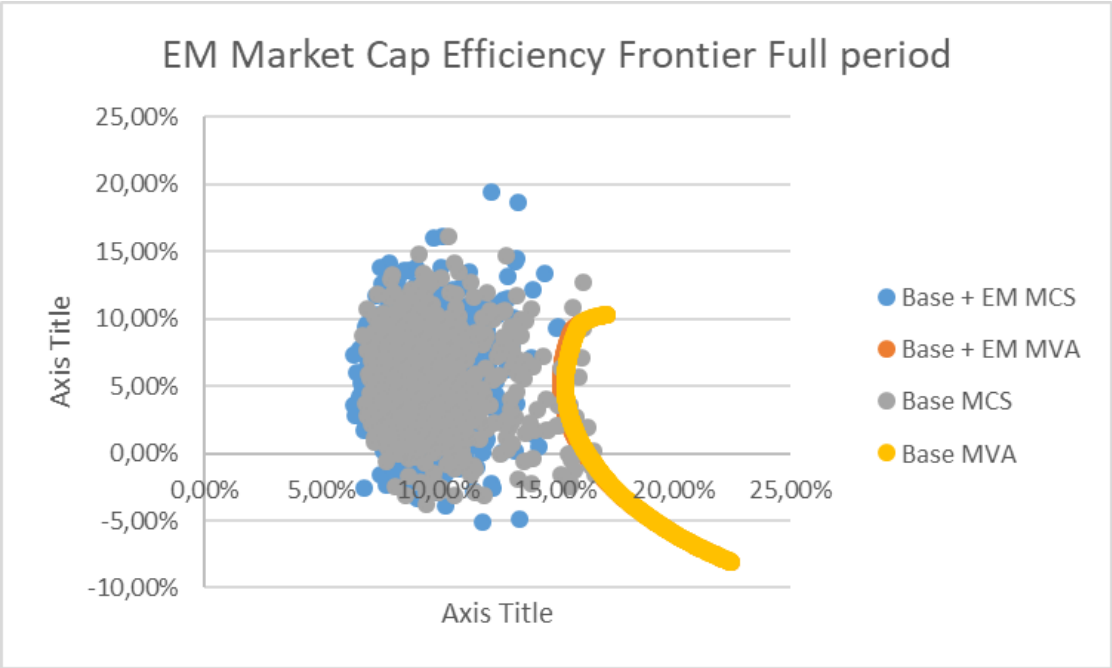

FIGURE 9- EM MARKET CAP EFFICIENCY FRONTIER FULL PERIOD

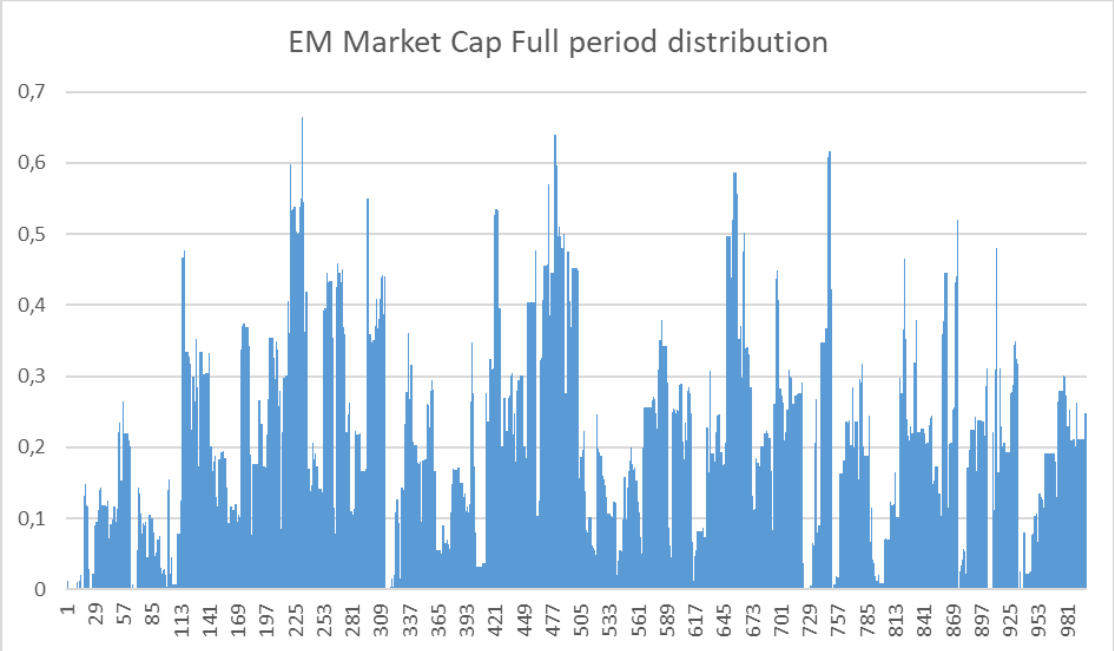

FIGURE 10-EM MARKET CAP FULL PERIOD DISTRIBUTION

The performance ratios are shown in Appendix A for the Value at Risk, the Expected Shortfall at their corresponding confidence intervals and the semivariance. The VaR is higher for the EM index compared to the Base Portfolio, but the ES is clearly much lower. This indicates that the losses are higher for the EM portfolio at the 90% and 95% confidence interval, but when the losses occur the average losses are much lower when compared to the Base Portfolio. The SV is slightly higher for the Base + EM Market Cap portfolio but does not differ much for the Base

Portfolio. This supports the second hypothesis that the performance ratios are better when adding an EM index.

4.2.2. BASE + EM SHARPE

When looking at the simulated portfolios shown in figure 11 all of the simulated portfolios are left of the efficiency frontier created by the MVA. Similar to the Base + EM Market Cap portfolios the Base + EM Sharpe distribute slightly more to the left and up, indicating a better risk-to-reward ratio. When looking at the weights of the EM index in the simulated portfolios shown in figure 12, it is clear that for the optimal portfolios simulated the EM index plays a fairly big part ranging up to about 0.67 with a mean of about 0.24 contribution of the EM index. Both numbers are slightly higher than the EM Market Cap index, showing the EM Sharpe index has a slight edge. This also shows evidence for the first hypothesis as the optimal portfolios include the EM index.

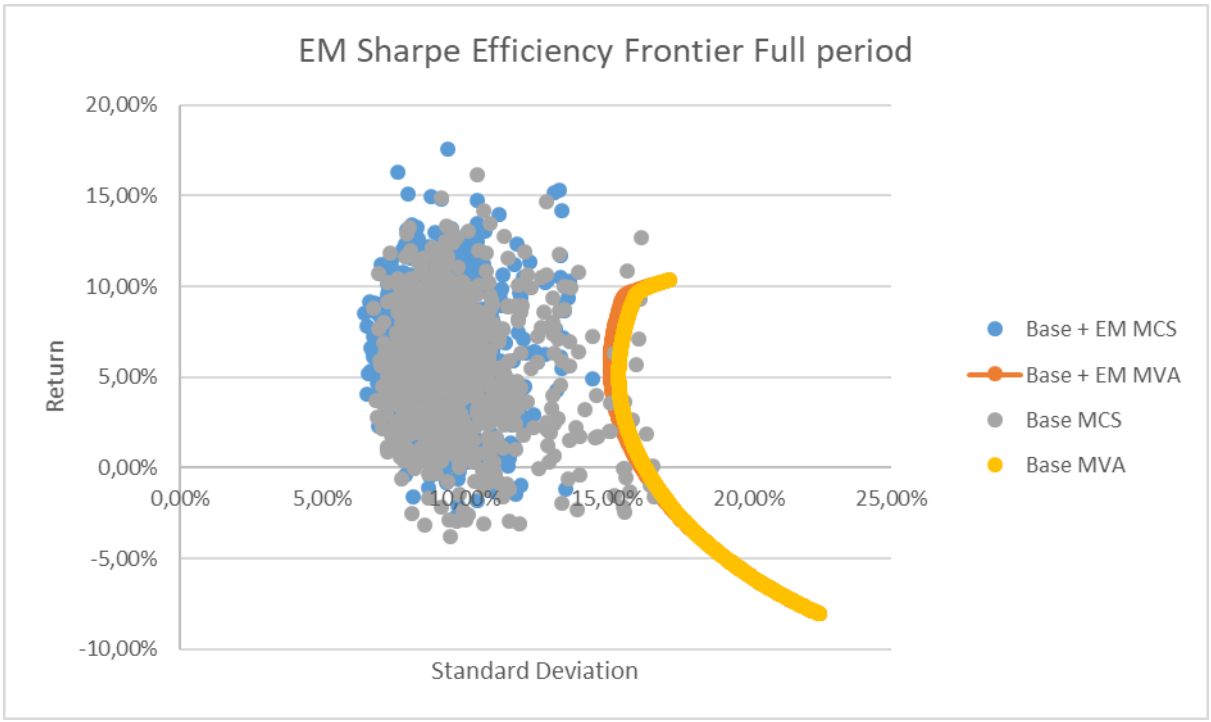

FIGURE 11-EM SHARPE EFFICIENCY FRONTIER FULL PERIOD

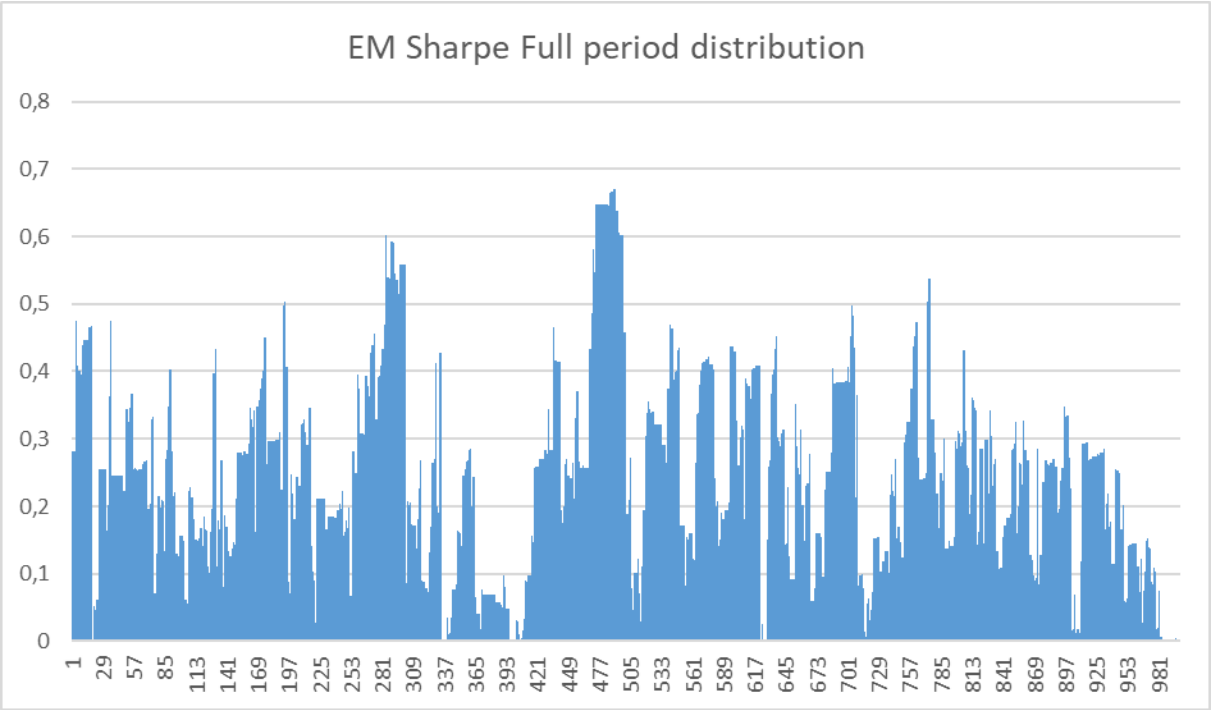

FIGURE 12-EM SHARPE CAP FULL PERIOD DISTRIBUTION

The performance ratios are shown in Appendix A. The VaR is higher for the EM index compared to the Base Portfolio, but for the 90% and 95% confidence intervals the ES is clearly much lower. Thus the losses are higher for the EM portfolio at all confidence intervals, but when the losses occur the average losses are much lower when compared to the Base Portfolio. The SV has relatively decreased by a lot from 0.3054% to 0.2859%, indicating the downside risk to be much lower when including the EM Sharpe index to the Base Portfolio. This supports the second hypothesis that the performance ratios are better when adding an EM index.

4.2.3. BASE + EM EQUAL WEIGHTS

The last simulations performed for the full period is the Base + EM Equal Weights portfolio shown in figure 13. Similar to both the Base + EM Market Cap and Base + EM Sharpe portfolios the simulated portfolios are dispersed more leftward. Here it seems especially more evident that the efficiency frontier that can be made from the simulated portfolios is outperforming the Base Portfolio. This strengthens the findings of DeMiguel et al. (2009) confirming that when suboptimal weights are added superior returns can be achieved. Figure 14 shows the weights of the EM index in the optimal portfolios, whereas the EM index is clearly present albeit with a lower peak at 0.58 but still an average of 0.21. This also shows evidence for the first hypothesis as the optimal portfolios include the EM index.

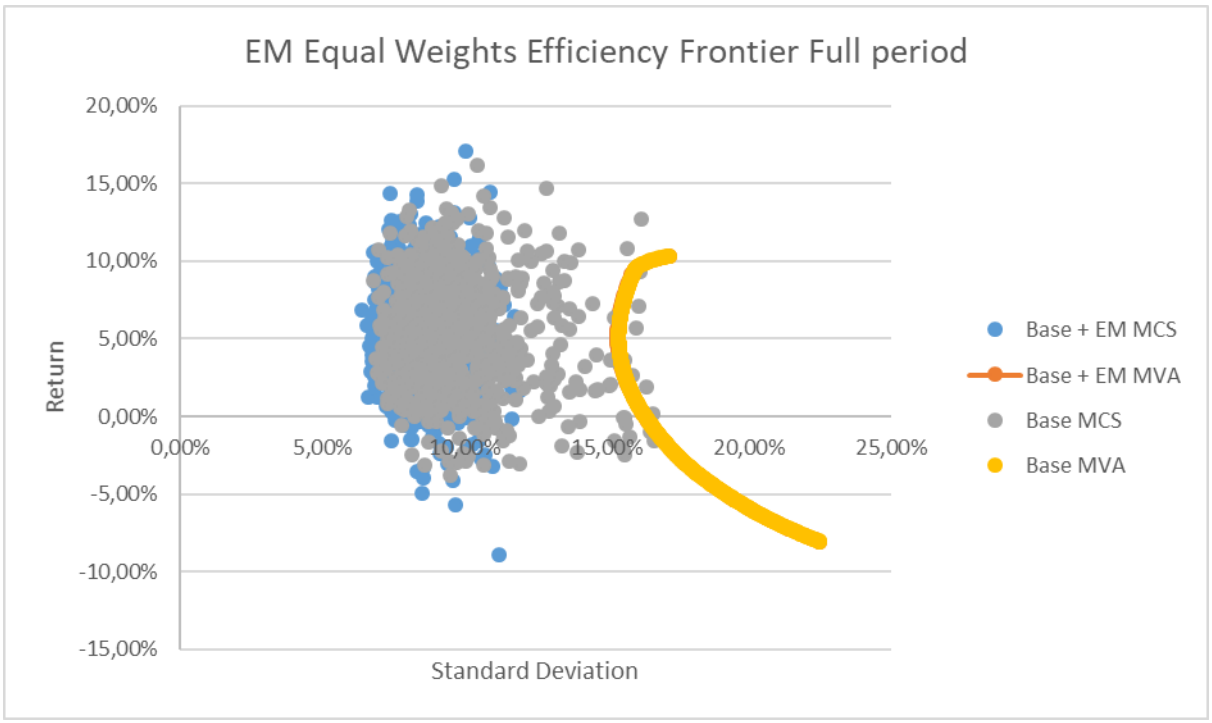

FIGURE 13-EM EQUAL WEIGHTS EFFICIENCY FRONTIER FULL PERIOD

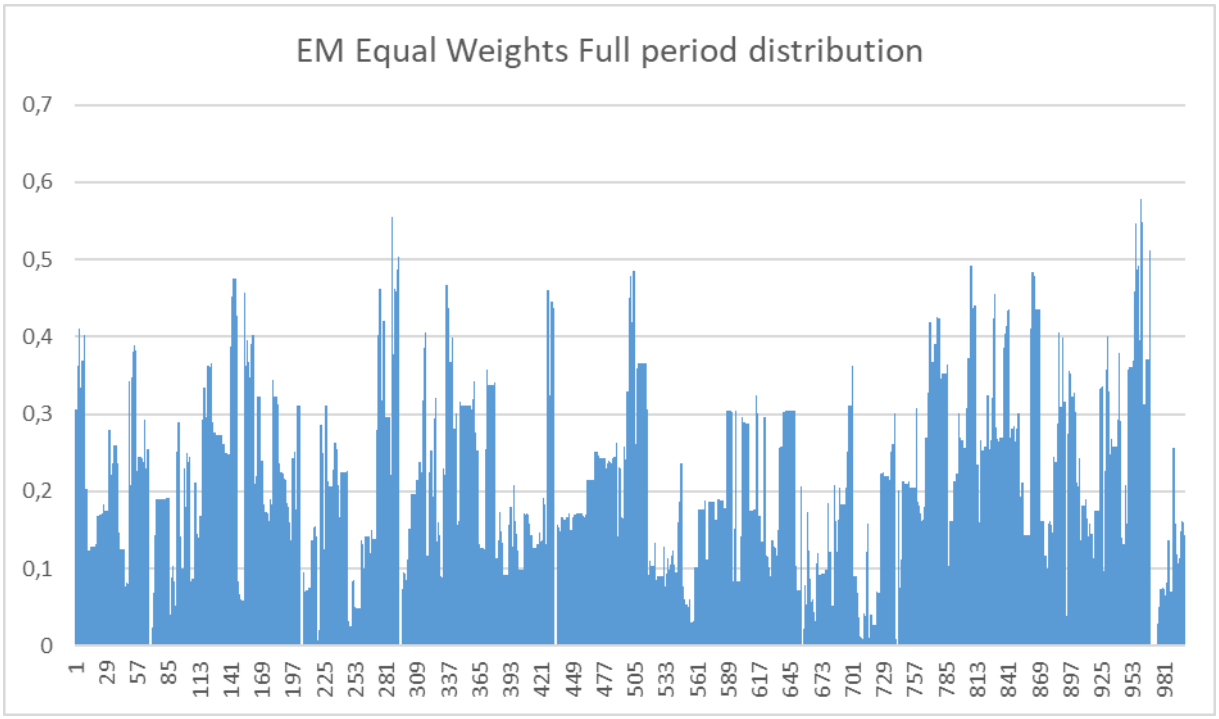

FIGURE 14-EM EQUAL WEIGHTS FULL PERIOD DISTRIBUTION

The performance ratios are shown in Appendix A. They follow the trend where the VaR is higher for the portfolio with the EM index, but except for the 90% confidence interval the ES is also higher for the EM Equal Weights index. The SV has remained nearly equal with a difference of 0.0007%. These results do not support any of the hypotheses.

4.2.4. GENERAL PERIOD

In general the findings support the hypotheses for the full period. The EM index is present in pretty much all generated portfolios averaging from 21% to 24%. Therefore these findings support the first hypothesis heavily. The performance ratios were about equal but slightly favoring the portfolios with EM indices, especially the addition of the EM Sharpe index to the Base Portfolio resulted in much better performance ratios thus supporting the second hypothesis.

4.3. RECESSION PERIOD

When looking at the combined efficiency frontiers created with the MVA shown in figure 15, the base portfolio is not visible. This is because the efficiency frontiers of the Base Portfolio, the Base + Sharpe and the Base + Equal Weights are exactly equal. The portfolio with the Market Cap seems to be better than the Base portfolio for the lower (return) spectrum of the efficiency frontier. The higher (return) spectrum the frontiers cross each other and the Base + Market Cap portfolio is inferior to the others. These findings do not provide much evidence for the first hypothesis that EM indices provide diversification potential.

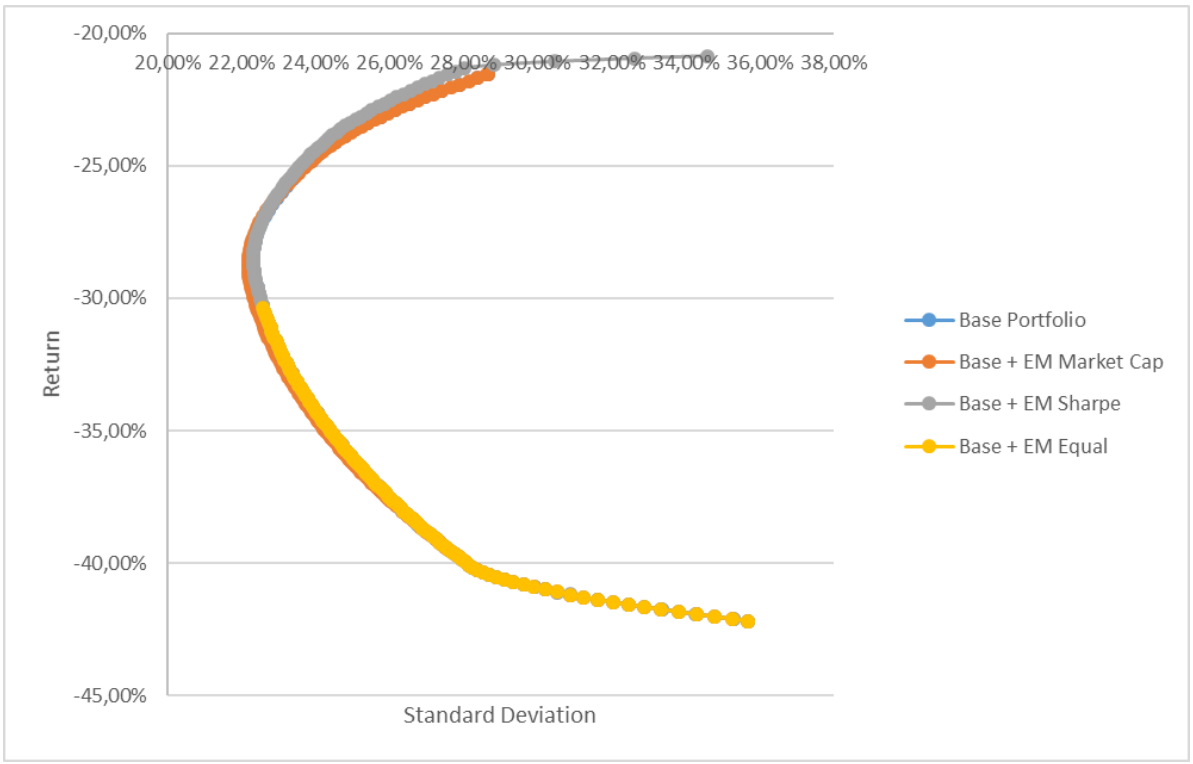

FIGURE 15-COMBINED EFFICIENCY FRONTIERS BEAR PERIOD

4.3.1. BASE + EM MARKET CAP

The simulated portfolios in figure 16 show mixed results, as for the Base Portfolio MCS is dispersed quite significantly to the left, whereas the Base + EM Market Cap are dispersed more

upward. Thus for a given return the standard deviation of the Base Portfolio can be lower. However for a given standard deviation, the Base + EM Market Cap can have a higher return. Therefore the figure gives mixed results, implicating that to obtain a higher or even positive return during times of turmoil one must take higher risks and invest in emerging markets. Figure 17 shows that the EM index is always used with a minimum weight of 0.19 and also the average weight (0.40) for the EM index is rather high compared to the full period overview. but this is paired with a lower peak attribution of 0.54. In 3.3% of cases of the Base + EM Market Cap the return was higher than −0.10%, whereas for the Base Portfolio this was only 1.1%. As for positive returns in a bear market for the Base + EM Market Cap this was 3 times as frequent. All in all this does support the first hypothesis where EM do provide diversification possibilities. The third hypothesis is also supported by the higher amount of weight attributed to emerging markets and the fact that adding it to the portfolio increases the likeliness of obtaining positive returns.

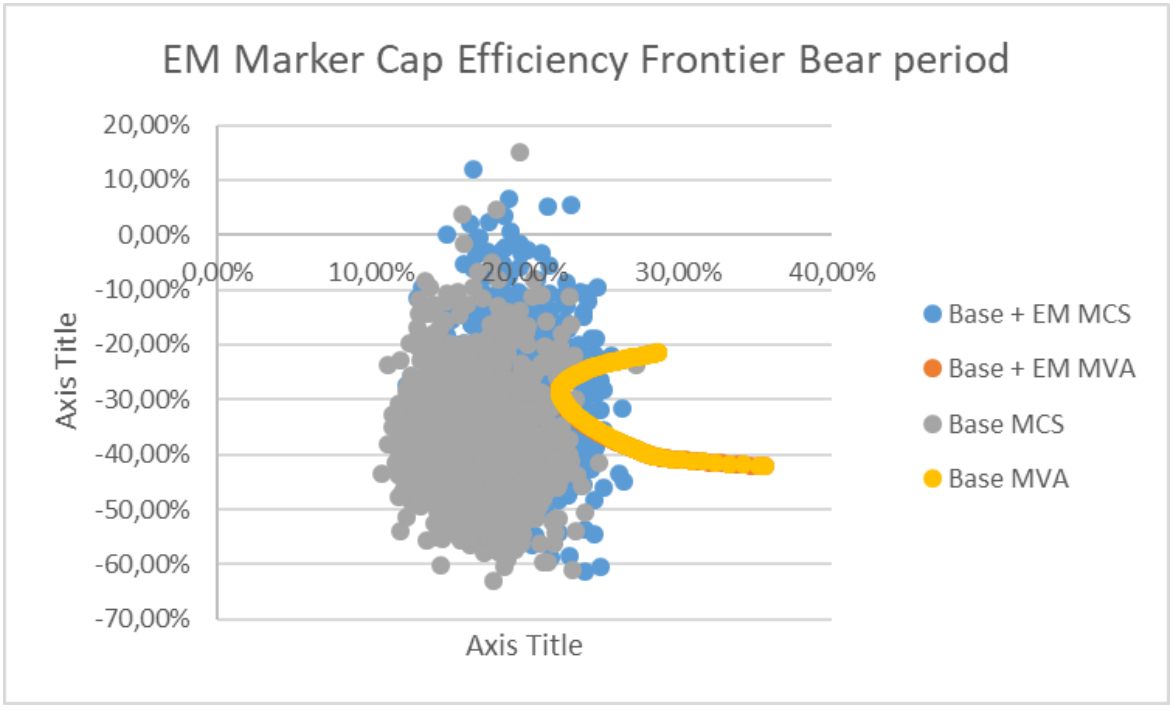

FIGURE 16-EM MARKET CAP EFFICIENCY FRONTIER BEAR PERIOD

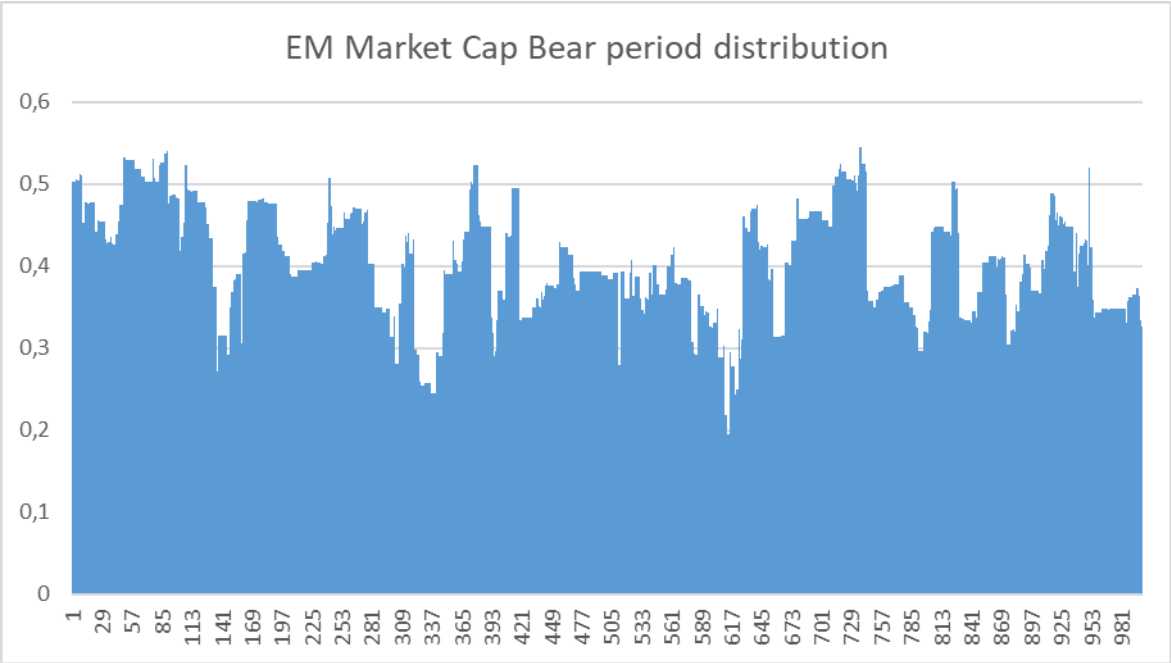

FIGURE 17-EM MARKET CAP BEAR PERIOD DISTRIBUTION

Appendix A shows the performance ratios where we see all values for the Base + EM Market Cap portfolio to be lower compared to the Base Portfolio. The SV did decrease but does not differ much from the Base Portfolio thus proves no support for any hypothesis. These finding support the second hypothesis strongly.

Table 7 shows the correlation coefficients of the EM Market Cap index for the different time periods. Expected was that the correlation between the EM index became lower during times of turmoil. This holds for the S&P 500, the World Index, Real Estate and the Commodities. Europe and Japan however see their correlation increase with the EM Market Cap index. For Japan this could be because of its geographical region close to the selected emerging markets indices. Therefore this does not fully support the safe haven hypothesis.

Market Cap	Bear	Full	Bull
EM Index	1	1	1
S&P Euro 350	0,57144	0,49795	0,45856
EuroMid	0,53107	0,51773	0,50422
Europe Small	0,54815	0,53110	0,51458
London	0,58452	0,56893	0,55426
S&P 500	0,42402	0,49924	0,52426
Japan 225	0,57750	0,48550	0,44418
World index	0,58468	0,59364	0,58995
Real Estate	0,54435	0,57328	0,58980
Commodities	0,26162	0,36490	0,40319

TABLE 7- CORRELATION COEFFICIENTS EM MARKET CAP

4.3.2. BASE + EM SHARPE

The Base + EM Sharpe simulated portfolios seem to be inferior to the Base Portfolio. Shown in figure 18 the Base Portfolio has distributed more to the left than the Base + EM Sharpe portfolio. Figure 19 does show that the Base + EM Sharpe portfolio use the EM index often, albeit less often than the EM Market Cap index, with an average of 0.38 and the minimum being 0.17. These findings do not fully support the first hypothesis as the EM index is used frequently but does not result in better results.

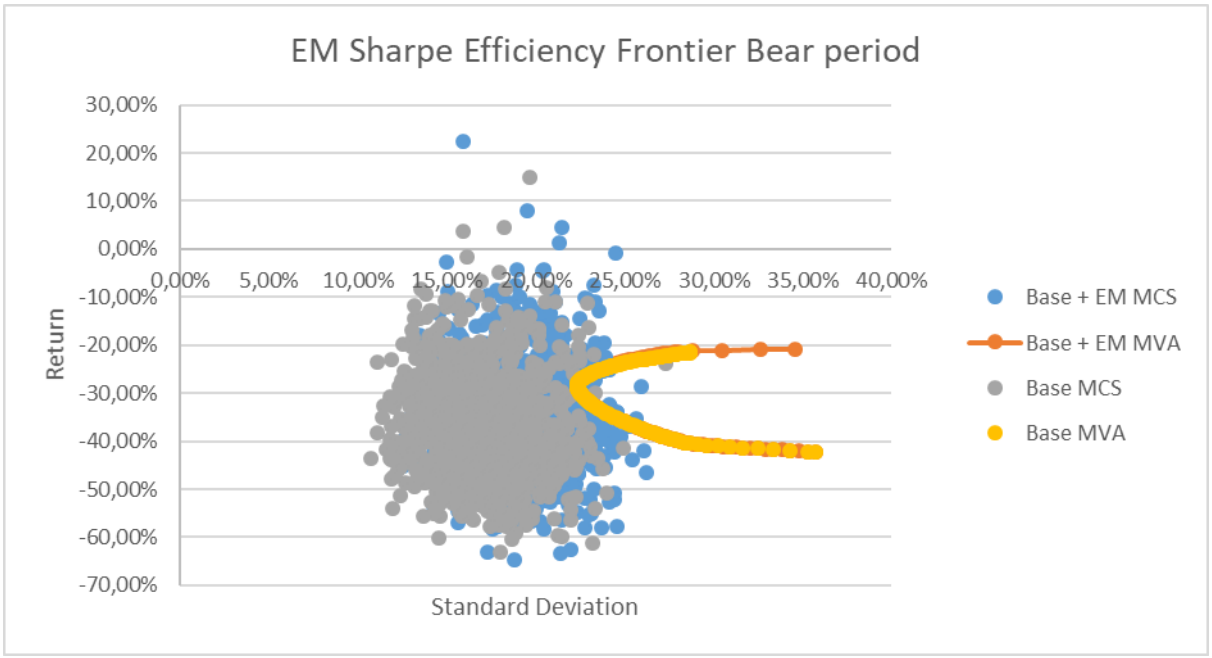

FIGURE 18-EM SHARPE EFFICIENCY FRONTIER BEAR PERIOD

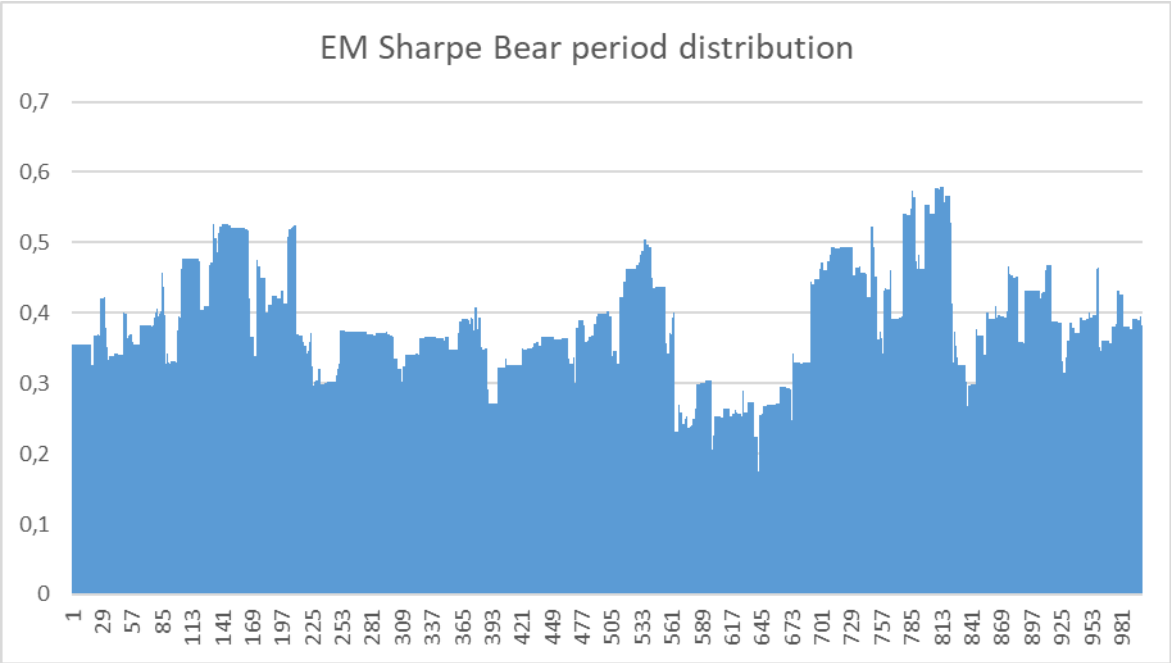

FIGURE 19-EM SHARPE CAP BEAR PERIOD DISTRIBUTION

The performance ratios in Appendix A also show support as the values for the Base + EM Sharpe portfolio are better, except for the 99% confidence interval. The SV did decrease but does not differ much from the Base Portfolio thus proves no support for any hypothesis.

Table 8 shows the correlation coefficients for the EM Sharpe index and they give the opposite results of what was expected. During the bear period the correlation coefficients are in general higher than those during the full period. For the bull period however it shows that the correlation coefficients are close to 0 for all assets. This does not support the safe haven hypothesis.

Sharpe	Bear	Full	Bull
EM Index	1	1	1
S&P Euro 350	0,63495	0,47289	0,01027
EuroMid	0,64967	0,51517	0,00838
Europe Small	0,66157	0,53639	-0,00146
London	0,64145	0,56021	0,00206
S&P 500	0,45022	0,51597	-0,01465
Japan 225	0,65204	0,57847	-0,01552
World index	0,63750	0,61125	-0,00532
Real Estate	0,60904	0,60891	-0,03152
Commodities	0,40132	0,38531	0,03549

TABLE 8-CORRELATION COEFFICIENTS EM SHARPE

4.3.3. BASE + EM EQUAL WEIGHTS

Similar to the previous two EM index portfolios the Base + EM Equal Weights simulation as displayed in figure 20 gives an inferior efficiency frontier to the Base Portfolio. The trend is similar

but the Base Portfolio is slightly more to the left than the Base + EM Equal Weights. Again the EM index is heavily used with an average weight of 0.42 peaking at 0.60 . Nevertheless the performance ratios are better for the Base + EM Equal Weight except for the ES 99% confidence interval, where the Base Portfolio is only the slightest lower. The SV did decrease but does not differ much from the Base Portfolio thus proves no support for any hypothesis. The correlation coefficients do not decrease during bear periods, except for the S&P 500, Real Estate and Commodities. The other coefficients increase or remain equal.

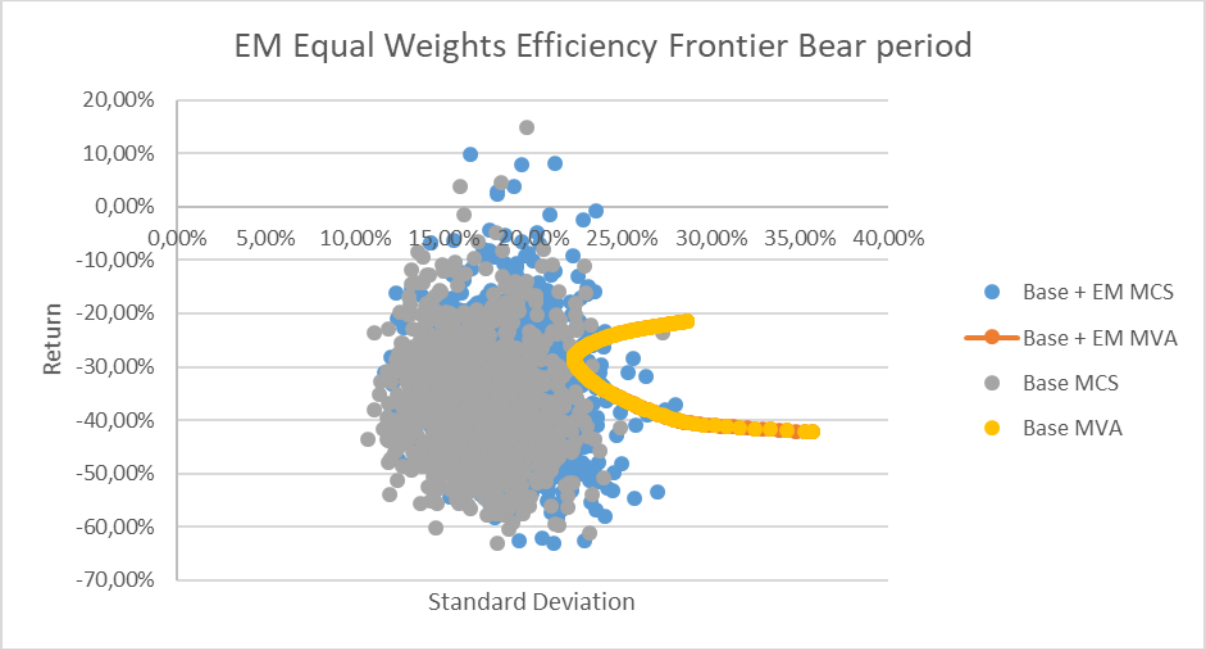

FIGURE 20-EM EQUAL WEIGHTS EFFICIENCY FRONTIER BEAR PERIOD

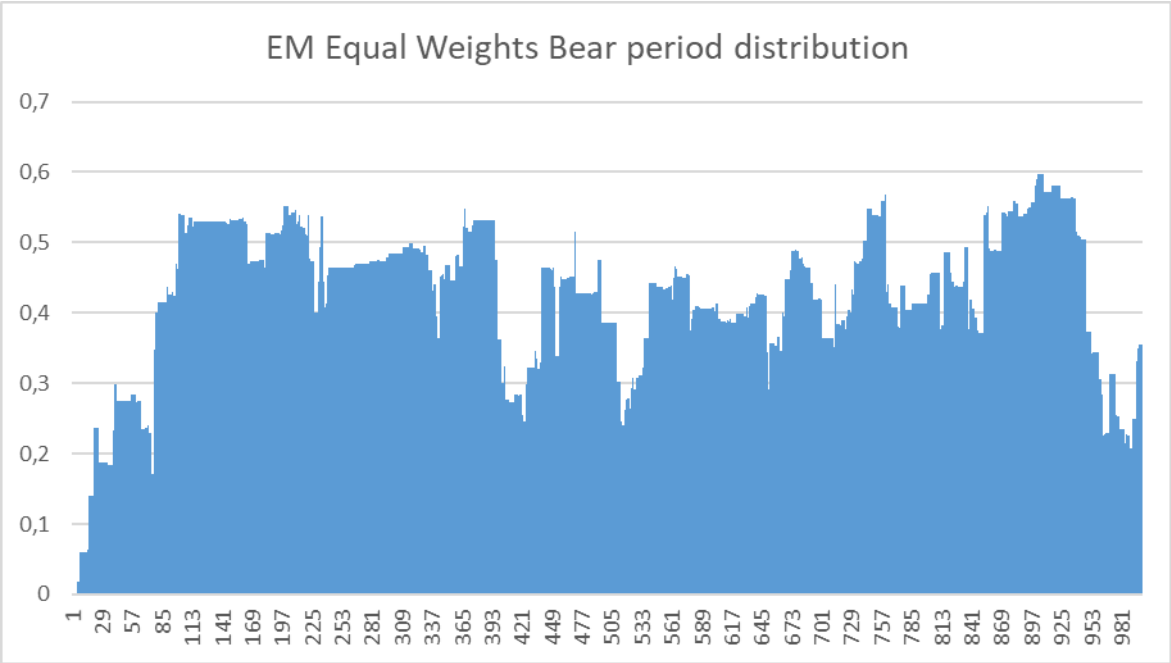

FIGURE 21-EM EQUAL WEIGHTS BEAR PERIOD DISTRIBUTION

Equal Weights	Bear	Full	Bull
EM Index	1	1	1
S&P Euro 350	0,76302	0,65159	0,59229
EuroMid	0,74481	0,69656	0,65897
Europe Small	0,77114	0,71100	0,66860
London	0,75003	0,72244	0,70027
S&P 500	0,51423	0,60555	0,64723
Japan 225	0,72239	0,61637	0,56871
World index	0,74002	0,74303	0,74062
Real Estate	0,73803	0,74611	0,74495
Commodities	0,36970	0,44076	0,47131

TABLE 9- CORRELATION COEFFICIENTS EM EQUAL WEIGHTS

4.3.4. RECESSION PERIOD

The results support the first hypothesis that emerging markets can provide diversification potential in a Europe based global portfolio. The SV did not differ much for any of the portfolios, but including the EM indices to the Base Portfolio in general decreased the VaR and ES. Therefore the addition of emerging markets during bear period does generate better performance. The third hypothesis can neither be accepted nor rejected as the emerging markets did appear to have safe haven properties during times of turmoil, but this did not result in better portfolios.

4.4. EXPANSION PERIOD

When looking at the combined efficiency frontiers created with the MVA shown in figure 22, the base portfolio is barely visible. When zooming in on the graph as shown in figure 23, it becomes visible the Base portfolio is the rightmost efficiency frontier. Similar to the full period overview, this provides evidence for the first hypothesis that EM indices provide diversification potential. Especially for the Base + Sharpe where the return and standard deviation peak much higher than the other portfolios.

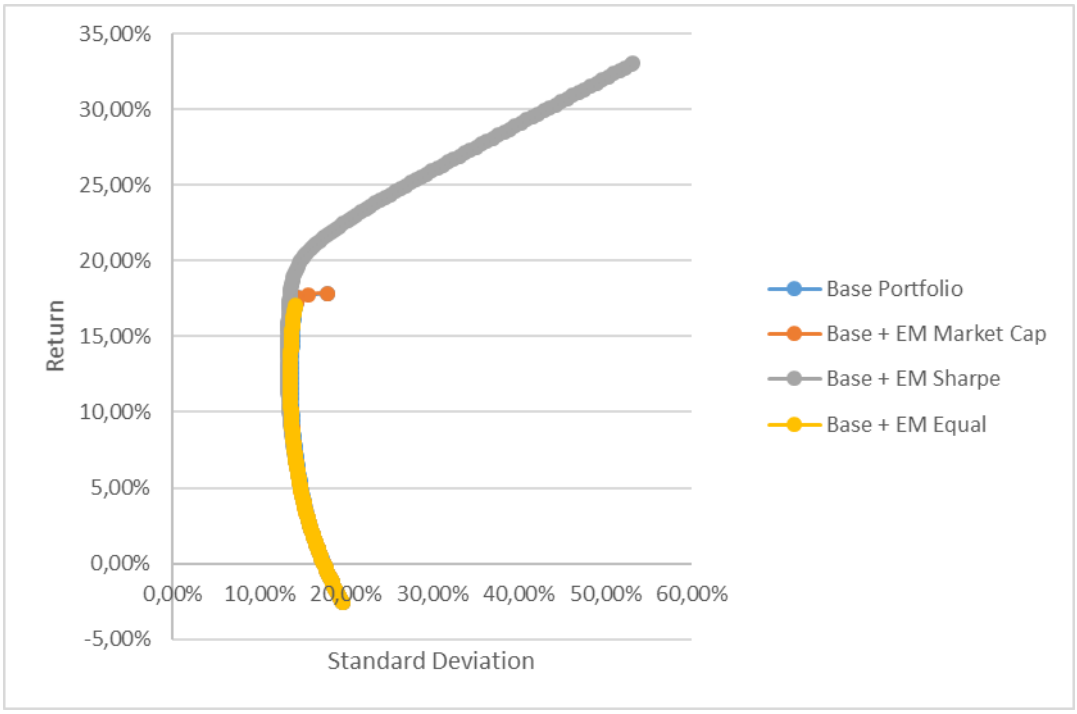

FIGURE 22-COMBINED EFFICIENCY FRONTIERS BULL PERIOD

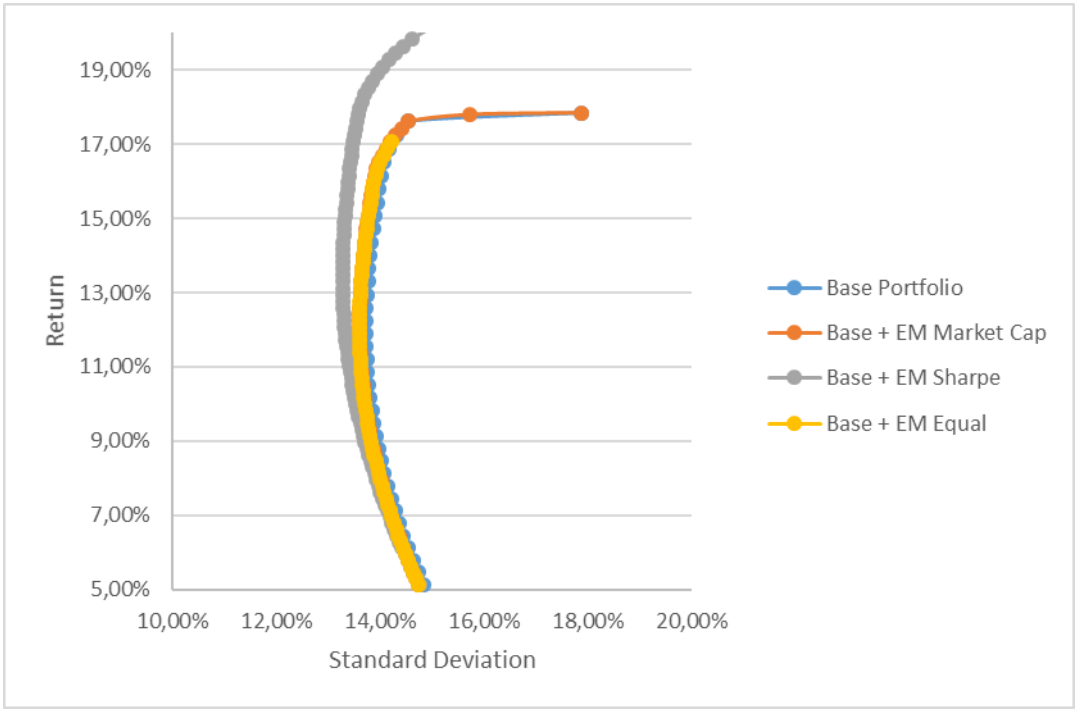

FIGURE 23-COMBINED EFFICIENCY FRONTIERS BULL PERIOD ZOOM

4.4.1. BASE + EM MARKET CAP

The simulated portfolios shown in figure 24 of the Base + EM Market Cap are distributed slightly to the left of the Base Portfolio indicating that for a bull period the inclusion of a EM Market Cap index offers better risk-to-reward. The EM Market Cap index is used with an average weight of 0.17, peaking at a weight of 0.54 as shown in figure 25.

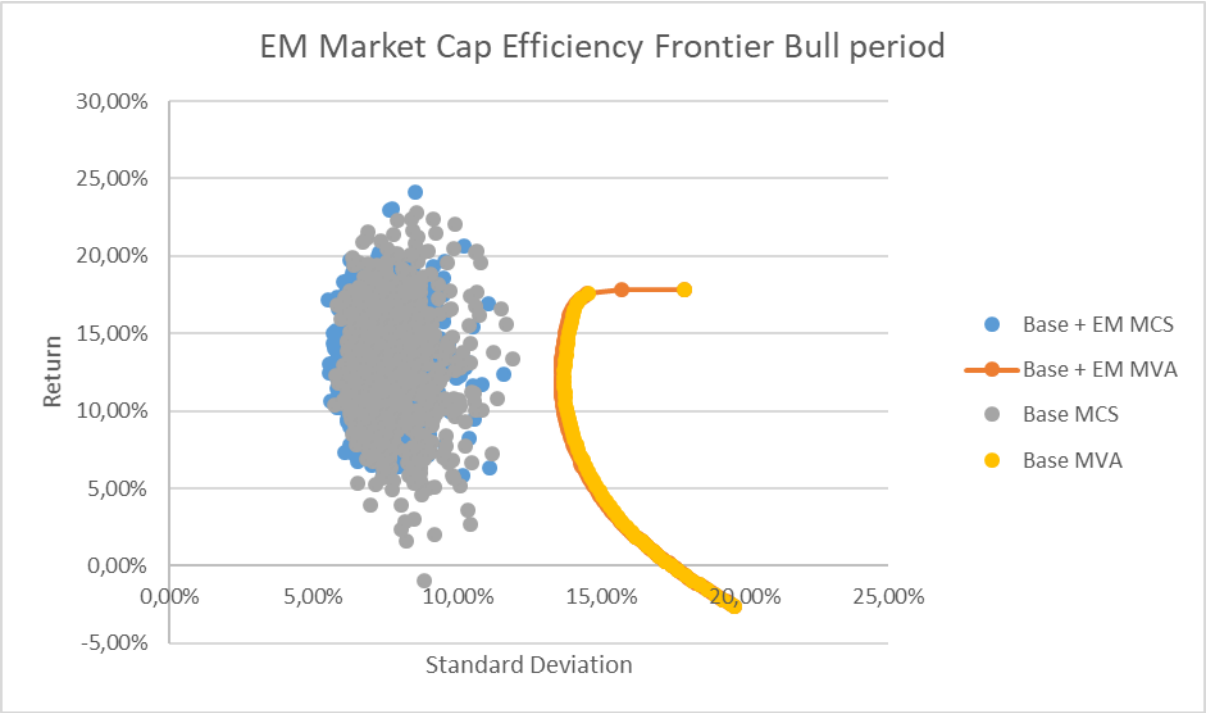

FIGURE 24-EM MARKET CAP EFFICIENCY FRONTIER BULL PERIOD

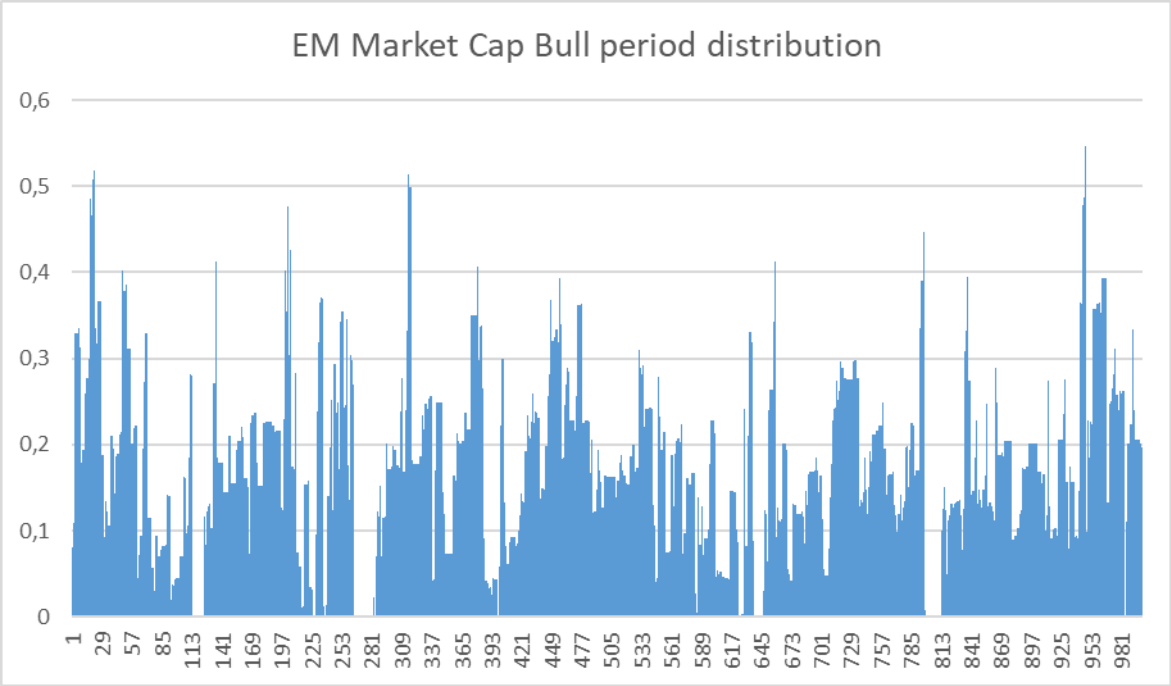

FIGURE 25-EM MARKET CAP BULL PERIOD DISTRIBUTION

The VaR and ES ratios in Appendix A are worse for all confidence intervals when including the EM Market Cap index in the portfolio. This indicates that the inclusion of the EM Market Cap index causes the portfolio in extreme cases to be riskier and does not support the second hypothesis. However, the SV did decrease from 0.3172% to 0.2507% indicating a decrease of the downside risk.

4.4.2. BASE + EM SHARPE

As seen in figure 26 the efficiency frontier of the Base + EM Sharpe portfolio is left of the Base Portfolio. This follows in the MCS where the simulated portfolios of Base + EM Sharpe are distributed left of the Base Portfolio, supporting the first hypothesis. The EM Sharpe index is again heavily used shown in figure 27 with an average weight of 0.21 peaking at 0.60.

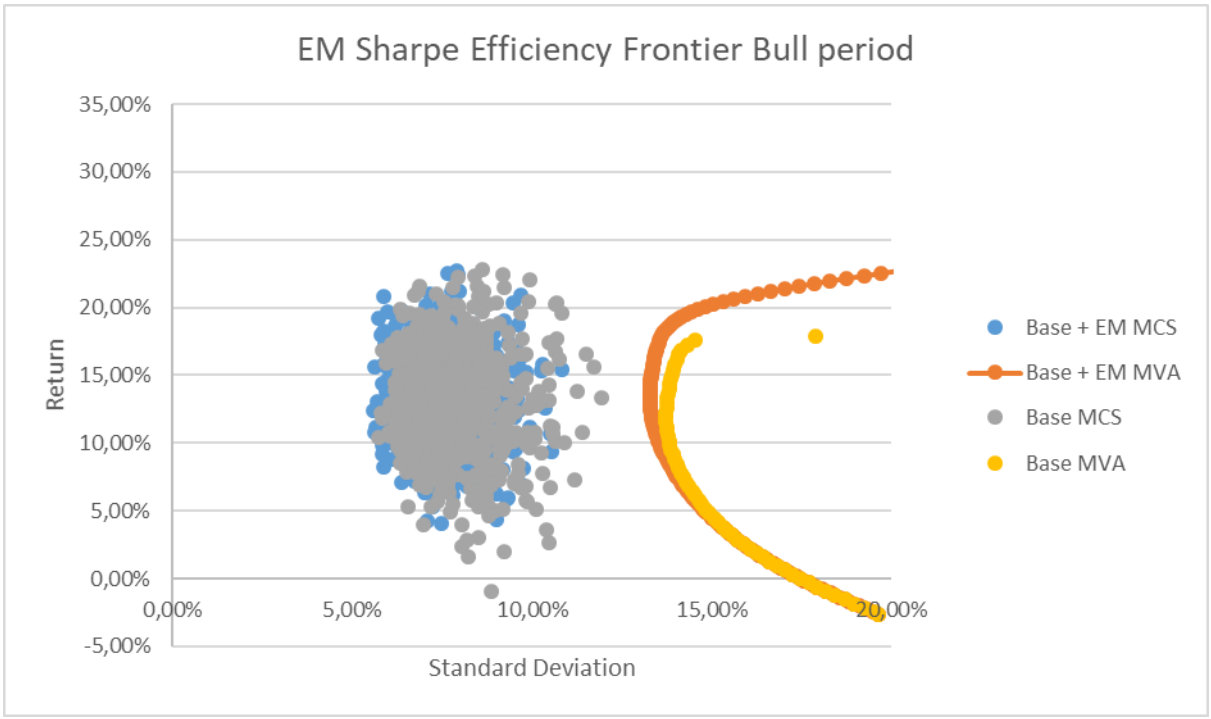

FIGURE 26-EM SHARPE EFFICIENCY FRONTIER BULL PERIOD

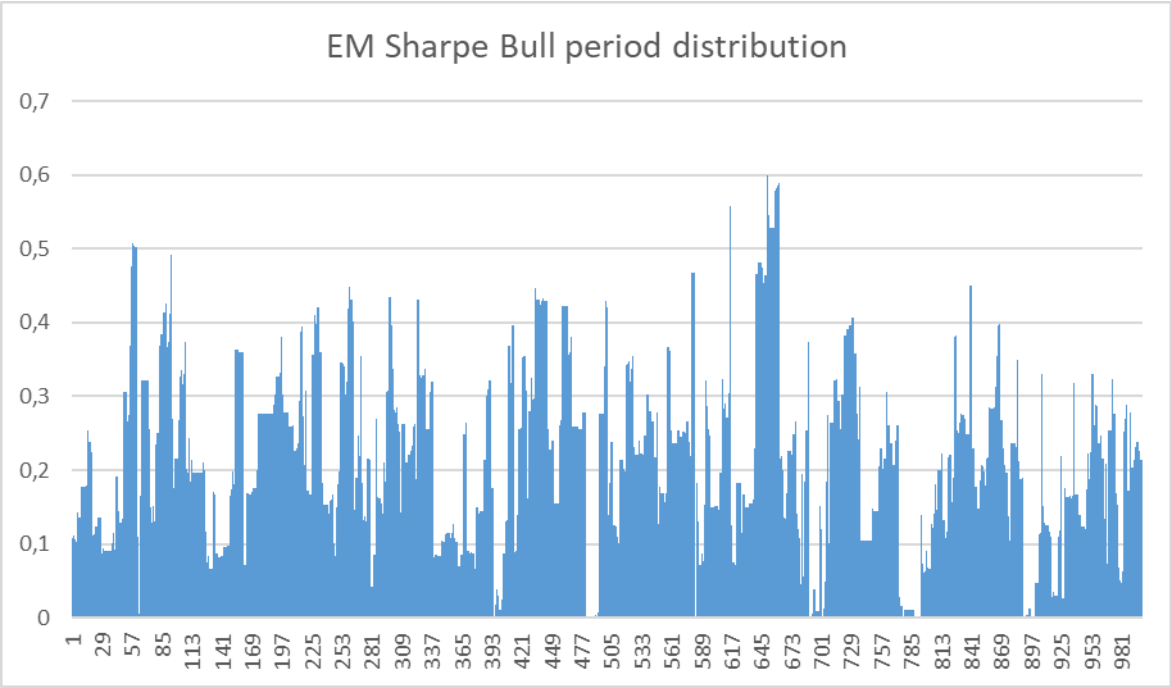

FIGURE 27-EM SHARPE CAP BULL PERIOD DISTRIBUTION

Similar to the Base + EM Market Cap portfolio the SV is much better for the Base + EM Sharpe portfolio, but the VaR and ES are slightly worse than the Base Portfolio for the bull period.

4.4.3. BASE + EM EQUAL WEIGHTS

Figure 28 shows that the Base + EM Equal Weights portfolio outperformed the Base Portfolio in the bull period. This goes for the MVA as well as the simulated portfolios through the MCS. The dispersion of the Base + EM Equal Weights is left of the Base Portfolio as well. The EM Equal Weights index can be accounted for on average 0.22 with a peak at 0.56 as weight as is seen in figure 29. This supports the first hypothesis concerning the diversification potential. The performance ratios of the Base + EM Equal Weights follow the same trend as the ratios did for the Base + EM Market Cap and Base + EM Sharpe.

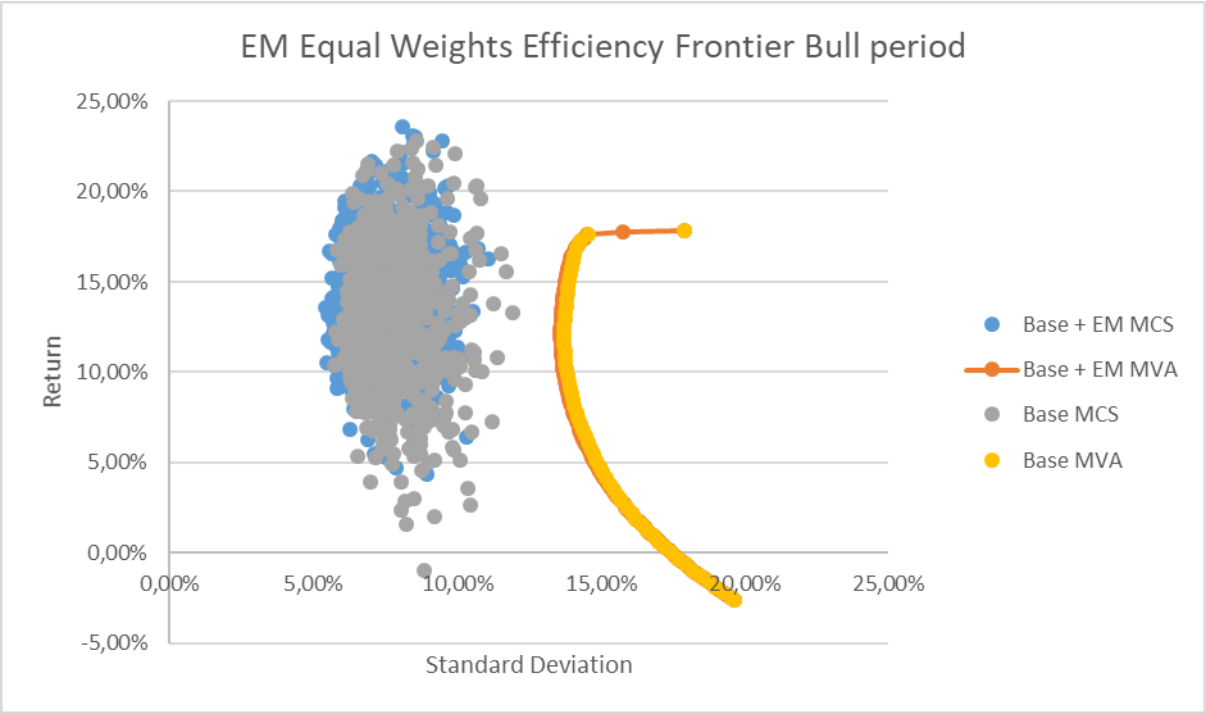

FIGURE 28-EM EQUAL WEIGHTS EFFICIENCY FRONTIER BULL PERIOD

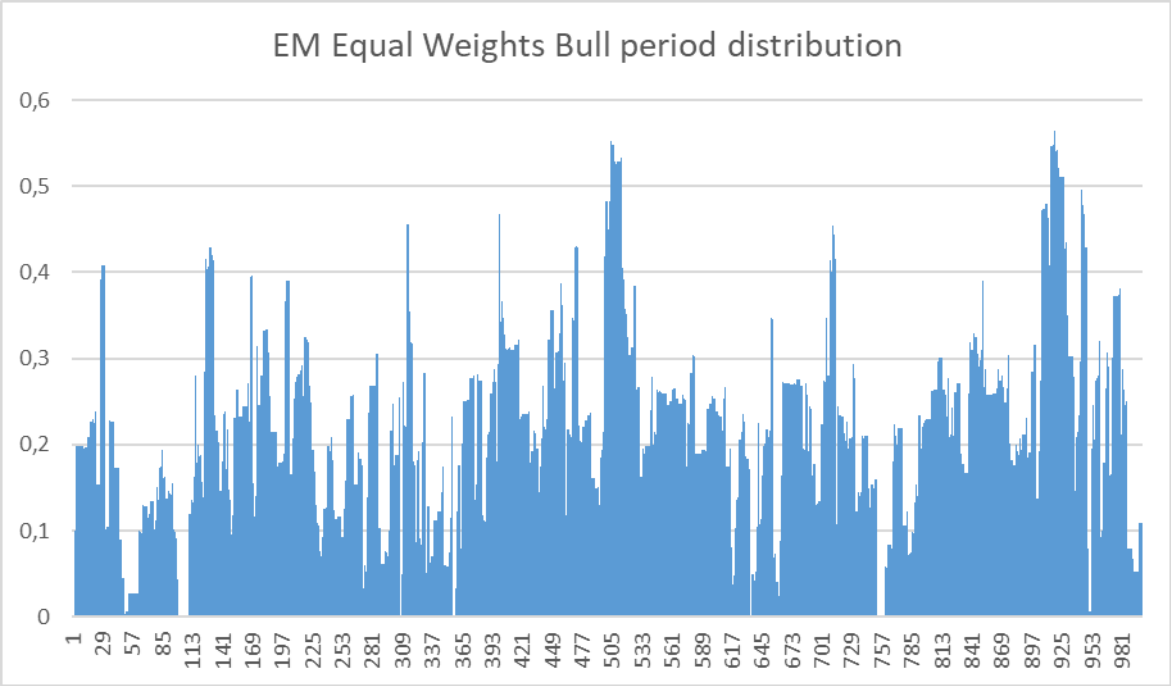

FIGURE 29-EM EQUAL WEIGHTS BULL PERIOD DISTRIBUTION

4.4.4. EXPANSION PERIOD

The findings for the bullish period support the first hypothesis. During the bullish period the diversification potential of the emerging markets has been clearly established. The indices are used frequently and resulting in a better risk-to-reward ratio. The downside risk does decrease during a bullish period, but the VaR and ES increase. This is shown by the performance ratios for

the different portfolios and indicates that in general the portfolios have a lower downside risk, but the losses are higher on average the higher the confidence intervals.

5. ROBUSTNESS CHECKS & DISCUSSION

As robustness check the indices and portfolios have been simulated with short selling as option. For two out of three EM indices this did not affect the outcomes, namely the EM Market Cap and EM Equal Weights. Both have a fixed weight and therefore when performing a MVA with short selling available the returns and standard deviations do not deviate from the regular MVA. For EM Sharpe this does make a big difference, as is visible in figures 30, 31 and 32. The full period, bear period and bull period had a return of 10.08%, 30.86% and 14.25% with a standard deviation of 20.62%, 108.98% and 16.87% respectively. For the regular MVA with the short selling constraint the corresponding returns were 5.45%, −20.85% and 13.75% with a standard deviation of 19.80%, 34.59% and 16.42% for the full period, bear period and bull period respectively. The full period sees its return double while the standard deviation falls slightly and the bull period has a slight increase of return with a slight decrease of standard deviation. The bear period however has a massive increase in return, resulting in a positive return instead of a negative return over the time period. This goes paired with a higher standard deviation. Theoretically this makes sense as short selling assets that are making losses, will result in profit in one's portfolio. Therefore being able to sell short in a bearish market will result in much better results.

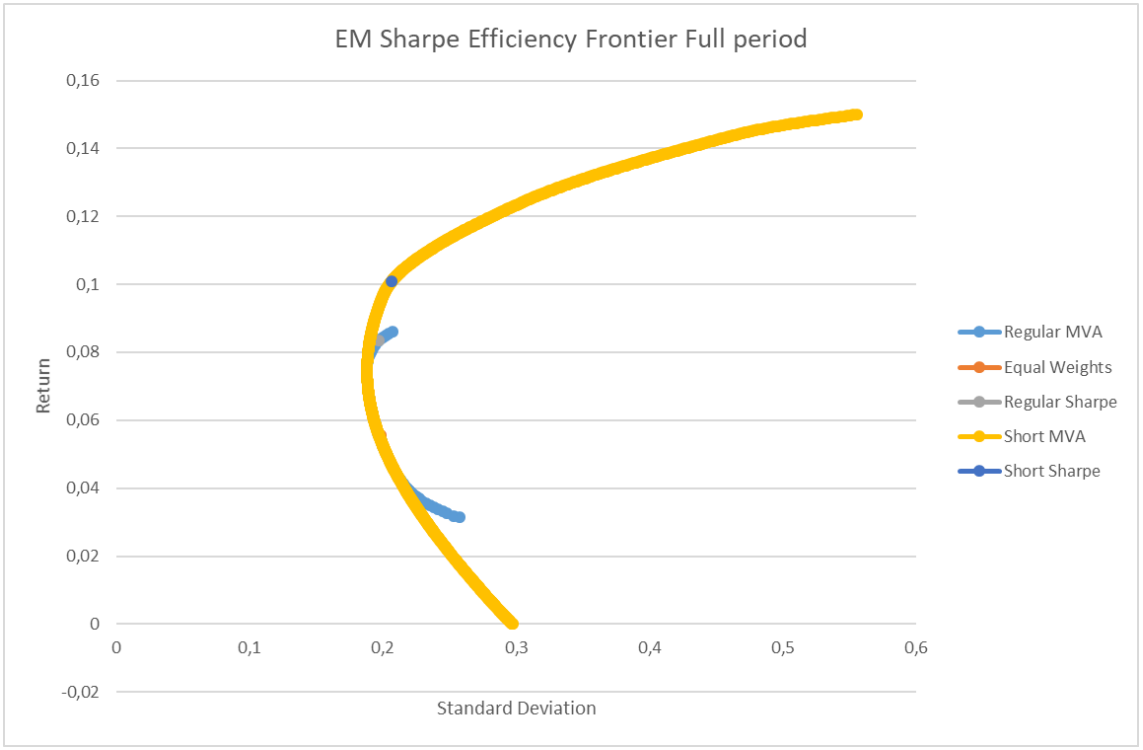

FIGURE 30-EM SHARPE EFFICIENCY FRONTIER FULL PERIOD

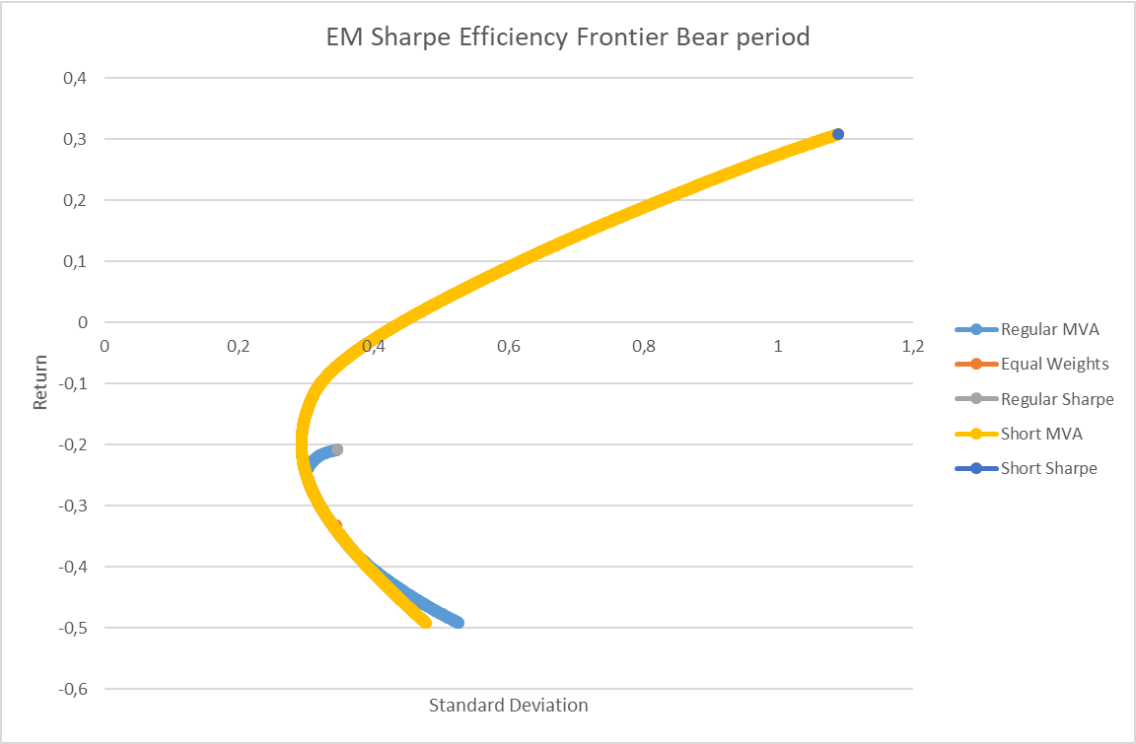

FIGURE 31- EM SHARPE EFFICIENCY FRONTIER BEAR PERIOD

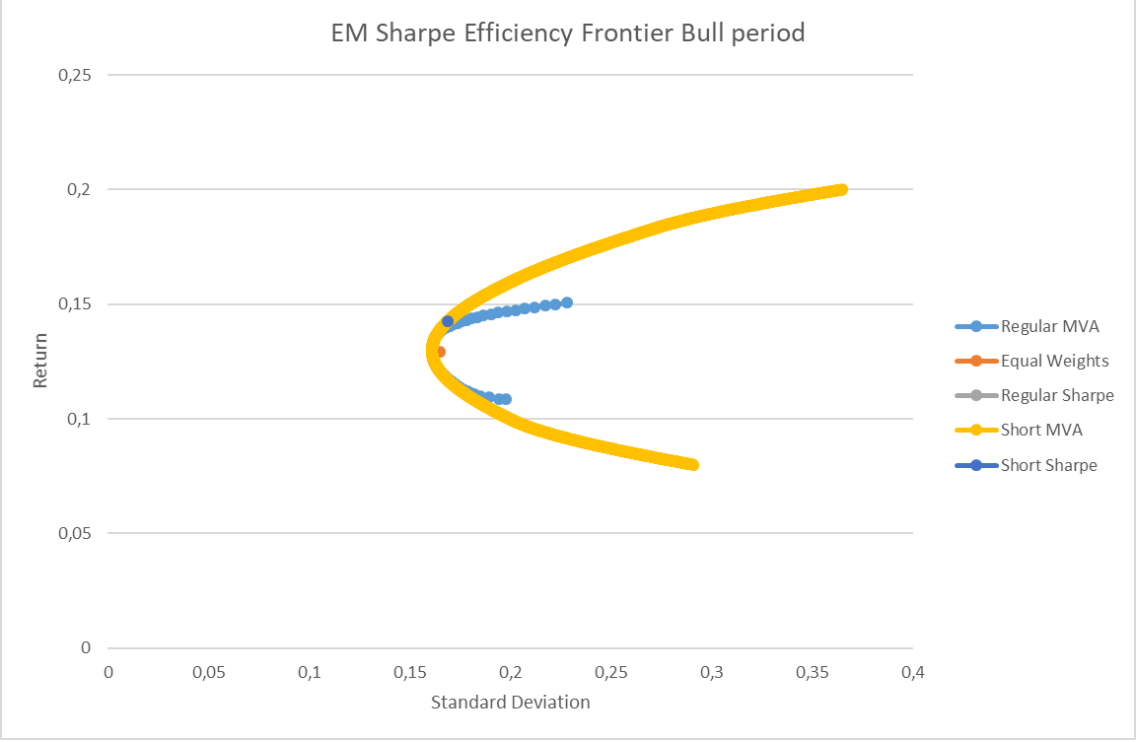

FIGURE 32- EM SHARPE EFFICIENCY FRONTIER BULL PERIOD

The simulated portfolios as shown in Appendix B show similar results to the regular MCS. This supports the estimation bias error found in the MVA, as the MCS does not differ much for the full period and bullish period. The bearish period however exploded and the diffusion is all over

the place. These 'explosions' of the MCS are also visible in every, with exception of the Base Portfolio bull period, other MCS performed with the short sale constrained lifted as can be seen in Appendix C. No explanation for these extreme results have been found, albeit that for the bear period it could have something to do with the Sharpe ratio.

As mentioned in the theoretical framework a negative Sharpe ratio could hugely impact the results of the portfolio selection process. Different theories exist about this subject, however theoretically this could still prove the results of the bear period to be incorrect. For it does not make sense that an index is included heavily to reduce risk only resulting in a lower risk-to-reward ratio. If including an EM index would result in an inferior portfolio, it should not be selected and the weight should correspondingly be 0. The VaR and ES also indicate that the portfolios should theoretically be better as their corresponding ratios are lower than the Base Portfolio. Therefore the results about the bear period can be biased by the Sharpe ratio.

This study relies heavily on Excel as main program for the analyses. Excel proves to not be able to compute many results in a quick way, resulting in a very time consuming process. Even though Visual Basic for Application (VBA) was used to program the documents to not have to perform manual simulations, a statistical program like SPSS or STATA could prove to add value. The amount of iterations per simulation still were 1.000, which should result in valid results.

It is common to cut off a certain amount of probability, for instance 5% of the generated portfolios (Jorion, 1992). This study was partly about the downside risk, therefore cutting of the lowest 5% of the generated portfolios would probably have impacted the results about downside risk heavily. Therefore the decision was made to not cut off an amount of the generated portfolios.

Data limitations should be taken into consideration when looking at the results of this study. Not all indices were available as return index, which has probably impacted the relations between the assets slightly. Also due to unforeseen reasons the bonds of Europe, the U.S. and Japan caused an error in the document making it incapable of calculating the results. Therefore the bonds have been left out of the study as a whole, except for the European bond which was used for calculation of the risk free rate. Within a well-diversified portfolio an investor normally uses bonds as well, future research could focus on the effect these bonds have in a European based global portfolio.

6. CONCLUSION

This study has focussed on the role of emerging markets in a European based global portfolio. Emerging markets has been defined and a selection of emerging markets countries has been made. According to theory and own results from the portfolio optimization process the traditional BRICS countries have been replaced by the TICKS in an EM index. Using historical data and a portfolio optimization process the benefits of the emerging markets have been visualised. According to theory it is unclear whether or not emerging markets could serve as an safe haven. To further explore this the full period has been divided in two sub time periods, one consisting of a bear market and the other of the bull market. To further elaborate on the role of emerging markets there were several indices created each with different characteristics. For both time periods, the full period and for every different EM index a mean variance analysis has been performed. To correct for estimation errors and further strengthen the findings the results from the MVA were used as input for a Monte Carlo Simulation.

The results of the MVA show that emerging markets perform well using historical data of a European based global portfolio. For all time frames and different indices for emerging markets this holds true in the MVA. The MCS however shows different results for the different time periods.

The emerging markets account on average between 21% and 24% for the full period and can therefore be considered dominant. The ES was lower for every 95% confidence interval, the other confidence intervals had mixed results for the different indices. The EM Sharpe index was by far superior in all performance ratios, especially SV, and the best possible index for emerging markets.

For the bear period emerging markets the weight contributed to the EM index was between 38% and 42%. Nevertheless the by MCS simulated results did not outperform the Base Portfolio, the performance ratios were better but the risk-to-reward ratio was lower. The best EM index to include in a portfolio is the EM Market Cap resulting in the best performance ratios. The third hypothesis however can neither be rejected nor accepted. The results were inconclusive in the sense that the amount invested into EM indices increased heavily during bear periods, but this did not cause the simulated optimal portfolios to outperform the Base Portfolio even though the performance ratios were better.

The bull period showed that emerging markets are used less on average than the other time periods (17% to 22%), but do contribute in better optimal portfolios. Especially the EM Sharpe index shows superiority to the Base Portfolio. The VaR and ES ratios however seem to increase, indicating that the downside risk increases as an EM index is added to a portfolio. The

SV on the other hand did decrease greatly, thus the downside risk on average is lower, but for the extreme cases it is higher.

In general these findings prove the diversification potential for emerging markets in a European based global portfolio. Looking at performance ratios during times of turmoil emerging markets can reduce the downside risk whereas they increase the downside risk during times of prosperity. This further supports the idea of emerging markets as safe haven, but the fact that this didn't result in better portfolios provides evidence against the idea of emerging markets as safe haven.

The role of emerging markets within a Europe based global market portfolio seems to be prevalent as a diversifier. This does differ in times of distress as does it in times of prosperity as does it over the period combined. The exact role during those different time frames is still uncertain and requires further research.

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APPENDIX

A. PERFORMANCE RATIOS

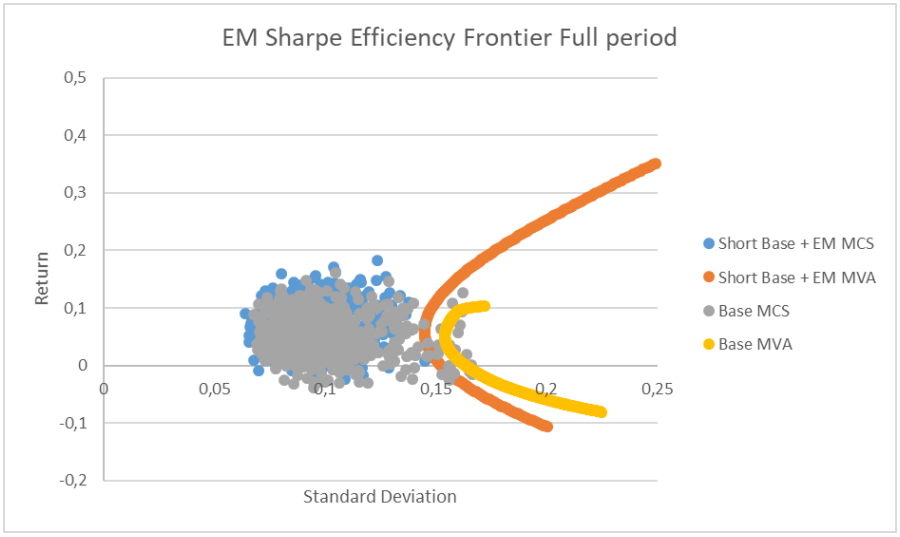
			Base Portfolio	Base + EM Market Cap	Base + EM Sharpe	Base + EM Equal Weights
Full period	VaR					
		90	0,0250%	0,0339%	0,0516%	0,0321%
		95	0,0025%	0,0095%	0,0257%	0,0060%
		99	-0,0505%	-0,0475%	-0,0201%	-0,0557%
	ES					
		90	-0,0062%	-0,0007%	0,0194%	-0,0052%
		95	-0,0269%	-0,0243%	-0,0006%	-0,0292%
		99	-0,0605%	-0,0670%	-0,0311%	-0,0891%
Bear	VaR					
		90	-1,3762%	-1,2314%	-1,2940%	-1,3165%
		95	-1,4984%	-1,3506%	-1,4299%	-1,4624%
		99	-1,6967%	-1,5845%	-1,7120%	-1,6612%
	ES					
		90	-1,5275%	-1,3876%	-1,4717%	-1,4831%
		95	-1,6264%	-1,4922%	-1,5918%	-1,5884%
		99	-1,8003%	-1,7129%	-1,8315%	-1,8063%
Bull	VaR					
		90	0,1697%	0,1927%	0,1865%	0,1899%
		95	0,1418%	0,1768%	0,1653%	0,1722%
		99	0,0777%	0,1340%	0,1227%	0,1242%
	ES					
		90	0,1313%	0,1690%	0,1593%	0,1648%
		95	0,1070%	0,1517%	0,1398%	0,1481%
		99	0,0493%	0,1240%	0,1056%	0,1089%

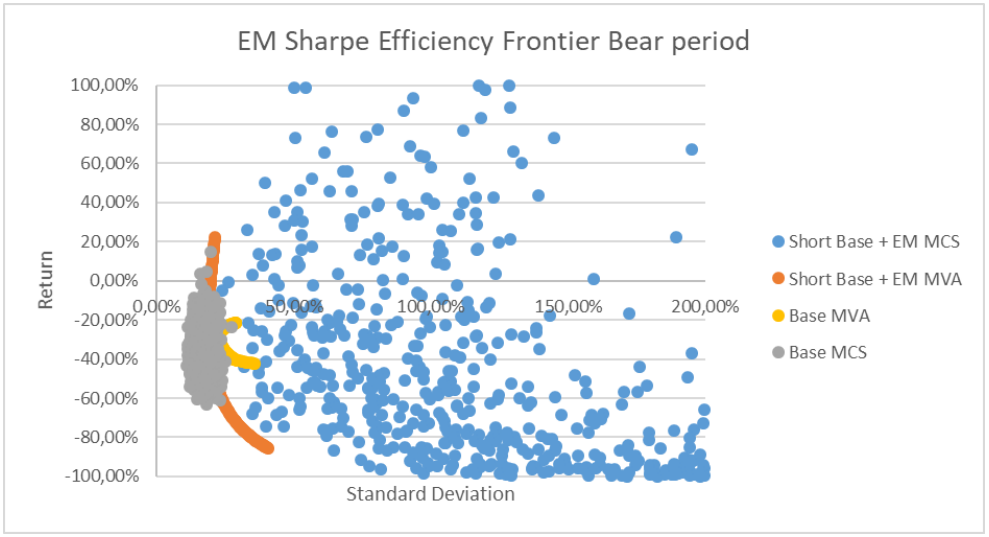
TABLE 10- VALUE AT RISK AND EXPECTED SHORTFALL RATIOS

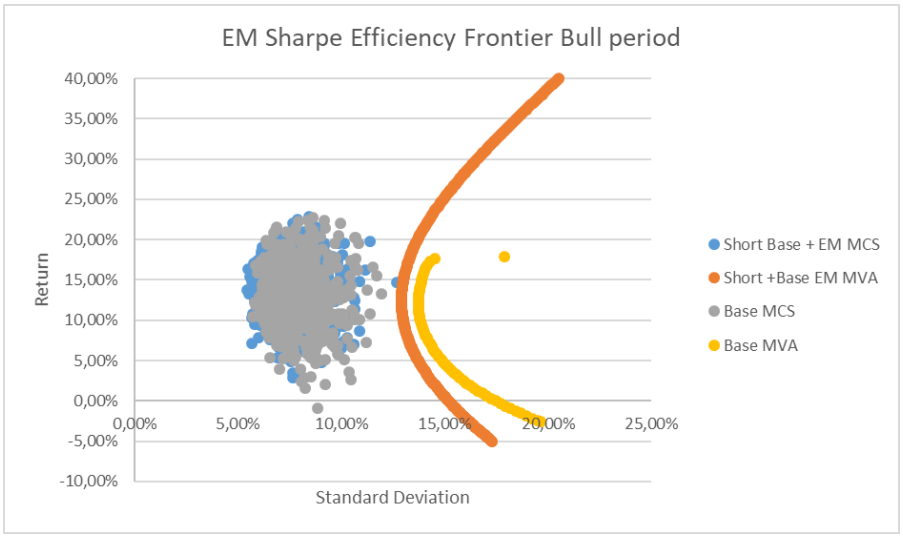
	Base Portfolio	Base + EM Market Cap	Base + EM Sharpe	Base + EM Equal Weights
Full period	0,3054%	0,3130%	0,2859%	0,3061%
Bear	1,6624%	1,6458%	1,6555%	1,6990%
Bull	0,3172%	0,2507%	0,2563%	0,2695%

TABLE 11- SEMIVARIANCE RATIOS

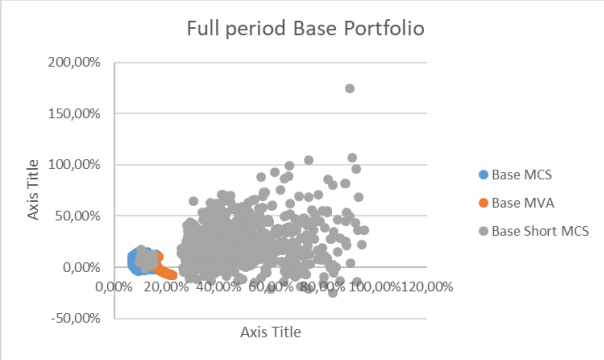
B. EM SHARPE SHORT MONTE CARLO SIMULATIONS

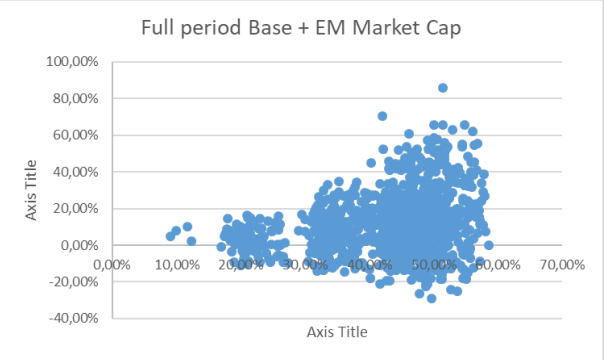


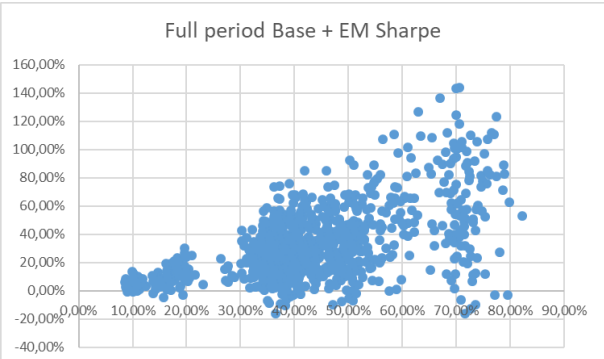


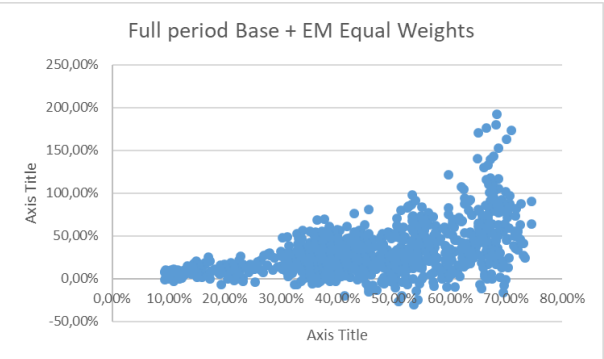


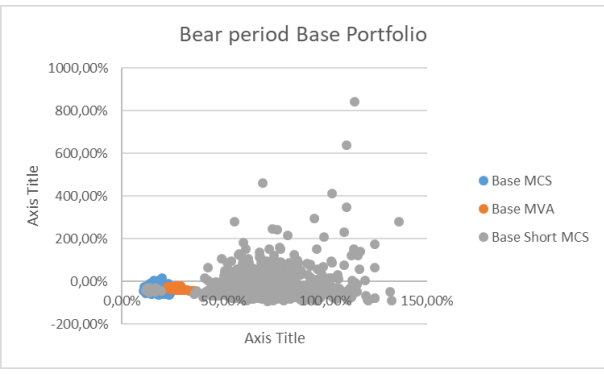
C. MCS WITH SHORT SALE

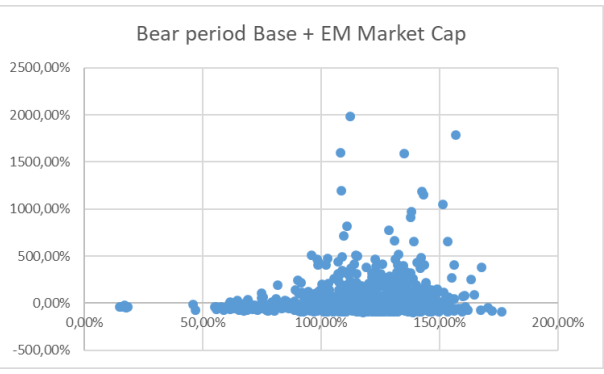


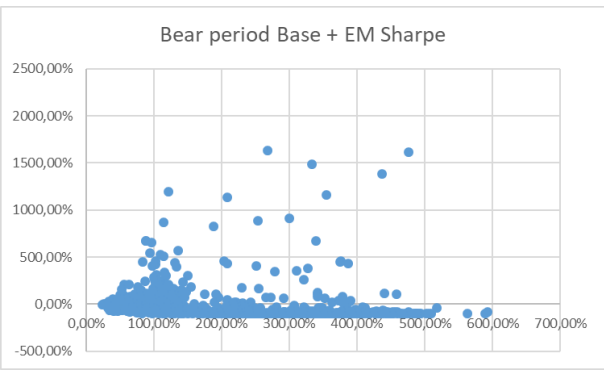


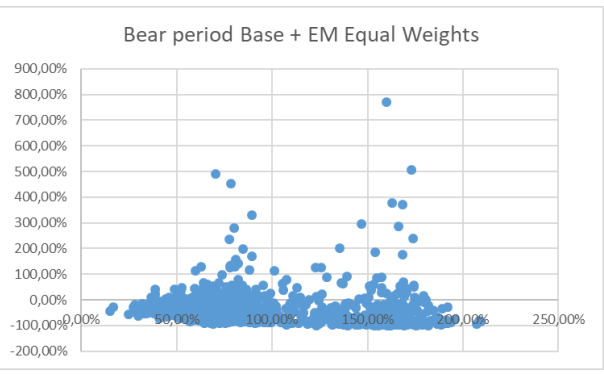


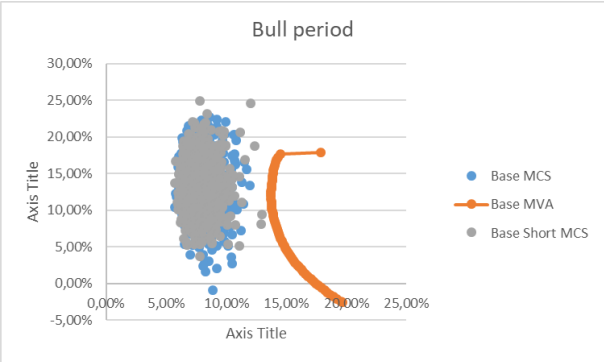


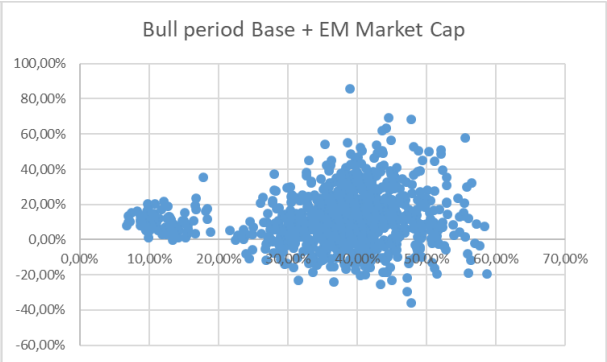


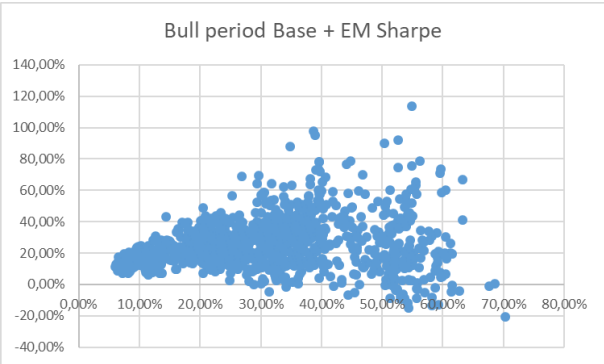


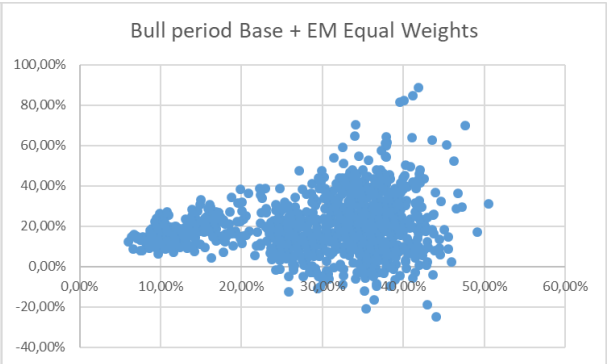





Bull period
30,00%
25,00%
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
Axis Title
0,00% 5,00% 10,00% 15,00% 20,00% 25,00%
Axis Title
Base MCS
Base MVA
Base Short MCS


Bull period Base + EM Market Cap
100,00%
80,00%
60,00%
40,00%
20,00%
0,00%
-20,00%
-40,00%
-60,00%
0,00% 10,00% 20,00% 30,00% 40,00% 50,00% 60,00% 70,00%


Bull period Base + EM Sharpe
140,00%
120,00%
100,00%
80,00%
60,00%
40,00%
20,00%
0,00%
-20,00%
-40,00%
0,00% 10,00% 20,00% 30,00% 40,00% 50,00% 60,00% 70,00% 80,00%


Bull period Base + EM Equal Weights
100,00%
80,00%
60,00%
40,00%
20,00%
0,00%
-20,00%
-40,00%
0,00% 10,00% 20,00% 30,00% 40,00% 50,00% 60,00%