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International Portfolio Diversification: Analyzing efficient portfolios with various risk measures from a Dutch perspective

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This paper investigates whether there are international portfolio diversification benefits from a Dutch perspective. To accomplish this, several domestic, regional (European) and international portfolio were created. These portfolios were analyzed using the Efficient Frontier Model of Markowitz as altered by Solnik (1974; 1993) in conjunction with several quantitative measures; EF index, Sharpe ratio, Sortino ratio and Treynor ratio. The analysis covers a sample period of 14 year (2002 – 2015) as well as sub-periods before and after the Global Financial Crisis. The results of this study are expected to show there are international diversification benefits for the Dutch investor.

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1. Introduction

For about more than 6 decades after the rise of the Modern Portfolio Theory, diversification remains essential for the construction of portfolios. It is a technique for reducing risk by investing in various types of assets. In other words, it can be seen as a risk management process concerned with the allocation of capital among various assets within a portfolio (Gurrib & Alshahrami, 2012). The ideology behind this is that an investor can obtain either a higher return at the same level of risk or the same return at a lower level of risk for a particular portfolio compared to a single asset.

A more enhanced approach towards portfolio construction is by investing abroad, otherwise known as international portfolio diversification. According to Abidin et al. (2004) international investment has become compelling to institutional portfolio managers in developed countries because international diversification provides a higher portfolio return and reduces risk. Abidin et al. (2004) stated that many markets have removed some regulations over the past two decades, which opened the door for foreign investors. However, this higher return seems to be neutralized by fluctuations in currency exchange rate. For this reason, currency risk is considered the most common risk of foreign investment Abidin et al. (2004). Besides, currency risk another impediment to international portfolio diversification includes transaction cost (Solnik & Mcleavey, 2009). Nonetheless, financial markets are becoming more integrated over the years; meaning that markets are being deregulated and opened to foreign investors (Solnik & Mcleavey, 2009; Abidin, Ariff, Nassir, & Mohamad, 2004). Similarly, an earlier study of Gilmore and McManus (2001) also pointed out that markets are becoming more integrated because of the tendency towards deregulation in the money and capital markets of countries. Hence, this implies that markets are becoming synchronized. As a result, this integration of financial markets has reduced transaction cost thereby making it easier for investors to diversify internationally. However, when other costs such as management fees, taxes, and commissions are taken into consideration, international diversification might be more costly for the investor (Solnik & Mcleavey, 2009). In fact, all these costs in combination with political risk sometimes provide comparative advantage for the investor to overweigh domestic diversification benefits compared to international diversification benefits, as explained by Solnik and Mcleavey (2009).

However, the actual benefits of international diversification rely on the correlation between financial markets, in particular correlations between domestic and foreign assets. Although, the integration of financial markets might be beneficial as it opens the door for foreign investors, it also increases the correlation of asset prices among financial markets. Consequently, this reduces the international diversification benefits, according to Solnik and Mcleavey (2009). Several research within the last decades have illustrated that correlations do increase over time (Tang, 1995; Login & Solnik, 1995; Goetzmann, Lingfeng, & Rouwenhorst, 2005)

In fact, this does indeed casts some doubts on the potential international diversification benefits (Vermeulen, 2013). The study of Abidin et al. (2004) showed that the international diversification does not always need to be better than the domestic diversification for the Malaysian Investor. They analyzed international and domestic portfolios for pre-, during- and post-crisis periods. The findings point out that under certain economic condition, the domestic portfolios seem to perform better. For this reason, the outcomes of their study are not in full support of international diversification. So, could this also be the case for the Dutch investor, even though financial integration in the Euro area has increased after the introduction of the Euro currency (De Santies & Gerard, 2006; Aslanidis & Savva, 2009). Thus, with financial markets becoming more integrated worldwide over the years, are there still enough diversification benefits for the Dutch investors?

The objective of this paper is to conduct a similar research as Abidin et al. (2004), and examine the case for international diversification benefits based on a Dutch investor perspective. However, this study covers a period of 14 years (January 1, 2002 to December 31, 2015), which includes the introduction of the Euro currency as well as the recent global financial crisis. In comparison with the previous study of Abidin et al. (2004), this study will include a European portfolio for further comparison with the domestic portfolio and international portfolio. In addition, besides the Efficient Frontier Index measurement proposed by Abidin et al. (2004), this study will include various risk-adjusted performance measurement such as the Sharpe, Sortino and Treynor ratio in order to analyze the portfolios and to determine the most efficient portfolio. Markowitz (1952) defined “efficient” as the portfolio with the lowest risk for a given level of return, and therefore suggested to choose such a portfolio as well. Ultimately, this study will show if international diversification benefits is substantial compared to domestic or European diversification benefits, as markets are becoming more unified.

The motivation for the study is due to the fact that there are various studies in the past on international portfolio diversification; most of which cover correlation, integration, exchange rates, application of different methods, different markets and perspectives, and different periods. However, there are not so many studies after the recent global financial crisis that investigates international diversification benefits through optimal allocation of capital among different countries and through the application of the Efficient Frontier (EFs). In particular, there are also no past studies found based on the Duct investor's perspective that is executed in this manner in conjunction with the measures chosen. Hence, this study will apply the Modern Portfolio Theory of Markowitz (1952) as extended by Solnik (1974; 1993). Moreover, this study will add to the literature on international portfolio diversification and also serve as a guideline for the Dutch investor.

The remainder of the paper is organized as follows; section 2 will provide overview of the theories and related literature, section 3 discusses the data and methodology, section 4 will present the result and discussion and section 5 will present the conclusion.

2. Literature overview

1.1. Portfolio Diversification theory

Portfolio selection is a common topic pertaining to the field of finance, and refers to the selection of various different securities that will realize an investor's objective (Mansourfar, Mohamad, & Hassan, 2010). The Modern Portfolio Theory (MPT), proposed by Markowitz (1952), is a mathematical formulation of portfolio selection problem in the framework of risk-return relationship, as stated by Mansourfar, Mohamad, and Hassan (2010).

Moreover, Markowitz illustrated that an investor is able to identify particular combinations of securities which maximizes the expected return for a desired level of risk. He named this the efficient frontier; portfolios in the universe of expected return and risk (standard deviation). In addition, based on the Expected return-Variance (E-V) rule of Markowitz, investor should choose those portfolios that are located on this efficient frontier. This is because the efficient frontier recognizes all the risky investments and examines which could be the optimal among them all. The idea behind the optimal portfolio can be described in the two ways. First, in terms of the given level of risk, an investor should choose the one which has the highest expected return.

Second, in terms of expected return, the investor should choose the one which has the lowest risk. However, both statements are the same. So, the efficient frontier is compromised out of a series of points of which each expresses distinct allocation of capital among the assets chosen. This particular allocation produces a particular risk for a particular level of return as mentioned in Abidin et al. (2004).

There are also two restrictions that are placed on the portfolio in order to determine the efficient frontier. The first one is that the sum of the weights of the assets in the portfolio should add up to one, meaning that the portfolio is fully invested. The second constraint has to do with short-selling of the assets in the portfolio; meaning that the portfolio weights can be negative. On the other hand, if there is short-selling constraint imposed; all the weights of the assets in the portfolio have to be bigger or equal to zero. This matter will be further explained later on in the methodology section. With these two restrictions imposed, all the points of the efficient frontier are found between the minimum-risk portfolio and the maximum-return portfolio that can be achieved, and in this manner the efficient frontier can be outlined.

1.2. International Portfolio Diversification theory

International Portfolio Diversification is a more enhanced approach towards portfolio selection, which entails investing abroad. The standard argument regarding international portfolio diversification is that it provides the investor with the benefit of reducing the total risk of the portfolio (Solnik & Odier, 1993; Solnik & Mcleavey, 2009). Certainly, this can be achieved by holding international assets as well as domestic assets in a portfolio.

Solnik (1974) made this significant contribution, by showing that an investor can achieve great reduction of the total portfolio risk though the inclusion of international assets to a domestic portfolio. In addition, Solnik and Odier (1993) demonstrated that even greater reduction in risk can be achieved by adding not only international assets but also bonds to a domestic portfolio. This is because bonds have lower risk than stocks, in general. Therefore, this study will include a bond in the portfolio in order to have more risk reduction. Moreover, by constructing such a portfolio, implies that the efficient frontier will be more to the left compared to a portfolio based only on domestic stocks or only on international stocks, as illustrated by Solnik and Odier (1993). They also stated that the benefits of international diversification can hold from all national viewpoints as well.

While an international portfolio might offer risk reduction, it can also provide higher return simultaneously. However, this higher return seems to be neutralized by fluctuations in currency exchange rates movements (Solnik & Odier, 1993) . For this reason, currency risk[1] considered to be the most common risk in international investments Abidin et al. (2004). Solnik and Mcleavey (2009) illustrated the implications of currency risk when considering foreign assets for an international portfolio. They showed how the currency risk increases the risk of foreign assets when denominated in domestic currency. However, currency exchange rates also cause the correlations among foreign denominated assets to increase as well. Hence, all the international assets within the study will be denominated in euro currency in order to account for currency exchange rate risk. Despite the effects of exchange rates, this may not seem to be a big deal according to Solnik and Mcleavey (2009), as this represents the opportunity to profit from currency returns as well. This can be done by hedging currency risks such as selling futures or forward currency contracts, and buying currency options, for example. Nevertheless, in an international portfolio, the depreciation of one currency is offset by the appreciation of another.

Besides currency risk, another common risk to international portfolio diversification is transaction cost. Nonetheless, markets are becoming more integrated over the years which imply that markets are merging due to deregulation (Solnik & Mcleavey, 2009; Abidin, Ariff, Nassir, & Mohamad, 2004). In other words, markets are becoming more synchronized and opened for foreign investors. As a result, this has reduced transaction cost as well as the cost of obtaining information, thereby making it easier for investors to have access to international assets (Solnik & Mcleavey, 2009). However, when other costs such as management fees, taxes, and commissions are taken into consideration, international diversification might be more costly for the investor (Solnik & Mcleavey, 2009).

On the other hand, while the integration of financial markets opens the door foreign investors, it also increases the correlation of asset prices among financial markets, according to Solnik and Mcleavey (2009). Consequently, this reduces the international diversification benefits. Several studies (Tang, 1995; Login & Solnik, 1995; Goetzmann, Lingfeng, & Rouwenhorst, 2005) have illustrated this situation; increase in correlation reduces diversification benefits. In general, despite that correlation between markets change over time, correlations remain low (Solnik &

[1] Currency risk is a component of the total risk of a foreign investment which can be estimated by comparing standard deviation of assets returns when measured in foreign currency against the standard deviation in domestic currency, as stated by (Solnik & Odier, 1993).

Odier, 1993; Solnik & Mcleavey, 2009). Hence, there is sufficient room for risk spreading as stated in Abidin et al. (2004). Nevertheless, when the benefit of diversification is most essential, correlations tend to be increasing as market volatility increase

Besides the risk mentioned above, other barrier to international portfolio diversification according to Solnik and Mcleavey (2009), include the following;

Acquaintance with international markets: Investors are often not familiar with foreign markets and may feel uneasy or uncertain about how business is done abroad; trading procedure, language, how reports are presented, and so on.

Political Risk: Some countries may run the risk of being politically unstable. Any form of crisis (political, economic, and monetary) can badly affect the value of local investments.

Market efficiency: Some markets are smaller than others in terms of liquidity. Another liquidity risk has to do with capital controls on international investments, such as the sale of international assets. Moreover, in some countries, corporations do not provide reliable as well as timely information. In addition, market efficiency has to do with price manipulation and insider trading.

Regulations: This can constrain the amount of international investment that can be undertaken by domestic investors. Institutional investors are sometimes constrained on the amount of international assets they can hold. Some countries, like the emerging markets, tend to limit the amount of international ownership to a certain percentage of capital in their national corporation. On the other hand, the EU prohibits such discrimination among its members and often forces national institutional investors to hold domestic bonds, which is rarely the case for bond investments.

Thus, international investing increases profit opportunities for the investor while providing risk reduction through diversification. However, there is also various risk and barriers to international portfolio diversification that the investor needs to take into consideration. More importantly, the investors should assess whether the benefits of international diversification is larger enough in order to face the costs and risks, as markets are becoming more integrated worldwide over the years.

1.3. Related literature on International Portfolio Diversification

The basic argument for international portfolio diversification is that it enables the investor to reduce the total risk of a portfolio while simultaneously enhancing returns. According to Solnik (1974) the total risk of the portfolio depends on the number of assets included in the portfolio, the riskiness of each individual security as well as how these risks are independent on each other. Solnik showed how diversification will be improved once a certain amount of assets are added to the portfolio. This was done for several European countries (UK, Germany, France, Switzerland, Italy, Belgium and Netherlands). The results on a domestic level indicated that as diversification increases, the risk of the portfolio decreases. However, the risk of a portfolio can be eliminated to a certain extent. Increasing the amount of assets after a particular amount will have no further impact on the domestic level. Nonetheless, by investing internationally in different countries, the portfolio risk can be reduced even further. Solnik illustrated how an international portfolio of the same size as a domestic portfolio of the European countries, provides substantial risk reduction. Furthermore, the study of Solnik and Odier (1993) analyzed whether the contribution of bonds would improve the risk-adjusted performance of an international diversified portfolio. The findings show that the efficient frontier of an international stocks and bonds portfolio is better than a domestic portfolio of stocks and bonds.

After all, the addition of international assets to a domestic portfolio depends on the correlation among the assets (Solnik & Mcleavey, 2009) In particular, as long as the correlation of the international assets and domestic assets is not large. This has led various studies to investigate correlations. The study of Tang (1995), Login and Solnik (1995), found out that correlation between stock indices increases over time. The study of Chatrath, Ramchander and Sanjay (1996), validated the belief that correlations between the U.S and emerging market returns have the tendency to increase if markets deteriorate, however this only affect those investor who hold stocks for short term periods. On the other, Koshers, Koshers, and Vivek (1998) documented that emerging markets that have low correlations with other countries thereby can contribute to diversification benefits. Similarly, the study of Gilmore and McManus (2001) examined the short- and long-term relationship between the US stock market and three Central European market and found low correlation between the markets. The study of Goetzmann, Li and Rouwenhorst (2005) analyzed the correlation structure of the global equity market over the last 150 years, and found that the correlation structure changes substantially over time.

According to Solnik and Mcleavey (2009), financial markets are becoming more integrated, therefore correlation among asset price are increasing over time. In other words, financial markets are becoming more synchronized due to deregulation. De Santis and Gerard (2006) found that the adaptation of the euro currency seemed to have enhanced financial integration regionally in the euro area in both bond and equity markets. Fadhlaoui, Bellalah, Dherry, and Zouaouii (2009) also documented increase in the degree of financial integration in the long-run for seven developed equity countries (United States, Canada, United Kingdom, France, Germany, Italy, and Japan) and three Central European emerging countries (Czech Republic, Hungary and Poland). However, the increase in integration does not seem to affect the benefits of international diversification in these emerging markets. The study of Aslanidis and Savva (2009) also found evidence that diversification benefits if affected by integration of markets, like in the case of the European Union. The authors looked at the integration between the new EU members (Hungary, Czech Republic and Poland, who joined in 2004) and the Euro-zone and found that diversification benefits deteriorated for country based equity market in the region. Berger, Pukthuanthong, and Yang (2011) analyzed the frontier markets (25 frontier indices, according to MSCI classification) with respect to integration and diversification benefits. The results indicate that frontier markets have low levels of integration. In comparison with developed and emerging markets, frontier markets do not reveal that integration will increase over time. Therefore, frontier markets add great improvements in terms of risk reduction. Hence, although financial integration might be beneficial as it opens the door for foreign investors, it also reduces the diversification benefits by increasing correlations among asset prices.

Another common factor that can impede international diversification benefits is the currency exchange rate fluctuations (Solnik, 1974; Solnik & Odier, 1993). However, the study of Solnik, Boucrelle, and Fur (1996) found that exchange rates do not play a major role on the return of a well-diversified portfolio, because as one currency depreciates the other appreciates and the effect is neutralized. On the other hand, Kwangsoo (1998) did found some effects of exchange rate, however the effects does not seem to be strong enough to have an impact on the international portfolio returns. In fact, Solnik (1974) showed that the total risk of an international portfolio unprotected against exchange rate is still much smaller compared to a domestic portfolio of the same size.

Furthermore, other studies on international portfolio diversification apply various methods to examine diversification benefits. The study of Eiling, Gerard, & Hillion (2012) use the mean-variance analysis to examine the importance of country, industry, world markets and currency risk factor for international stock returns. Seven major developed stock market indices (US, Canada, UK, Japan, Germany, Italy and France) were used. The results show that equity returns are driven by global industry and currency risk factors. Moreover, they analyzed the implications of these findings for diversification strategies. The results showed that industry-based diversification strategies outperform country-based strategy only when short selling is allowed and currency investing is essential because it adds great diversification benefits to the portfolio. Abid, Leung, Mroua, and Wong (2014) also applied the mean-variance portfolio framework of Markowitz to examine the preferences for international versus domestic diversification from American investor's perspective. Stock prices of 30 highest capitalization US stocks and 20 international indices were used. The results point out that domestic diversification strategy is superior to the international diversification strategy at a lower risk level and the contrary is true for higher risk level. Using the Stochastic Dominance approach, domestic diversified portfolios with smaller risk is superior to internationally diversified portfolios with higher risk and the contrary holds as well. Allen, McAleer, Powell, and Singh (2014) analyzed a variety of portfolio diversification strategies using ten market indices that represent the major European markets. The results suggested that none of the strategies used were better that naïve diversification strategy (1/N). However, the most successful of the optimization strategies was the Markowitz mean-variance analysis with constraints. The study of Alexeev and Dungey (2015) used high frequency data into their analysis in order to determine the amount of stocks necessary to achieve a particular level of diversification. According to the authors, intraday data is more appropriate for this task as it provides a better estimate of volatility, thereby providing more accurate assessment of portfolio risk. The results indicated that by using five-minute daily and weekly data (on S&P500 constituents) seven stocks in an equally weighted portfolio would be sufficient to diversify 85% of the risk. Moreover, low frequency data seems to overestimate the number of stocks to be held in a portfolio, especially during periods when financial markets are in distress.

Another branch of international portfolio diversification focuses on different markets and investor perspective. The study of Mansourfar, Mohamad, and Hassan (2010) examined whether the Middle East and North African (MENA) countries provided diversification benefits for

international investors. The MENA countries were divided into two groups; oil producing and non-oil producing countries. The results point out that the stock markets of oil producing countries have the potential for international portfolio diversification for investors from the same countries as well as from other MENA markets. Furthermore, the results also point out that portfolios constructed from a combination of all MENA equity markets proved to be better than the portfolios of sub-groups. The study of Gurrib and Alshahrani (2012) looked at the presence of portfolio risk management for the UEA Financial Market. The study proved that forming a portfolio of stocks from different sectors will yield a lower risk than the weighted risk of individual stocks. A more recent paper by Lee, Cheng, and Chong (2016) examines whether CAPM is valid to forecast the behavior of individual stocks and their return listed in Malaysia. The study also analyzes whether the Markowitz's model is suitable to evaluate the portfolio performance of the Malaysian investor. The results show that the CAPM is reasonable to be the indicator of stock prices in Malaysia. In addition, systematic risk itself is already sufficient to explain CAPM and there is no need for analyzing unique risk. In terms of the Markowitz model, the framework in Malaysia does not support that portfolio diversification can generate higher return while reducing risk. It appears to be unsuitable for short-term investment, such as weekly investment. However, the results show that increasing the number of stocks in the portfolio, the unsystematic risk can be diversified away. Therefore, it is suggested to apply portfolio diversification to reduce the unsystematic risk of the portfolio.

Moreover, there are also studies who examine international portfolio diversification benefits before, during and after crisis periods. The study of Abidin et al. (2004) examined whether diversification gains in equity investment are present for the Malaysian investors. They compared two domestic portfolio based on market capitalization against several international portfolios. The portfolios were analyzed for several period of pre-, during- and post-crisis over a 17 year period. In general, the results show that the international portfolios performed better in most of the sub-periods. However, the findings are not in full support of international diversification for the Malaysian investor. They found that it is not always the case that an international portfolio has to perform better, because the domestic portfolios have shown to perform better in crisis periods and even non-crisis periods. The study of Vermeulen (2013) investigated the portfolios of international equity investors before and during the recent financial crisis for 42 countries. He found out that diversification benefits were greater during the financial crisis, which is due to

stock market correlations. It seems that during the period of financial crisis investors acquire large positions in foreign stocks that are less correlated with the domestic market. However, this was not the case in the period before the crisis. A more recent study of Syamala and Wadhwa (2016) examined the co-movement among various world market stock indices before and after the recent financial crisis in order to find out whether there are potential diversification benefits for the Indian Investor. The results indicate that the financial crisis has changed the dynamics of the world market indices; the markets are not moving together as they were before the crisis. Therefore, the more appropriate markets to have in portfolio for the Indian Investor are Germany, Malaysia, Jakarta, Mexico and Israel.

There are indeed numerous amount of literature on international portfolio diversification; covering risk reduction with assets, correlation, integration, exchange rates implications, different methods, different perspectives. However, it can be noticed through the literature that correlations among financial markets which are essential for international diversification appear to be increasing over the years, as markets are becoming more integrated. Consequently, this causes investor to have some doubts on international portfolio diversification as the benefits deteriorate. One particular study of Abidin et al. (2004) showed that international portfolio diversification needs not necessarily to be always better. The study examined diversification opportunities for the Malaysian investor, where they compared diversification gains at the domestic level against international level for several periods. Unfortunately, their findings are not in full support of international portfolio diversification for the Malaysian investor. Moreover, could this also be the case for the Dutch investor at the European country level, since financial integration in the Euro area has increased after the introduction of the Euro currency. Hence, this study will explore the possible benefits from international portfolio diversification for the Dutch investor in comparison with domestic as well as European diversification; using the Modern Portfolio Theory of Markowitz (1952) as amended by Solnik (1974; 1993).

3. Methodology and Data

1.4. Methodology

The main task of the study is to create a portfolio of assets that can minimize the risk for a given level of return. In order to identify the best portfolio or optimal portfolio in terms of risk-return tradeoff, the mean-variance model is applied. The search for this optimal portfolio is represented by the efficient frontier model of Markowitz. The expected return of the portfolio is the sum of the individual asset weights multiplied by their expected return which is obtained in the following way;

$$E(R_p) = \sum_{a=1}^{n} W_a E(r_a)$$

Where,

$\sum W_a$ = 1

$E(R_p)$ = the expected return of the portfolio

W_a = the proportion of the assets of the country in the portfolio

$E(r_a)$ = the expected return on asset A

n = the number of assets in the portfolio

On the other hand, the portfolio variance is represented by the weighted average variance and correlation of all the assets in the portfolio and is obtained as follows;

$$\sigma_p^2 = \sum_a \sum_b w_a w_b \sigma_a \sigma_b \rho_{ab}$$

Where,

σ_p^2 = variance of the portfolio

$\sigma_a \sigma_b$ = the standard deviation of asset[2] a and b

$W_a W_b$ = the proportion of asset a and b in the portfolio

Moreover, there are two constraints that are taken into account;

$W_a \geq 0$ = which means that short-selling is <u>not</u> allowed

$\sum W_a$ = 1 means that portfolio is fully invested

[2] Assets represent the stock market indices in some portfolios and individual stocks in others

The short-selling constraint is imposed for the analysis because it may not be possible to short sell in vast majority of countries, according to Jain et al. (2013) , including most of the countries in this study. However, it is worth mentioning that, portfolios appear to perform better when there is no short selling constraint imposed. The efficient frontier of such portfolios appear to be more to the left of those portfolios with short selling constraint imposed, as documented in Abidin et al. (2004). In reality, many restrictions are imposed on institutional investors or fund managers in order to limit the exposure of investing in one single asset, thereby ensuring the safety of investment funds as well, as stated in Abidin et al. (2004). Furthermore, the total risk of the portfolio is defined by its standard deviation and is obtained by taking the square root of the portfolio variance;

$$\sigma_p = \sqrt{\sigma_p^2}$$

The risk and expected return of the portfolios were calculated using the Data Solver in Microsoft Excel, which made it possible to minimize the level of risk for a desired target return. However, a number of steps are required before the expected return and risks of the portfolios can be calculated. First, the weekly returns of the stock market indices and individual stocks are calculated by taking the natural logarithm of the prices because this takes continuous compounding into consideration, and by doing this also makes the returns become more symmetric. As weekly data is used, natural logarithm will be a better measure to deal with price fluctuations. The returns of the individual assets are obtained by taking the average of the weekly returns, and the standard deviations are obtained by calculating the standard deviations of the weekly returns. Second, the weekly returns and standard deviation are converted to annual returns and standards deviation in order to make the data more representative. Third, the correlation matrix and the covariance matrix are calculated. Fourth, the expected return and risk of the portfolios are calculated by assigning equal weights to the assets in the portfolio. Equal weights are chosen for its simplicity. Despite its simplicity, Plyakha, Uppal, & Vikov (2014) found that equal-weighted portfolio outperforms value-weighted in terms of total mean return and Sharpe ratio, even though equal-weighted portfolios have greater portfolio risks. Finally, the solver is used to set the constraints mentioned above as well as to choose a desired target return. By doing so for several target returns the minimum-variance frontier can be graphed, and will present all the portfolios with the lowest risk that can be achieved for a given level of return.

The efficient frontier will be graphed for all the portfolios in order to evaluate which will provide the best risk-return relationship. In the domain of expected return and standard deviation, the more left the efficient frontier of a particular portfolio, the better its performance compared to others who are not, according to literature (Solnik & Mcleavey, 2009; Moffet, Stonehill, & Eiteman, 2012) that covers the mean-variance framework. This is relatively simple to grasp because the more left a particular portfolio implies a lower risk (standard deviation) and higher return than other portfolios. On the contrary, the more right a particular portfolio is located, the more inferior it will be, as it will have a higher risk in comparison with those portfolios that are more to the left. Investors most of the time use the MSCI[3] portfolio as a benchmark for comparison against their portfolio. Moreover, the efficient frontier begins where the risk is the lowest (also known as the minimum-variance portfolio) among the other portfolios on the opportunity set because a rational investor will not choose a lower return for a higher amount of risk. Therefore, the lower part of the efficient frontier is considered to be inefficient.

In some occasions, visual evaluation might be insufficient to indicate which efficient frontier is more superior, because it is difficult to do so through visual presentation alone. In fact, it is more difficult to evaluate various efficient frontiers altogether, because these might be crossing each other. Moreover, a particular efficient frontier may look superior for some individuals, while it may be different in the eyes of others. Therefore, various quantitative measures have been chosen to provide clarity and support on the superiority of the efficient frontiers. Abidin et al. (2004) proposed the Efficient Frontier (EF) Index, which they developed for this occasion. The EF index measure provides an indication of the superiority of a set of optimal portfolio by assigning a value to the efficient frontier, as stated by Abidin et al. (2004). The EF Index is calculated as follows:

$$EF\ Index = \left(\sum_{i=1}^{n} \frac{R_i}{\sigma_i}\right)\left(\sum_{i=1}^{n} \frac{R_i - R_{lowest}}{\sigma_i - \sigma_{lowest}}\right)$$

Where,

R_i = all points of expected return on a set of efficient frontier

σ_i = all point of standard deviation on a set of efficient frontier

R_{lowest} = lowest return on a set of efficient frontier

[3] This index captures the performance of the world (MSCI, 2016)

σ_{lowest} = lowest standard deviation on a set of efficient frontier

Hence, the efficient frontier which has the highest value of EF Index can be considered more superior. It can be noticed that EF index takes the whole efficient frontier into account; however an investor only chooses one optimal portfolio on the efficient frontier. According to Markowitz (1952), this optimal portfolio is the most efficient one which represent the best risk-return tradeoff. Therefore, Markowitz suggested choosing such a portfolio on the efficient frontier.

For this reason, other measures such as the Sharpe ratio, Treynor ratio and Sortino ratio have been chosen. These ratios analyze all the optimal portfolios on the efficient frontier individually and identify the most efficient one. All these ratios make the performance of the portfolios comparable to each other by making an adjustment for risk, thereby known as risk-adjusted performance measures. However, each measure uses a different type of risk. The Sharpe ratio is calculated as follows;

$$Sharpe\ Ratio = \frac{E(R_P) - r_f}{\sigma_P}$$

Where,

$E(R_p)$ = the expected return of the portfolio

r_f = the risk-free rate[4]

σ_P = the standard deviation (risk) of the portfolio

This measure gives the amount of return per unit of risk. In other words, the ratio indicates how much excess return an investor receives for extra volatility for holding a riskier asset. The intuition behind the Sharpe ratio is that investors seek to maximize this ratio (Solnik & Mcleavey, 2009). In addition, the highest Sharpe ratio on a particular efficient frontier signifies the optimal portfolio as well. Furthermore, the optimal portfolio of each frontier will be compared with each other, and in this way the highest Sharpe ratio will determine the superiority of the efficient frontiers.

The Treynor measure is very similar to the Sharpe ratio, however in place of the standard deviation of the portfolio's return as a measure of risk; it uses the portfolio's beta. The beta is considered the systematic risk of the portfolio as measured against a desired benchmark portfolio,

[4] The three month EURIBOR over the sample period is chosen as it is widely used interest rates for various financial products. Furthermore, the average EURIBOR rate is calculated for each sample period

which is the world market portfolio[5] in this case (Moffet, Stonehill, & Eiteman, 2012). The Treynor is obtained as follows:

$$Treynor\ Ratio = \frac{E(R_P) - r_f}{\beta_i}$$

Where,

$E(R_p)$ = the expected return of the portfolio

r_f = the risk-free rate

β_i = the systematic risk of the portfolio

So, unlike the Sharpe ratio, the Treynor ratio seems to be more appropriate for diversified portfolios, as it measures the systematic risk (risk that cannot be diversified away) of the portfolio to the market as a whole. According to Moffet, Stonehill and Eiteman (2012), the Treynor ratio will give a similar result to the Sharpe in case of a perfectly diversified portfolio as the portfolio risk is equal to the systematic risk, otherwise the Treynor ratio will provide a higher value that the Sharpe ratio. Nonetheless, these two measures are considered to complement one another while providing different information.

Finally, the Sortino ratio is said to be an extension or modification of the Sharpe ratio as suggested by Sortino (Kolbadi & Ahmadinia, 2011; Rollinger & Hoffman, 2013). Moreover, this ratio considers the downside deviation of a portfolio as a measure of risk instead of total risk compared to the Sharpe ratio, and is obtained as follows;

$$Downside\ risk\ (\sigma_d) = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(r-t)^2 f(t)}$$

Where,

r = the portfolio return

t = minimum acceptable return (MAR) or target return

n = total number of returns

f (t) = lognormal distributions of the returns

f (t) = 0 if return ≥ target return

Notice that the downside risk considers the deviations of the return's underperformance from the target return where all returns above the target return are treated as underperformance of zero

[5] The MSCI All Country World Index (ACWI) is used and the data is gathered from Datastream over the sample period.

(Rollinger & Hoffman, 2013). Hence, only the negative excess returns will be considered. Moreover, in terms of the target return, any value can be selected depending on the application. Nevertheless, the same target return value must be used for comparison with other measures (Rollinger & Hoffman, 2013). For this study, the average risk-free rate (EURIBOR) will be used as the target rate, as already mentioned. The average rate will be calculated for all the periods within the study. After obtaining the downside risk, the Sortino ration is calculated as follows;

$$Sortino\ Ratio = \frac{E(R_P) - r_f}{\sigma_d}$$

Where,

$E(R_p)$ = the expected return of the portfolio

r_f = target return or risk-free rate

σ_d = standard deviation of returns below the target return or risk-free rate

According to Kolbadi and Ahmadinia (2011), the Sortino ratio penalizes investors only for downside deviation, while the Sharpe ratio penalizes investors for both upside and downside deviation. A high Sortino ratio for a particular portfolio implies lower risk of large losses.

Hence, all the measures will be applied to the portfolios. First, the EF index measure will be conducted, followed by the risk-adjusted measures mentioned above. In this manner, the best portfolio will be identified; through different quantitative measures. This will be done for three periods; period one will be the whole sample period of 14 years (January 2002 – December 2015), period two will represent the sub-period before the crisis (January 2002 - December 2006) and period three will represent the sub-period after the crisis (January 2009 – December 2015). In this way, the changes in superiority of the portfolios can be documented over the periods. Overall, this method is based on of the study of Abidin et al. (2004), but applied to the Dutch stock market instead of the Malaysian stock market. Furthermore, the differences with this study are as follows; although having less periods to analyze, it covers a more recent time frame, it investigates diversification benefits at the regional level by including a European portfolio, in term of domestic portfolio it only has one which covers small medium and large capitalization stocks instead of only small and large capitalization stocks, it includes a domestic bond in the portfolios, it has two combination portfolios of domestic and international assets, and finally this study uses three risk-measures which seems to be more appropriate for analyzing portfolios.

1.5. Data

The effect of exchange rates is a factor that cannot be ignored in international portfolio diversification. Since the study is based on the perspective of the Dutch investor, the exchange rate between Netherlands and other selected countries are taken into consideration. Therefore, all the data gathered are in euro currency or are denominated in euro currency for the calculation of the expected return and standard deviation (risk) of the portfolios. The study uses weekly closing price data of 20 European[6] and 20 international stock market indices and one bond of the Netherlands (see Table 1). The indices represent the most widely used stock market index of each country over a 14 year period from January 2002 to December 2015. The countries were selected based on the best performing global markets (from July 2014 to July 2015).[7] Nevertheless, the availability of data is also taken into consideration. Apart from the most widely used indices of each country, most of the indices are part of the Morgan Stanley Composite Index (MSCI)[8], which is a type of country index used as benchmark for those (fund managers) who invest internationally. In addition, 18 indices pertain to the develop countries MSCI and eight pertain to the emerging countries MSCI. For this study, eight portfolios are created for the analysis (see Table 2). The domestic portfolio01 (DP01) consist of three indices of the Netherlands plus one Dutch bond. The domestic portfolio02 (DP02) consist of 30 domestic stocks plus a bond of the Netherlands (see Table 3). The stocks are chosen in a similar manner than the study of Abidin et al. (2004) and Abid et al. (2014), based on market capitalization. However, due to the fact that the Netherlands has three indices already classified based on market capitalization (large, mid and small) it is decided to choose the 10 largest capitalization of each index. In other words, 10 stocks of the AEX, 10 of the AMX and 10 of the ASCX are chosen, thereby forming a diversified portfolio that covers stocks of the whole Dutch market.

[6] Actually, 22 European stock indices in total including the AMX and ASCI of the Netherlands which are nor provided the table

[7] According to a report of CNN (Yellin, 2016)

[8] As indicated on their website (MSCI, 2016)

TABLE 1: LIST OF SELECTED COUNTRIES, STOCK EXCHANGES AND STOCK INDICES

#	Country	Stock Exchange	Stock Market Index
1	Hungary	Budapest Stock Exchange	BUX Index
2	Denmark	Copenhagen Stock Exchange	OMX20 Index
3	Slovakia	Bratislava Stock Exchange	SAX Index
4	Malta	Malta Stock Exchange	MSE Index
5	Portugal	Lisabon Stock Exchange	PSI20 Index
6	Russia	Moscow Exchange	MICEX index
7	Italy	Milan Stock Exchange	MIB Index
8	Estonia	Tallinn Stock Exchange	OMXT Index
9	Germany	Frankfurt Stock Exchange	DAX Index
10	France	NYSE Euronext Exchange	CAC40 Index
11	Netherlands	NYSE Euronext Exchange	AEX index
12	Austria	Vienna Stock Exchange	ATX Index
13	Ireland	Irish Stock Exchange	ISEQ Overall Index
14	Belgium	NYSE Euronext Exchange	BEL20 Index
15	Luxembourg	Luxembourg Stock Exchange	LUXX index
16	Finland	Helsinki Stock Exchange	OMX25 Index
17	Sweden	Stockholm Stock Exchange	OMXS30 Index
18	Czech Republic	Praque Stock Exchange	PX Index
19	Spain	Madrid Stock Exchange	IBEX35 Index
20	Romania	Bucharest Stock Exhange	BET Index
21	Unites states	New York Stock Exchange	Dow Jones Industrial Average
22	Canada	Toronto Stock Exchange	TSX60
23	Argentina	Buenos Aires Stock Exchange	MERVAL Index
24	Jamaica	Jamaica Stock Exchange	JSE Index
25	Iceland	OMX Nordic Exchange	OMX Iceland Index
26	Lebanon	Beirut Stock Exchange	BLOM Stock Index
27	China	Shanghai Stock Exchange	SHCOMP Index
28	Japan	Tokyo Stock Exchange	Nikkei-225 Stock Average
29	New Zealand	New Zealand Stock Exchange	NZX 50 Index
30	Korea	Korea Stock Exchange	KOSPI Index
31	Hong Kong	Hong Kong Stock Exchange	Hang Seng Index
32	Saudi Arabia	Saudi Stock Exchange	Tadawul All Share Index
33	Norway	Oslo Stock Exchange	OBX Index
34	Mexico	Mexican Stock Exchange	MEXBOL Index
35	India	National Stock Exchange of India	NINFTY50 Index
36	Australia	Australian Stock Exchange	Australian All Ordinaries Index
37	Phillipines	Phillippine Stock Exchange	PSE compisite Index
38	Oman	Muscat Securities Market	MSM30 Index
39	Botswana	Botswana Stock Exchange	BSE FC Index
40	Taiwan	Taiwan Stock Exchange	TAIEX Index

Notes: Table 1 shows the 40 selected countries with their stock exchange as well as the stock market index that are chosen. Numbers 1-10 represent European stock indices and numbers 11-20 represent international stock indices.

TABLE 2: PORTFOLIO OVERVIEW

#	Portfolio	ID	Components
1	Domestic 01	DP01	3 Dutch indices (AEX, AMX, ASCX) and 1 Dutch bond
2	Domestic 02	DP02	30 domestic stocks (10 domestic stocks of the AEX, AMX and ASCX index) and 1 bond
3	European 01	EP01	20 European stock indices and 1 Dutch bond
4	International 01	IP01	20 International stock indices and 1 Dutch bond
5	Developed Markets	DMP	8 Developed country indices and 1 Dutch bond
6	Emerging Markets	EMP	8 Emerging country indices and 1 Dutch bond
7	European 02	EP02	20 European stock indices, 30 domestic stock and 1 Dutch bond, (EP01 + DP02)
8	International 02	IP02	20 International stock indices, 30 domestic stock and 1 Dutch bond, (IP01 + DP02)

Notes: The table shows the eight portfolios that are constructed with their IDs and components.

TABLE 3: DOMESTIC PORTFOLIO 02 (DP02)

#	Name of the stock	Industry	#	Name of the stock	Industry
1	RDSA	Oil gas & coal	16	PostNl	Transportation & logistics - industrials
2	Unilever	Consumer products	17	Sligro food group	Commercial services
3	ING	Banking	18	Furgo	Oil gas & coal - energy
4	Heineken	Consumere products - beverages	19	TKH	Electrical equipment - industials
5	ASML	Semiconductors - technology	20	USG People	Commercial services
6	RELX	Technology services	21	Brunel	Commercial services
7	Unibal Rodamco	Real estate - financials	22	Wessanen	Consumer products
8	Phillips	Medical equipmnt & devices	23	Acomo	Consumer products
9	Ahold	Retail - consumer staples	24	Beter bed	Retail discretionary
10	Kpn	Communications - telecom	25	Kendrion	Industrials - Electrical equipment
11	SMB offshore	Oil gas & coal - energy	26	Nedap	Commercial services
12	Air france klm	Passenger transportation	27	Heijmans	Engeneering & construction services
13	ASM international	Technology - semiconductors	28	Tmg	Media - communications
14	Wereldhave NV	Real estate - financials	29	Kasbank	Financials - Institutional financial services
15	Eurocommercial properties NV	Financial - real estate	30	Stern	Retail discretionary
	Other				
1	Bond (DGB10Y)				

Notes: The table presents the assets that are included in the Domestic Portfolio02 (DP02), which are 30 domestic stocks and one domestic bond. Moreover, numbers 1 -10 represent the 10 highest capitalization stocks of the AEX index, numbers 11-20 represent the 10 highest capitalization from the AMX index and numbers 21-30 represent the 10 highest capitalization stocks of the ASCX index. This covers stocks of the whole Dutch market.

The European portfolio (EP01) consists of 20 European indices and the international portfolio (IP01) consists of 20 international indices (see Table 4). For further investigation, two other international portfolios are constructed based on the developed markets (DMP) and emerging markets (EMP) of the MSCI, in order to find out which is better for diversification. For this, the best eight developed and emerging countries out of all indices within this study are chosen (see Table 5). For more in depth analysis on the potential of investing at the national and international level a second European (EP02) and international (IP02) portfolio were created. These two portfolios are an extension of the EP01 and IP01; as now both include the DP02. In this way, the actual diversification benefits can be analyzed since the idea behind international diversification is to have a combination portfolio consisting of domestic as well as international assets.

All the data are gathered from Datastream Limited. The 14-year period is used as it covers a more recent time frame of analysis as well as the last financial crisis of 2007-2008 which is necessary to study international portfolio diversification pre-and post-crisis period.

TABLE 4: EUROPEAN (EP01) AND INTERNATIONAL (IP01) PORTFOLIO

European				International			
#	Country	#	Country	#	Country	#	Country
1	Hungary	11	Netherlands	1	Unites States	11	Hong Kong
2	Denmark	12	Austria	2	Canada	12	Saudi Arabia
3	Slovakia	13	Ireland	3	Argentina	13	Norway
4	Malta	14	Belgium	4	Jamaica	14	Mexico
5	Portugal	15	Luxembourg	5	Iceland	15	India
6	Russia	16	Finland	6	Lebanon	16	Australia
7	Italy	17	Sweden	7	China	17	Phillipines
8	Estonia	18	Czech Republic	8	Japan	18	Oman
9	Germany	19	Spain	9	New Zealand	19	Botswana
10	France	20	Romania	10	Korea	20	Taiwan
	Other				**Other**		
1	Bond (DGB10Y)			1	Bond (DGB10Y)		

Notes: Table 4 presents the components that are included in the European Portfolio (EP01) as well as in the International Portfolio (IP01). The EP01 consists of 20 European stock indices and one Dutch bond, whereas the IP01 consists of 20 international stock indices and one Dutch bond.

TABLE 5: DEVELOPED MARKETS (DMP) AND EMERGING MARKETS (EMP) PORTFOLIO

#	Developed Countries	#	Emerging Countries
1	Denmark	1	Hunagry
2	Ireland	2	China
3	Japan	3	Czech Republic
4	Italy	4	India
5	Germany	5	Korea
6	Netherlands	6	Mexico
7	Austria	7	Philippines
8	Belgium	8	Taiwan
	Other		**Other**
1	Bond (DGB10Y)	1	Bond (DGB10Y)

Notes: The table presents the components that form the Developed Markets Portfolio (DMP) and the Emerging Markets Portfolio (EMP). The DMP consists of eight developed country stock indices and one Dutch bond, whereas the EMP consists of eight emerging country stock indices and one Dutch bond.

4. Results and Discussions

1.6. Period 1: 14 years from 2002 to 2015

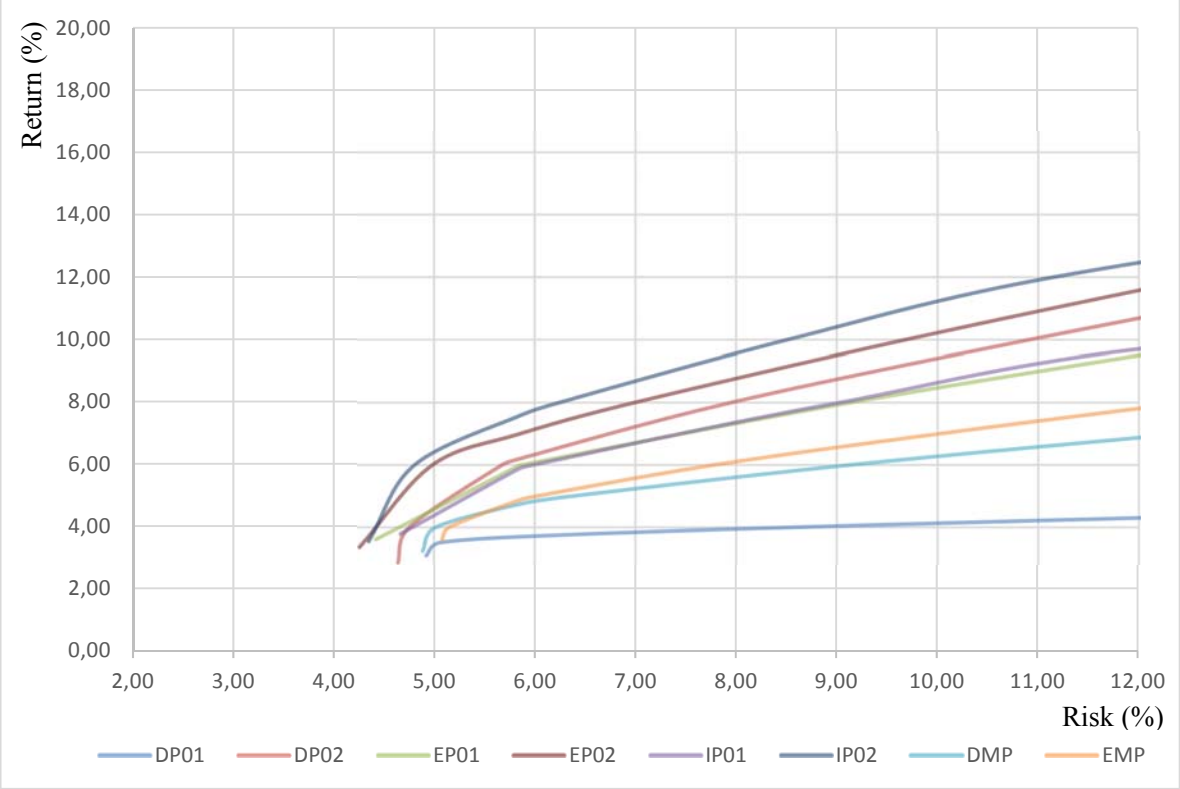

FIGURE: 1EFFICIENT FRONTIER OF THE PORTFOLIOS PERIOD 1(LONG-TERM)

Notes: The figure presents the efficient frontier of the domestic, European and international portfolios for the long term period. The efficient frontier of the international portfolio IP02 is located more to the left. Thereby, it is more superior to the domestic as well as European portfolios.

The results based on the efficient frontier shows that the efficient frontier of the international portfolio02 (IP02) is located more to the left and upwards compared to the other portfolios (see Figure: 1). This indicates that the IP02 is more superior to the other international, domestic and European portfolios.

In terms of the quantitative measures, it can be noticed that there is an overall pattern in ranking of the portfolios among the measures. It appears that the EF index provides the same ranking of the portfolios as the Sharpe ratio and Sortino ratio. However, the Treynor ratio only shows a different pattern in ranking for the first four portfolios (see Table 6). The EF index results show that the IP02 has the highest EF index value (1.00). Moreover, there is a small

difference in EF index value between the EP02 (0.81) and DP02 (0.80). The results also show that the emerging market portfolio is superior to the developed market portfolio, with EF index values of 0.35 and 0.26. Finally, the DP01 has the lowest EF index value of 0.08. So, the EF index results imply that the IP02 is the most superior investment, as it provides the highest risk-return relationship among the other portfolios. However, this is a combination portfolio constructed to capture the actual benefits of international portfolio diversification. This is the difference in comparison with the study of Abidin et al. (2004) which do not have such combination portfolio, and only compare pure domestic portfolio with pure international portfolios. Therefore, they found the domestic portfolio of smaller capitalization stocks to be more superior. Moreover, it can be said that their study does not capture the actual benefits of risk reduction in international portfolio diversification by comparing only pure domestic portfolio with pure international portfolio. However, with exception of the combination portfolios (IP02 and EP02) the findings are in line with the study of Abidin et al. (2004). Only in this case, the domestic portfolio (DP02) is found to be superior to the others. On the other hand, emerging markets appear to be better for diversification compared to developed markets which is in line with the study of Abidin et al. (2004), Solnik and Mcleavey (2009) as well as Bhatti, Islam, and Rehman (2015).

The Sharpe ratio results shows the same ranking order for the portfolios (see Table 6). This is interesting, because the EF index measures the whole index while the Sharpe takes only the most optimal portfolio into consideration, as mentioned above. So, in terms of the Sharpe ratio results, the IP02 gives the Dutch investor more excess return per unit of risk in the long term.

The results for the Treynor ratio show a different ranking order for the portfolios. Now the European portfolio EP02 has the highest EF index of 0.53 points. This different ranking order compared to the Sharpe ratio and Sortino ratio might be due to the performance of the portfolio in relation to the MSCI All World Country portfolio. European assets might be more sensitive to this world portfolio. Another interesting point is that there seems to be no difference between the international portfolio IP01 and the domestic portfolio DP02 as both have the same ratio of 0.48. Moreover, the emerging market portfolio has a higher ratio of 0.37 compared to the developed market portfolio with a ratio of 0.19. So, according to the Treynor ratio, the best diversified portfolio is the European portfolio EP02.

The Sortino ratio results show almost the same ranking in superiority as the EF index and the Sharpe ratio. The highest Sortino ratio (0.27) seems to be from the international combination portfolio IP02. However, there seems to be a very small difference between the Sortino ratio of the European portfolio EP01 (0.19) and Sortino ratio of the international portfolio IP01 (0.18), whereas there is no difference between emerging market portfolio and the developed market portfolio as these have the same ratio of 0.14. Hence, the international combination portfolio IP02 offers a low risk of obtaining large losses.

TABLE 6: QUANTITATIVE MEASURES

Period / Ranking per measure				Type of portfolio	EF Index	Sharpe	Treynor	Sortino
Period 1				14 years from January 2002 to December 2015				
EF Index	Sharpe	Treynor	Sortino					
1	1	4	1	IP02	1.00	0.92	0.48	0.27
2	2	1	2	EP02	0.81	0.82	0.53	0.24
3	3	3	3	DP02	0.80	0.69	0.48	0.21
4	4	2	4	EP01	0.58	0.65	0.52	0.19
5	5	5	5	IP01	0.46	0.63	0.42	0.18
6	6	6	6	EMP	0.35	0.46	0.37	0.14
7	7	7	7	DMP	0.28	0.44	0.29	0.14
8	8	8	8	DP01	0.08	0.26	0.15	0.08
Period 2				Pre-crisis from January 2002 to December 2006				
1	2	1	2	EP01	10.22	2.67	4.77	0.50
2	1	2	1	EP02	8.85	3.01	3.57	0.60
3	4	7	4	IP01	4.99	1.56	1.01	0.32
4	6	5	6	DMP	4.11	1.15	1.52	0.24
5	7	6	7	EMP	3.78	1.15	1.50	0.23
6	3	4	3	IP02	3.75	2.19	1.53	0.42
7	5	3	5	DP02	2.30	1.33	1.56	0.26
8	8	8	8	DP01	1.20	0.51	0.70	0.11
Period 3				Post-crisis from January 2009 to December 2015				
1	3	5	3	DP02	2.94	1.66	0.59	0.97
2	1	2	1	IP02	2.30	1.90	0.67	1.04
3	2	4	2	EP02	1.93	1.74	0.59	1.00
4	5	6	8	EP01	1.93	1.33	0.57	0.46
5	4	3	4	IP01	1.85	1.41	0.61	0.84
6	7	1	7	EMP	1.47	1.10	0.89	0.71
7	6	7	5	DMP	1.35	1.23	0.52	0.81
8	8	8	6	DP01	0.94	1.07	0.44	0.72

Notes: The table presents the ranking of the portfolios for each of the quantitative measures. For the first period, the EF index shows that the international combination portfolio IP02 is more superior to the other with a value of 1.00. The IP02 is the most optimal portfolio with the highest Sharpe ratio (0.92) and Sortino ratio (0.27), while the Treynor ratio indicates that the EP02 portfolio is the most optimal portfolio with a ratio of 0.53. For period two, the values of all the measures seem to be much higher. The EF index results show that the European portfolio EP01 is the most superior with a value of 10.22. The Sharpe ratio and Sortino ratio outcomes indicate otherwise, that the European portfolio EP02 is the most optimal portfolio with ratios of 3.01 and 0.60, while the Treynor ratio shows the European portfolio EP01 to be the most optimal, with a ratio of 2.67. For period three, between the values of the measures have decreased but remain higher than period one. The EF index illustrates that the domestic portfolio DP02 is most superior with a value of 2.94. However, the international portfolio IP02 has the highest Sharpe ratio (2.30) as well as Sortino ratio (0.67), whereas emerging market portfolio has the highest Treynor ratio (0.89).

1.7. Period 2: Pre- financial crisis 2007-08

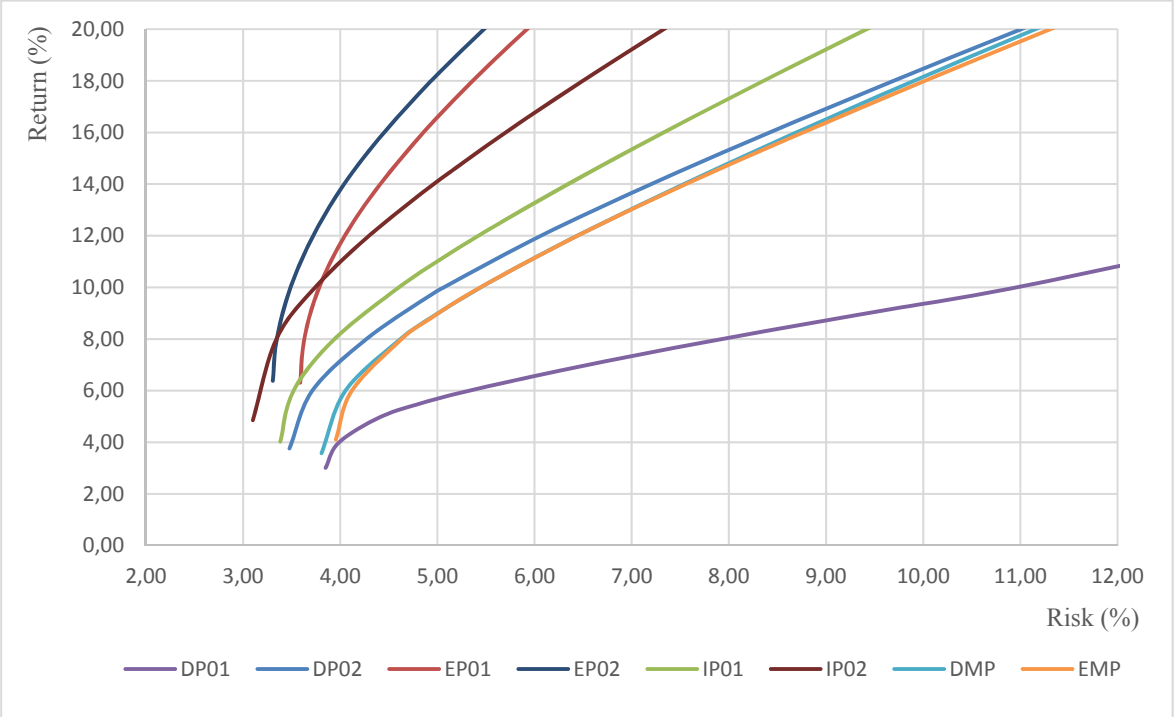

FIGURE 2: EFFICIENT FRONTIER OF THE PORTFOLIOS PERIOD 2 (PRE-CRISIS)

Notes: Figure two present the efficient frontier of the domestic, European and international portfolios for the period before the crisis. The efficient frontiers located more to the left are the international portfolio IP02, the European portfolio EP02, and the European portfolio EP01. However, the most superior portfolio is difficult to determine since these efficient frontiers are crossing.

The outcomes of the efficient frontier for period two illustrates that there are three efficient frontier that are located more to the left (see Figure 2). These are the efficient frontier of the international portfolio IP02, the European portfolio EP02, and the European portfolio IP01. However, it is difficult to determine which one is most superior, because the efficient frontiers appear to be crossing each other. This implies that these portfolios do not dominate each other in the risk-return range, as mentioned in the study of (Abid, Leung, Mroua, & Wong, 2014). Moreover, in such a particular case, the question of which portfolio is the more superior for the Dutch investor would depend on the level of risk and return desired. In addition, the efficient frontier of the developed market portfolio is slightly more to the left compared to the emerging markets, thereby is more superior to the emerging market portfolio. It also can be noticed by the

efficient frontiers that the portfolios provide less risk and more return opportunities, as the efficient frontiers are located more to the left and steeper compared to the period one.

The quantitative measure results for period two show that the Sharpe ratio and Sortino ratio provide the same pattern in ranking order for all the portfolios (see Table 6). However, all the measures show the same pattern in ranking for the domestic portfolio DP02, which is ranked eight for all the measures. Moreover, the results also show a change in superiority among the portfolios for this period. The EF index results point out that European portfolio EP01 has the highest EF index value (10.22). Nevertheless, this implies that it would be better for the Dutch investor to be holding only European assets. The reason being is that the domestic stocks or the domestic portfolio DP02 did not perform well this period, as it has an EF index value of 2.30 and is ranked seventh. Furthermore, the developed market portfolio has a higher EF index value (4.11) than the emerging market portfolio EF index value (3.78). Besides the European portfolio within this study, the findings in terms of the domestic portfolio are in line with the study of Abidin et al. (2004), while the findings for the developed market and emerging market seems to show the opposite.

On the contrary, the outcomes of the Sharpe ratio and Sortino ratio show that the international combination portfolio EP02 is the optimal portfolio, with ratios of 3.01 and 0.60. This implies that diversification benefits is indeed possible, even though the domestic stocks did not perform that well during this period, as they are ranked fifth after the international portfolio IP01. Moreover, the Sharpe ratio results show that there is no difference between the developed market portfolio DMP and emerging market portfolio EMP, as both have the same ratio (0.15), while the Sortino ratio results show that the developed market portfolio to have the higher ratio (0.24) compared to the ratio (0.23) of the emerging market portfolio. However, the Treynor ratio results also indicate that the European portfolio EP01 is the most optimal portfolio with a ratio of 4.77.

1.8. Period 3: Post-financial crisis 2007-08

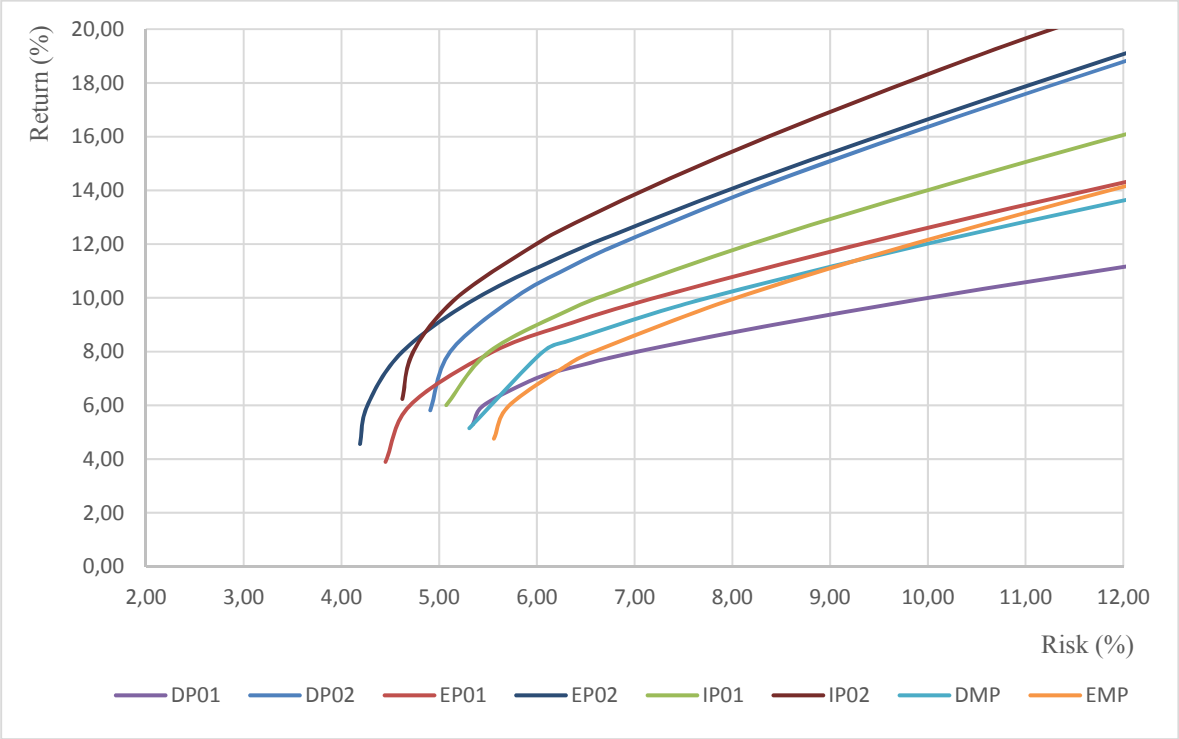

FIGURE 3: EFFICIENT FRONTIER OF THE PORTFOLIOS PERIOD 3 (POST-CRISIS)

Notes: Figure three shows the efficient frontier of the domestic, European and international portfolios for the period after the crisis. The efficient frontier of the domestic portfolio DP02 and the international portfolio IP02 are located more to the left. However, it remains difficult to determine the most superior portfolio because the frontiers are crossing each other.

The efficient frontier results for the period after the crisis, illustrates that all efficient frontier are crossing one another. The efficient frontier of the domestic portfolio DP02 and the international portfolio IP02 are located further upwards and to the left that the other portfolios. However, as already mentioned above, it remains difficult to do determine the superiority in this situation. Therefore, this will depend more on the risk-averseness of the Dutch investor. In addition, the portfolios risks have also increased for this period, as can be seen that the efficient frontiers have are located more to the right.

The quantitative measure results for this period show that the Sharpe ratio and Sortino ratio provide the same pattern in ranking order of the portfolios for the first three portfolios (see Table 6). There is also a pattern between the EF index, Sharpe ratio and Treynor ratio measures which displays the same ranking order for the domestic portfolio DP01. The EF index reveals that the

domestic portfolio DP02 has the highest value (2.94), thereby is the most superior portfolio for the period after the crisis. This suggests that the selected domestic stocks appear to recover faster than European and international stocks. Moreover, the EF index is higher for the developed market portfolio DMP (1.47) than the emerging market portfolio EMP (1.35), indicating that the developed market stocks perform better after the financial crisis period. However, these findings are in contrast to the study of Abidin et al. (2004), which found the international portfolio to be more superior as well as the emerging portfolio compared to the domestic portfolio for such a period after the crisis.

On the other hand, the Sharpe ratio and Sortino ratio reveal that the international combination portfolio IP02 is the most optimal, with the highest ratios of 1.90 and 1.04. Moreover, the developed market portfolio has the highest Sharpe ratio (1.23) and Sortino ratio (0.81). Surprisingly, the Treynor ratio results show that the emerging market portfolio EMP is the most optimal portfolio providing the highest ratio of 0.89. A possible reason might be that the emerging markets move less than the other portfolio in relation to the MSCI All World Country portfolio.

After all, there are various factors that can influence the results of the study. First, the amount of portfolio in each of the efficient frontier, as the EF index considers all the efficient portfolios of an efficient frontier. This does indeed affect the superiority of an efficient frontier, as mentioned by Abidin et al. (2004), because some efficient frontier have more efficient portfolios than others (see Table 7,Table 8Table 9 in appendix). Secondly, this also has to do with the mean-variance optimization technique as well as the performance of the portfolio as a whole, because a particular portfolio can have a higher maximum return-risk relationship than another portfolio. In this case, the optimization technique of Markowitz will consider all the portfolio possibilities for each level of return desired till this maximum return-risk relationship that can be achieved. As can be seen at the efficient portfolio sets for period one (see Table 7 in appendix), the maximum return-risk that can be achieved for the emerging markets portfolio EMP (11.83;23.91) is higher compared to the developed markets portfolio DMP (9.29;20.62). Therefore, more efficient portfolio can be considered for the emerging market portfolio which can influence the EF index value. Third, the portfolio weights of the most optimal/efficient portfolio have great impact on the overall portfolio risk, which affects the results of the Sharpe

ratio, Sortino ratio as well as the Treynor ratio. However, the weights depend yet again on the performance individual assets of the portfolio. This is because the mean variance optimization technique will assign the majority of the weights to an asset that performs well compared to the others. Within this study it appeared that the bond had the best performance it terms of risk compared to the other individual assets. Moreover, since the ratios are based on excess return per unit of risk, the risk-free rate also can affect the result. Within this study, the average risk free-rate was calculated to accommodate each period. This resulted in different risk-free rate for each period.

5. Conclusion

This study set out to investigate international diversification benefits for the Dutch investors since it is documented that international diversification benefits decreases over time as markets become more integrated. To facilitate this, several portfolio were constructed based on domestic, regional (European) and international assets. In this way, it can be seen were international diversification benefits stands compared to domestic and European diversification benefits for the Dutch investor. The portfolios were analyzed for a sample period of 14 years as well as sub-periods before and after the financial crisis of 2007-2008 using the Modern Portfolio Theory of Markowitz in combination with several quantitative measures; EF index, Sharpe ratio, Sortino ratio and Treynor ratio.

Overall, the findings indicate some mix outcomes in terms of the superiority of the portfolios. This is because there was no single portfolio that was superior in all three periods. The international combination portfolio appeared to be superior in two of three periods. In general, there are indeed international diversification benefits for the Dutch investor, as the findings point out for the long term period. Almost all the quantitative measures, besides the Treynor ratio reveal that the Dutch investor can combine domestic and international assets to have better diversification benefits in the long run. However, this does not seem to be the case in the period before and after the most recent financial crisis. The results for the pre-crisis period point out that it would be better for the Dutch investor to diversify with European assets. Even though the quantitative measures do not show the same outcome, they also suggest European assets. For the post crisis period, the quantitative measures besides the EF index indicate the international combination portfolio to be the most superior. Surprisingly, the Treynor measure indicates the

emerging market portfolio to be the best investment decision. However, in this occasion, the study suggests to follow the risk-adjusted performance measures as they are more suitable for assessing the risk of the portfolios located on the efficient frontier.

Other findings indicate that emerging markets are better for diversification over the long run, as indicated in the literature. However, this is not the case before and after the crisis where the measures shows mix results. Therefore, in the case for emerging or developed markets it depends on the quantitative measure chosen for the analysis, because this has to do with the measure of risk that is being considered. Furthermore, it can be noticed by the ranking order of the portfolios that the currency exchange rate might have an impact on the European and international assets. However, it appears that currency exchange rate might have less of an impact on European countries in comparison to international countries, as the findings indicate for all the periods. Only for the pre-crisis period, it seems that the currency exchange rate might have benefited European and international assets more than domestic assets, which is illustrated by the ranking order of the portfolios. Nevertheless, despite the currency exchange rate implications on the portfolios, European as well as international countries can still contribute to international portfolio diversification benefits; this was also mentioned through the literature.

In conclusion, it can be said that findings are in line with the expectations and hypothesis. Despite markets appear to be integrating, which cause the diversification benefits to decline, this study showed that there is still international diversification benefits for the Dutch investor. In addition, there are still diversification opportunities for the Dutch investor at the European level despite the integration of the Euro area through the Euro currency. Furthermore, the international diversified portfolios need not to be superior all the time. This is because the results reveal that the European portfolio is superior to the international portfolio in non-crisis periods. Therefore, the study does not fully support international portfolio diversification benefits because the Dutch investor can have diversification benefits with European assets as well. However, this also depends on the financial assets that are chosen and the market condition at the time.

Therefore, future studies should consider other financial assets or construct a benchmark portfolio that is more suiting for the Dutch investor. Besides this, a benchmark index can be made out of domestic stocks, which can be made equally or value weighted for comparison with international indices all over the world. In addition, domestic portfolios should not be compared with international portfolio of selected indices. This is because the selected assets within a

portfolio may provide greater positive or negative risk-return relationship compared to an index. This is due to the fact that indices may have different weighting systems. Hence, this study suggests comparing domestic portfolio of selected stocks with international portfolio of selected stocks for better comparison. In addition, further studies should examine pre-, during- and post-crisis periods for the Global Financial Crisis and the European Debt crisis. This will provide more periods of analysis as well. Most importantly, an extension of this study should find a way to incorporate transaction costs in the analysis in order to investigate how much it affects international diversification benefits. Extensions could also include the other methods such as the Stochastic Dominance (SD) approaches (Abid, Leung, Mroua, & Wong, 2014) , which is a tool used to rank investment prospects under uncertainty, in order to compliment the mean-variance optimization approach. These extensions can also help in examining whether the Dutch investors are home biased or not.

6. Bibliography

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7. Appendix

TABLE 7: EFFICIENT PORTFOLIO SETS OF EACH PORTFOLIO FOR PERIOD 1

DP01		DP02		EP01		EP02		IP01		IP02		DMP		EMP	
μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p
3.09	4.93	2.87	4.64	3.61	4.43	3.36	4.26	3.79	4.67	3.54	4.35	3.24	4.89	3.59	5.08
3.50	5.05	4.00	4.76	5.98	5.85	6.00	4.99	5.89	5.85	6.00	4.81	4.00	5.02	4.00	5.15
3.70	5.85	6.00	5.68	6.00	5.87	6.99	5.85	6.00	5.99	7.58	5.85	4.74	5.85	4.87	5.85
4.00	8.57	6.20	5.85	8.00	9.14	8.00	7.00	8.00	9.03	8.00	6.25	5.00	6.38	5.00	6.02
4.50	14.38	8.00	7.95	10.00	13.00	10.00	9.69	10.00	12.93	10.00	8.52	6.00	9.13	6.00	7.78
4.78	17.91	10.00	10.92	12.00	17.14	12.00	12.64	11.83	23.91	12.00	11.16	7.00	12.43	7.00	10.02
		12.00	14.15	12.96	20.20	14.00	15.76			14.00	15.41	8.00	15.94	8.00	12.48
		14.00	17.51			16.00	20.75			16.00	21.19	9.00	19.55	9.00	15.05
		16.00	21.45			16.60	23.70			16.60	23.70	9.29	20.62	10.00	17.68
		16.60	23.70											11.00	20.35
														11.83	23.91

Notes: The table present all the efficient portfolios set that forms each efficient frontier for period one. The sets consist of the portfolio return and risk. Each efficient frontier includes the minimum variance portfolio, the most efficient portfolio as well as the maximum portfolio in terms of risk and return. The optimum portfolios are the portfolios that display a portfolio risk of 5.85. Numbers are in percentages.

TABLE 8: EFFICIENT PORTFOLIO SETS OF EACH PORTFOLIO FOR PERIOD 2 (PRE-CRISIS)

DP01		DP02		EP01		EP02		IP01		IP02		DMP		EMP	
μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p
3.01	3.85	3.76	3.48	6.31	3.59	6.38	3.31	4.03	3.38	4.86	3.10	3.58	3.81	4.10	3.95
4.00	3.99	6.00	3.71	8.00	3.63	8.00	3.35	6.00	3.52	8.00	3.34	6.00	4.05	6.00	4.12
5.00	4.43	8.00	4.27	10.00	3.78	10.00	3.49	8.00	3.94	10.00	3.74	8.00	4.62	8.00	4.63
5.58	4.90	9.63	4.90	12.00	4.05	12.00	3.72	10.00	4.60	12.00	4.30	8.74	4.90	8.73	4.90
6.00	5.33	10.00	5.07	14.00	4.41	14.00	4.04	10.77	4.90	13.83	4.90	10.00	5.44	10.00	5.44
7.00	6.55	12.00	6.07	16.00	4.86	16.00	4.45	12.00	5.42	14.00	4.96	12.00	6.44	12.00	6.44
8.00	7.93	14.00	7.20	16.19	4.90	17.87	4.90	14.00	6.34	16.00	5.70	14.00	7.53	14.00	7.56
9.00	9.42	16.00	8.42	18.00	5.36	18.00	4.93	16.00	7.33	18.00	6.50	16.00	8.70	16.00	8.76
10.00	10.96	18.00	9.69	20.00	5.92	20.00	5.48	18.00	8.36	20.00	7.33	18.00	9.91	18.00	10.02
12.00	13.47	20.00	11.01	22.00	6.53	22.00	6.07	20.00	9.42	22.00	8.19	20.00	11.15	20.00	11.31
		22.00	12.35	24.00	7.17	24.00	6.69	22.00	10.50	24.00	9.08	22.00	12.43	22.00	12.62
		24.00	13.90	26.00	7.84	26.00	7.34	24.00	11.60	26.00	10.06	24.00	13.72	24.00	13.96
		26.00	15.87	28.00	8.53	28.00	8.01	26.00	12.72	28.00	11.39	26.00	15.03	26.00	15.30
		28.00	18.57	30.00	9.23	30.00	8.69	28.00	14.20	30.00	13.27	26.96	15.66	28.00	16.66
		30.00	22.21	32.00	9.98	32.00	9.51	30.00	16.33	32.00	15.54			30.57	18.19
		32.00	26.44	34.00	10.91	34.00	10.54	32.51	19.67	34.00	18.65				
		34.00	31.17	36.00	12.08	36.00	11.86			36.00	36.35				
		36.00	36.35	38.00	13.61	38.00	13.45			36.82	38.71				
				40.00	15.69	40.00	15.54								
				42.00	19.32	42.00	19.21								
				44.00	24.02	44.00	23.95								
						44.70	25.82								

Notes: The table presents the efficient portfolio sets that form each frontier for period two. The sets consist of the portfolio return and risk. Each efficient frontier includes the minimum variance portfolio, the most efficient portfolio as well as the maximum portfolio in terms of risk and return. The optimum portfolios are the portfolios that display a portfolio risk of 4.90 for this period. Numbers are in percentages.

TABLE 9: EFFICIENT PORTFOLIO SETS OF EACH PORTFOLIO FOR PERIOD 3 (POST-CRISIS)

DP01		DP02		EP01		EP02		IP01		IP02		DMP		EMP	
μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p	μ_p	σ_p
5.29	5.35	5.81	4.91	3.90	4.45	4.56	4.19	6.00	5.07	6.23	4.62	5.15	5.31	4.76	5.56
6.00	5.45	8.00	5.11	6.00	4.70	6.00	4.27	8.00	5.51	8.00	4.74	8.00	6.06	6.00	5.72
7.00	5.99	10.00	5.77	8.00	5.55	8.00	4.63	9.61	6.36	10.00	5.18	8.44	6.36	7.61	6.36
7.41	6.36	11.19	6.36	9.08	6.36	10.00	5.39	10.00	6.62	12.00	5.99	10.00	7.74	8.00	6.58
8.00	7.03	12.00	6.84	10.00	7.20	11.71	6.36	12.00	8.18	12.72	6.36	12.00	9.98	10.00	8.04
9.00	8.42	14.00	8.18	12.00	9.31	12.00	6.54	14.00	9.99	14.00	7.09	14.00	12.49	12.00	9.85
10.00	10.01	16.00	9.71	14.00	11.64	14.00	7.95	16.00	11.94	16.00	8.37	16.00	15.14	14.00	11.86
11.00	11.72	18.00	11.34	16.00	14.12	16.00	9.49	18.00	14.08	18.00	9.77	18.00	17.87	16.00	14.00
12.00	13.51	20.00	13.04	18.00	16.68	18.00	11.11	20.00	16.75	20.00	11.27	19.21	19.54	18.00	16.23
13.00	15.34	22.00	14.78			20.00	12.79	22.37	21.43	22.00	12.98			20.00	18.50
13.68	16.61	24.00	16.59			22.00	14.51			24.00	14.95			22.00	20.88
		26.00	18.85			24.00	16.39			26.00	18.10			22.37	21.43
						26.00	18.85			26.89	37.02				
						26.89	37.02								

Notes: The table presents the efficient portfolio sets that form each frontier for period three. The sets consist of the portfolio return and risk. Each efficient frontier includes the minimum variance portfolio, the most efficient portfolio as well as the maximum portfolio in terms of risk and return. The optimum portfolios are the portfolios that display a portfolio risk of 6.36 for this period. Numbers are in percentages.

TABLE 10: ADDITIONAL VARIABLES OF THE RISK-ADJUSTED MEASURES

Period / Ranking per measure				Type of portfolio	Expected return (μ_p)	Beta (β)	Downside risk (σ_d)
Period 1				14 years from January 2002 to December 2015			
EF Index	Sharpe	Treynor	Sortino				
1	1	4	1	IP02	7.58	0.11	19.77
2	2	1	2	EP02	6.99	0.09	19.99
3	3	3	3	DP02	6.20	0.08	19.52
4	4	2	4	EP01	5.98	0.07	19.76
5	5	5	5	IP01	5.89	0.09	20.81
6	6	6	6	EMP	4.87	0.07	18.93
7	7	7	7	DMP	4.74	0.09	18.30
8	8	8	8	DP01	3.70	0.10	18.29
Period 2				Pre-crisis from January 2002 to December 2006			
1	2	1	2	EP01	16.19	0.03	26.43
2	1	2	1	EP02	17.87	0.04	24.68
3	4	7	4	IP01	10.77	0.08	24.29
4	6	5	6	DMP	8.74	0.04	23.33
5	7	6	7	EMP	8.73	0.04	23.99
6	3	4	3	IP02	13.83	0.07	25.44
7	5	3	5	DP02	9.63	0.04	25.53
8	8	8	8	DP01	5.58	0.04	23.30
Period 3				Post-crisis from January 2009 to December 2015			
1	3	5	3	DP02	11.19	0.18	10.90
2	1	2	1	IP02	12.72	0.18	11.64
3	2	4	2	EP02	11.71	0.19	11.10
4	5	6	8	EP01	9.08	0.15	18.53
5	4	3	4	IP01	9.61	0.15	10.71
6	7	1	7	EMP	7.61	0.08	9.90
7	6	7	5	DMP	8.44	0.15	9.68
8	8	8	6	DP01	7.41	0.15	9.45

Notes: The table shows the other additional variables pertains to the ratio measures (see

Table 6) such as the Expected return, the Beta and the Downside risk. The expected returns for each period are from the most efficient portfolio (see Table 7,Table 8,Table 9). The betas represent portfolio betas, meaning that the optimal portfolio weights are multiplied with each beta of the individual assets within the portfolio. The downside risk is a more extension calculation. First, the excess return are calculated, then the only the negative excess returns are considered. These are the returns that are less than the risk-free rate. Afterwards, these negative returns are squared and the square root is taken from the standard deviation of the squared negative returns. Finally, the weekly downside risks are converted to annual downside risk. The standard deviation for period one, two and three are 5.85, 4.90, and 6.36 respectively. These are the risk for the most efficient portfolio as can be seen in Table 7,Table 8Table 9. The average risk-free rate is also calculated to accommodate each period. These are 2.18, 3.10, and 0.62 for period one, two and three. These additional measures are used to calculate the different ratios.

TABLE 11: EFFICIENT FRONTIER (EF) INDEX OF THE PORTFOLIO

Period / Ranking - 1=Highest 8=Lowest	Name of Period/Type of Portfolio	Lowest E(R) (A)	Lowest SD (B)	Number of Efficient Portfolios (C)	Summation of each E(R) / each SD (D)	Summation of each E(R) minus Lowest E(R) (E)	Summation of each SD minus Lowest SD (F)	Summation of each (E)/(F) (G)	**EF Index - Summation of each (G) x (D) (H)**
1	2	3	4	5	6	7	8	9	10
Period 1	14 years from January 2002 to December 2015								
1	IP02	3.54	4.89	9	0.93	61.86	57.23	1.08	**1.00**
2	EP02	3.36	4.26	9	0.89	59.08	64.71	0.91	**0.81**
3	DP02	2.87	4.76	10	0.82	66.97	69.01	0.97	**0.80**
4	EP01	3.61	4.43	9	0.77	33.28	44.62	0.75	**0.58**
5	IP01	3.79	4.35	6	0.73	22.76	36.27	0.63	**0.46**
6	EMP	3.59	5.15	11	0.62	40.81	72.66	0.56	**0.35**
7	DMP	3.24	5.08	9	0.56	27.11	54.09	0.50	**0.28**
8	DP01	3.09	4.93	6	0.42	5.03	27.10	0.19	**0.08**
Period 2	Pre-crisis from January 2002 to December 2006								
1	EP01	6.31	3.59	21	2.93	383.98	110.02	3.49	**10.22**
2	EP02	6.38	3.31	22	2.76	422.59	131.50	3.21	**8.85**
3	IP01	4.03	3.38	16	2.03	216.82	88.15	2.46	**4.99**
4	DMP	3.58	3.81	14	1.74	165.16	70.05	2.36	**4.11**
5	EMP	4.10	3.95	16	1.72	185.90	84.62	2.20	**3.78**
6	IP02	4.86	3.10	18	1.88	298.03	149.30	2.00	**3.75**
7	DP02	3.76	3.48	18	1.45	281.70	178.03	1.58	**2.30**
8	DP01	3.01	3.85	10	0.98	39.49	32.33	1.22	**1.20**
Period 3	Post-crisis from January 2009 to December 2015								
1	DP02	5.81	4.91	12	1.57	117.28	62.56	1.87	**2.94**
2	IP02	6.23	4.62	13	1.47	134.86	86.38	1.56	**2.30**
3	EP02	4.56	4.19	14	1.25	153.33	99.19	1.55	**1.93**
4	EP01	3.90	4.45	9	1.25	61.87	39.97	1.55	**1.93**
5	IP01	6.00	5.07	10	1.34	75.98	55.23	1.38	**1.85**
6	EMP	4.76	5.56	12	1.11	103.62	78.28	1.32	**1.47**
7	DMP	5.15	5.31	9	1.10	64.45	52.69	1.22	**1.35**
8	DP01	5.29	5.35	11	0.99	44.19	46.94	0.94	**0.94**

Notes: The table shows how the Efficient Frontier Index of the portfolios is calculated for all three periods. Column six shows the summation of the expected returns divided by the summation of the standard deviation that pertains to the efficient frontier (D) of a particular portfolio (see Table 7Table 8Table 9). Colum 7 is the summation of each expected return minus the lowest expected return (E) of a particular efficient frontier. Column 8 is similar but for standard deviations (F) of a particular frontier. Column nine is then (E) divided by (F). Finally, column 10 shows the EF Index value which is calculated by multiplying (G) with (D).