Portfolio Strategies in an International setting

Cand.Merc.AEF
Department of Economics

Master Thesis

Author: Thomas Grønsberg

Teaching supervisor:

Thomas Einfeldt

Graduation Date:
Spring 2010

Table of Content

Executive summary

The objective of this thesis is to investigate the performance of some of the most established portfolio allocation models and strategies in international perspective.

Our first goal was to find out the attractiveness of Denmark in a diversification perspective. Our result showed the Danish market has good diversification opportunities yielding a mean correlation 0.48 towards all countries. In contrast does the diversification potential seem to decrease when Denmark is in economic downturn. Moreover, our results showed that the Jordanian market had the lowest correlation against the Denmark both in general and in an economic down turn. Consequently this means that a Jordanian investor may find Denmark interesting for investment purposes, since an eventual down turn in a Denmark may be counter balanced with an upturn in Jordan. This supports the general opinion that markets located at a longer distance and the unlike market development had better diversification effect.

Next, we looked to the portfolio opportunities for a Danish investor to choose from when he wants to invest internationally, we see that the tangent portfolio seems to perform best of the portfolio models while a moving average trigger strategy does have the best overall performance. Furthermore, we also have found no support that the models that aimed to minimize risk do have a lower risk than other models.

Moreover, as we introduce a real life application namely transaction costs this did not change the rankings of the top portfolio models nor strategies. Again the trigger strategy is the definite winner with a Sharpe ratio of 34.47%, Jensen's Alfa at 1.18% per month and information ratio at 0.50. Because of its low tradability it is also the strategy with the lowest changes in performance. In overall matters this is clearly superior to the tangent portfolio as well. However, we see a clear tendency that strategies with a higher trading rate have a higher decrease in the performance measures Sharpe ratio, Jensen Alfa and the Information ratio.

The last event of this thesis shows how tangent and the trigger strategy perform compared to professional funds in the real world. The conclusion is surprising, showing that the trigger strategy clearly outperforms all funds throughout the period of 2005-2009.Seeing the other funds there is only one that beats the tangent portfolio, namely

Carnegie fund. Again this is quite surprising given the resources the fund managers and the simplicity of Markowitz tangent portfolio.

1.0 Introduction

The desire for reducing risk has always been present in human behaviour. Prior to the establishment of modern markets people relied on each other in order to reduce different types of risk. One example of this could be the role of the godfather when a child is baptized. In financial words, we can call this risk reduction.

Today, the desire of risk reduction is still present and is constantly used in a portfolio setting. In 1952, Harry Markowitz used this desire to formulate a method in order to reduce the risk of portfolio containing domestic securities. The method illustrated, that an investor could increase its risk-return payoff simply by increasing the number of securities in a portfolio. Moreover, Markowitz showed that the reduction of risk was a result of the unique behaviour of the securities. The name of this risk reduction technique was called diversification.

In time the ongoing process of globalisation reduced the barriers of trade and promoted investments abroad. Consequently, the aspect of diversification was extended into a new dimension. In 1974 Solnik promoted this dimension with he`s article "Why not diversify internationally rather than domestically". In the coming years, several researchers supported this way of thinking and embraced the aspect of international diversification.

Accordingly, investors also opened their eyes for the potential of international investments. According to Eun & Resnick, the US pension fund had circa $3 billion in foreign asset in 1980. In contrast, this amount had increased to $70 billion in 1989.

Even though investors had a seen a powerful tool for reducing risk, many had the same issues regarding portfolio allocation. Which theoretical framework should an investor rely on? What portfolio models and strategies are most successful over time?

In this thesis I will try to examine how some of the most used portfolio models and strategies perform in an international context over a 4 year period. The choice of the time period 2005-2009 are a result of careful consideration. Nonetheless, the main

argument is that the time period contains a solid base of both a bull market and a bear market.

Furthermore, many researchers have criticized the international diversification effect for not work in economic downturn. Consequently, this thesis will also examine the validity of this hypothesis and bring to a close the attractiveness of the Danish market in a diversification perspective. Moreover, the thesis will also reveal which country that has the best potential to diversify its investment in Denmark.

Furthermore, in the portfolio context this thesis will have the view of a Danish investor seeking to invest globally. Even though many researchers have investigated the international diversification effect before, there are relatively few who have investigated it from the Danish perspective.

In contrast, too several other investors are a Danish investor exposed to the nearly fixed rate exchange system and the overall decision making of the directives of the European Union. As the EU has developed into a single market, ensuring free movement of goods, labor, services and capital, the countries in the EU has become more dependent on each other behavior, reducing the diversification effect between EU countries. However, the elimination of barriers within the EU zone has reduced other risk barriers like political, legal and financial risk.

Overall, this thesis will aim to examine some of the most relevant portfolio theories and strategies performance in a global setting. I regard this possibility to be highly educational and motivational as it includes several of the AEF-line subjects and topics.

1.1 Research objectives

The following research questions will be answered in this thesis of international asset allocation.

Superior Problem Statement

- *How do international stock portfolio models and strategies perform in a Danish perspective?*

Subordinate problem statements

1. Is the Danish market an attractive market for foreign investors in a diversification perspective?

2. Does the diversification effect towards other markets reduce the risk in a Danish economic downturn? Which investor find Denmark most attractive?

3. How do the portfolio allocation models allocate its funds? Do the models prefer Denmark as an investment ground?

4. Which theoretical portfolio allocation models are superior in 2005-2009?

5. Do the risk minimizing models fulfill their obligation?

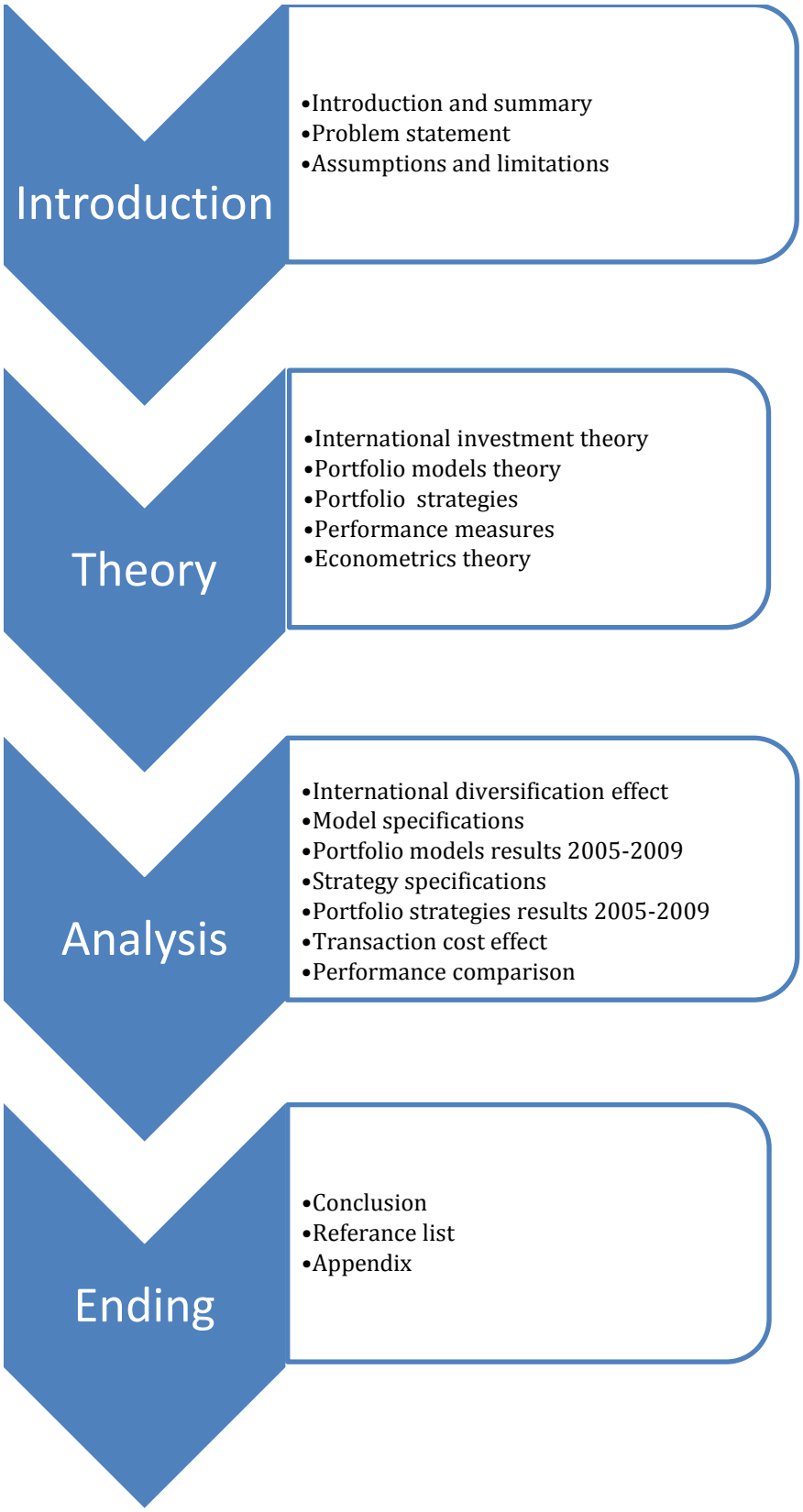
6. Are there any portfolio models that are superior in the bull and bear market?

7. How do portfolio strategies perform in comparison with the portfolio models in 2005-2009?

8. What are the effects of introducing transaction cost and will it alter our conclusions?

9. How do the top portfolio models and strategies perform in comparison with well known international traded funds?

Structure of thesis 1.2



1.3 Assumptions and limitations.

In order to maintain a clear focus and throughout the thesis it is necessary formulate some assumptions and limitations.

1.3.1 Assumptions

Throughout this thesis I will assume that the capital market is well functioning and that the returns are normal distributed. Included in the capital market premises are that the indices chosen are tradable and liquid instruments.

Moreover, as I approach the transaction cost part I will assume that all transactions have equal expense.

Last, I will assume that the investors are rational suggesting that they prefer more to less and that all hedging of currency are completed by future contracts meaning that we only view the index movement excluding the currencies behavior. Moreover, we will not incorporate any tax effects. This I mainly because the complexity of the Danish tax system and practical application of tax system used by investors to avoid taxes.

1.3.2 Limitations

1.3.2.1 Data

In order to investigate the global diversification effect and the portfolio framework I have chosen to use 13 country indices. These global equity benchmark indices are collected from MSCI Barra and are currently the one of the most used global equity indices. I find it impossible to include all nations' indices into our analysis as it will induce a huge amount of data and probably create problems regarding the procedure of theoretical models. As an alternative I have chosen the 13 nations who I believe represent the world and are attractive for a Danish investor.

On the first hand I have included the Nordic countries and the G7 countries. On the other hand I have chosen three emerging market participant which all represents their unique geographic locations. These three emerging markets participants are Mexico, Korea and Jordan. Before choosing these three participants, I examined the historical returns, variance and covariance of all emerging markets defined by MSCI BARRA indices. Nevertheless, the examination showed that Mexico, Korea and Jordan had relatively high risk-return payoff while having some of the lowest average correlations in towards other markets. Moreover, the relative long indices history and the geographic locations also induced a positive aspect of including these countries.

In order to utilize some of the theoretical portfolio strategies it is required to include a passive asset represented as bonds or bills. Since our perspective is Danish we include a Danish treasury bond starting in 2005 with maturity in 10 years. Optimally, we should have included a bond with maturity equal to our time horizon. However, the minimum maturity of a Danish treasury bond in this period was 10 years. Moreover, since a Danish treasury bond is close to risk free we assume that any capital gains or loss due to price fluctuations are insignificant.

The data we use to build our asset weights are the time period of 1988-2004. This estimation period of 17 years are based on monthly data and are hopefully sufficient to capture the behavior of the different stock exchanges.

1.3.2.2 Theoretical framework

In portfolio theory there are numerous models and applications in order to decide asset weights. I have chosen to use the framework that I believe is of high relevance to practice use and are understandable for any kind of investor.

The thesis will mainly focus on models based on a mean-variance approach. The models will be explained superficial, thus any derivations and complex details will not be incorporated in the theory. However, all theories will be applied in all of its complexity in the empirical approach of the models.

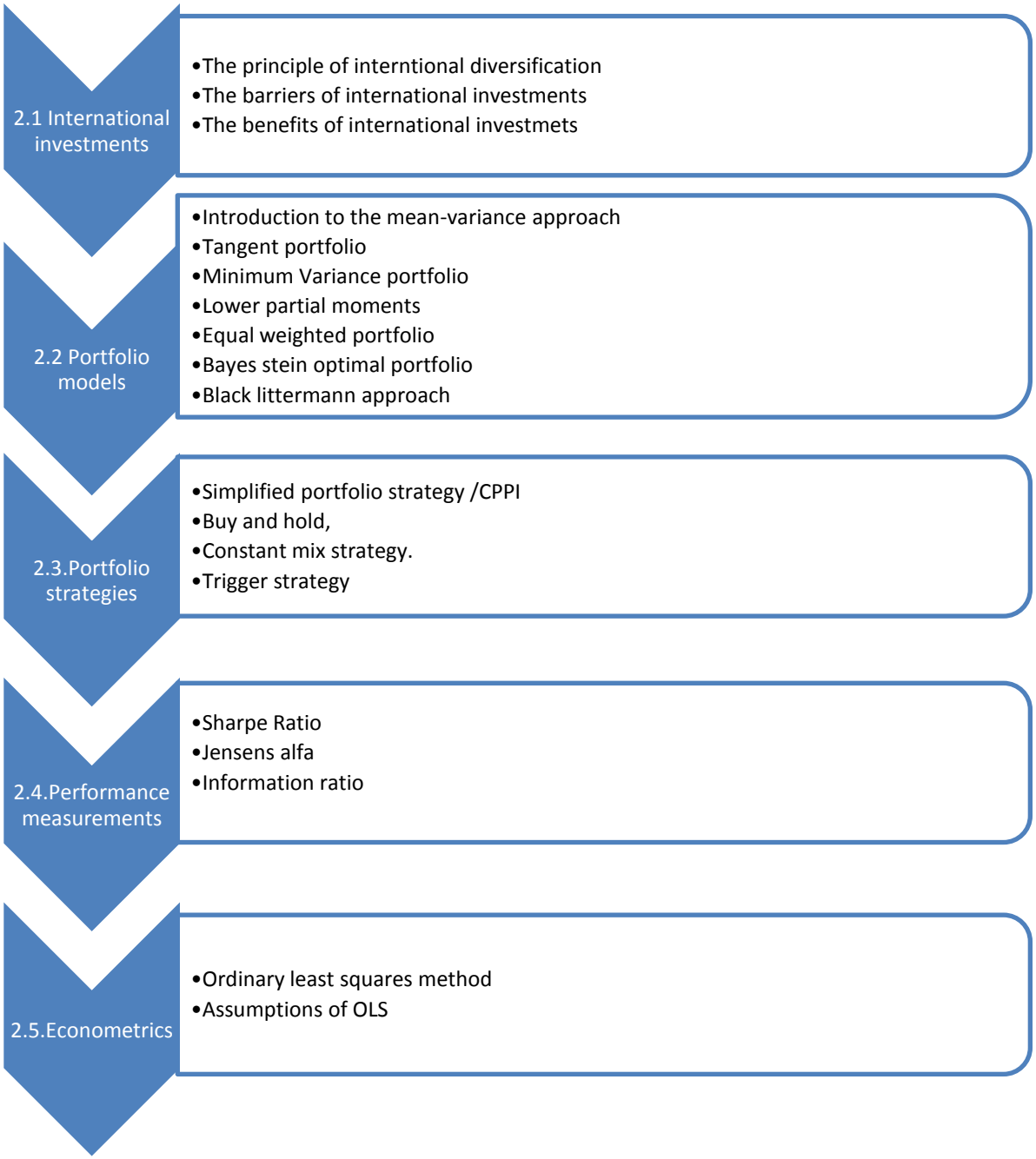
Short sales will not be allowed throughout this paper. The reason for this is that in many theoretical models incorporates extreme values in their asset weights when short sales are included. Another reason is that many stock exchanges treat short sales as an OTC

transaction and have unique short sales regulations. Moreover, I will assume that the sums of all the weights invested in the countries are equal to 100%.

Last, all investors will be treated as a group rather than individuals. This means that I will not incorporate individual utility functions, thus leave investor to self combine portfolio of choice and personal utility.

2.0 Theoretical approach

The section of theories aims to describe the aspect of international investments, relevant portfolio theories and strategies and the tools that are used throughout this thesis. The theory is structured the following way:



2.1 International Investments

2.1.1 The principle of international Investments and diversification

In portfolio context, diversification is probably one of the most discussed and embraced aspects. The importance of spreading the investment into several assets is one of most used techniques in order to reduce the risk of the portfolio. Diversification works because assets moves in different directions, hence one asset can upset a decrease in another asset. As a result, a diverse portfolio containing several assets has lower risk than one single asset alone.

Nowadays, portfolio diversification happens in different stages. Some spread their investments through different assets classes while other focus on spreading the investments through the same asset class. Since 1970 the focus on international investments created new diversification opportunities. Moreover, several studies highlighted the advantages of international diversification and showed that a portfolio containing international investments reduced the risk and increased the possibility of achieving better risk-return payoff. Before this period, many investors treated national boundaries as impregnable barriers, limiting their opportunities and financial options to only domestic and regional markets.

Today, companies and consumers are going global and so are an increasing number of investors. Globalization has integrated national economies in to social spanning international network of trade, increasing the correlation between markets. Nevertheless, the advantages of international diversification are still valid, present and just waiting to be exploited.

2.1.2 Barriers of international investments

While investments abroad can reduce the variability of a portfolio, it also has a downside. Political, economical and financial obstacles are in many countries enormous. According to A.M Best a well known full-service credit rating organization, Vietnam and Nigeria are some of the countries that have the highest country risk. The risk measure is based on an extensive amount of variables. Among these are economic policy, government stability, reporting standards and macro economy. Moreover, investing overseas induce several different currencies introducing exchange rate risk to a portfolio. However, since currencies move relative to each other, a gain in one currency can be upset by a decrease in another. Consequently, this means that a well diversified international portfolio can have a reduced currency risk. Moreover, most currencies movements can be hedged by use of futures contracts inducing that any risk due to exchange rates can be eliminated.

Even though some barriers are still present, globalization has opened markets and reduced the risk of investing abroad. Money invested abroad by institutions and investors are increasing drastically. The signs are clear, investors and institutions are starting to realize the potential of international investments.

However, some barriers are still present. Especially, the barrier called home bias. When investors exclusively hold much capital in domestic securities, despite the alleged benefits of diversifying into foreign securities this phenomenon is called home bias. Some researchers maintain that this preference of holding domestic securities without any apparent reason comes from the difficulties associated with investing in foreign securities and the natural tendency to avoid the unknown. According to the research done by Ahearne, William L. Griever, and. Warnock* (2000) estimate that foreign securities are about 12% of a US portfolio. Moreover, the research concludes that the home bias phenomenon is reducing but is still a valid and present issue. Additionally, a study of Glassman & Riddick (2001) claim that investors allocate to little funds in international equities in order to exploit the portfolio diversification effect. Conversely, later studies are less excited about international diversification in order to reduce risk. These maintain that international markets are highly correlated when markets experience high volatility. As a consequence, the study concludes that international diversification will not help an investor in order to reduce risk in these circumstances.

2.1.3 The benefits of international investments

International investing offers several advantages. First, the diversification effect that increases the risk-return trade off in most cases. Second an international focus offers more opportunities than a domestic focus.

International focus

Most of the world's stock market capitalization is in none Danish companies. Consequently, this means that if you want to invest in certain products and industries, many of the big and most profitable firms are located overseas. As a result, we can conclude that an international focus offers more investment opportunities than a domestic focus. The opportunities depend on how big and the structure of your domestic market. The smaller and less diversified the domestic market is, the more opportunities of international investing. Consequently, this means that a Danish investor can find more opportunities abroad than domestic.

Diversification benefit

Since an international focus suggests more securities to choose from, an investor can also anticipate a better risk-return tradeoff. The focus will create a broader the diversification that will result in an increase of the stability of returns and more diffuse risk. . Through international diversification across nations with different economic cycle's investors should be able to reduce variability of the portfolio returns. In other words, some domestic systematic risk can be diversifiable in a global context. This is supported by Shapiro (2005) that claims that an international diversification for an US investor can reduce the portfolio risk by 10%. In search of the international diversification benefit of our country selection it is useful to look at inter-correlation between the countries.

Table 2.1 Correlation matrix monthly data (Jan 1988-Dec 2004)

	Nordic Countries			G7 Countries							Emerging markets		
	Norway	Denmark	Sweder	France	Italy	Japan	UK	Germany	Canada	USA	Jordan	Mexico	Korea
Norway	**1,00**	0,61											
Denmark	0,61	**1,00**											
Sweden	0,58	0,58	**1,00**										
France	0,58	0,60	0,66	**1,00**									
Italy	0,50	0,55	0,56	0,65	**1,00**								
Japan	0,36	0,32	0,44	0,39	0,37	**1,00**							
UK	0,61	0,56	0,59	0,68	0,54	0,38	**1,00**						
Germany	0,58	0,65	0,70	0,83	0,64	0,34	0,64	**1,00**					
Canada	0,58	0,54	0,55	0,59	0,46	0,40	0,58	0,57	**1,00**				
USA	0,55	0,54	0,59	0,65	0,44	0,39	0,73	0,64	0,75	**1,00**			
Jordan	0,13	0,17	0,14	0,12	0,13	0,10	0,18	0,09	0,05	0,14	**1,00**		
Mexico	0,41	0,36	0,39	0,45	0,33	0,32	0,43	0,43	0,45	0,49	0,09	**1,00**	
Korea	0,26	0,28	0,32	0,23	0,26	0,39	0,37	0,23	0,32	0,34	0,12	0,26	**1,00**

The correlation matrix above illustrates the 13 markets that are included in my research exclusive exchange rates.

From the table above we see that all countries has a inter-correlation under 1, meaning that it is a potential for increasing the risk-return payoff by including some of these countries. The obvious conclusion is therefore that international diversification widen the efficient frontier. Especially, Jordan distinguishes from the rest when it comes to diversification effect. From all countries Jordan has the lowest historical correlation and has therefore the best potential for risk reduction towards any investor holding domestic stock.

However, this matrix does not comprehend with the fact that correlation between some markets often increases in a recession. Moreover, some countries even form economic blocks that makes them more vulnerable for economic shocks struck within the block countries. These economic blocks are often formed by neighboring countries to increase trade and importance of the countries involved. As a result, we tend to see a higher correlation towards countries located close to each other.

In general, the more independent a country are towards other countries import and export, the better will the country be in a global recession. However, the globalization and the presence of a global market place, forces countries to exploit their competitive

advantage. Consequently, countries are getting more dependent on other countries import and export. Especially, the developed countries whose all compete in almost every aspect of trade in a global market place. In later years, we have seen the negative effect globalization, leading a local downturn into a global recession. In academic terms, the word contagion describes this development. However, it should be mentioned that the local economy that lead to the global crisis of 2007 was the United States of America. Accordingly this crisis was special because of the US immense role in the world trade and market capitalization. Before the crisis of 2007 we have seen domestic crises that have not developed into a global crisis. One example are the Scandinavian Bank crisis during the 1990`s.

We can therefore conclude that a broad international diversification should in most circumstances be beneficial for an investor. Especially markets that are located far from each other tend to have a better diversification effect.

2.2 Portfolio theory

2.2.1 Introduction to portfolio models and strategies

Before we explain the actual portfolio models, we should give an introduction into a framework of the mean-variance approach and investor utility.

In a composition of a financial portfolio an investor has to choose between the two main goods, namely risk and return. In contrast to usual utility evaluation whereas both goods are positive, we see that one of the goods in this type of utility evaluation is negative (risk). However, risk and return often come hand in hand. In theory we generalize the different types of investor by their risk appetite. The three types we normally separate the investor are:

- Risk averse investors, $\lambda > 1$
- Risk seeking investor, $\lambda < 1$
- Risk neutral investor, $\lambda = 1$

The difference between the investor types are their demand for compensation in return to obtain any new risk. In general most investor is risk averse because they demand compensation for taking on new risk. This rationality is commonly used practice and is the general motive for why some people choose risky assets instead of a risk free asset.

In the 1950`s Harry Markowitz found a stunning result when investigating the risk of a portfolio containing several assets. He showed that by spreading the investments into several assets, an investor can claim a higher return per unit of risk than any of the asset alone. Accordingly this implied that the compensation of having risk was increased. Moreover, Markowitz also discovered that the returns of the different asset tend to behave close to the normal distribution within short intervals. Consequently, this meant that the only two factors that where relevant in a portfolio context was the mean and the standard deviation. As a result the basis of mean-variance approach in portfolio context was established.

2.2.2 Portfolio models

Already established the foundation of the mean-variance framework, we will explain the models that will be used in this thesis.

2.2.3 Tangent Portfolio

The tangent portfolio is based on the principle of rationality that people want to maximize the return and minimize the risk. The tangent portfolio is a mathematical formulation derived from the theory of diversification , with the intension of selecting a set of investment assets that has collectively the highest Sharpe ratio possible.

Tangent portfolio assumes that the assets return are a normally distributed random variable whose risk can be defined as the standard deviation of return and that the return of the portfolio is the weighted combination of assets.

$$\text{Return Portfolio} = \sum_{i=1}^{N} X_i \, (R_i) \qquad (1)$$

Where:

$\mathbf{X_i}$ Represents the weight invested in stock (i),

$\mathbf{R_i}$ Represents the return given that stock (i),

And the risk of and portfolio is:

$$\text{Variance to the portfolio} = \sum_{i=1}^{N} X_i^2 \, \sigma_i^2 \sum_{i=1}^{N} \sum_{j=1}^{N} X_i X_j \sigma_{i,j} \qquad (2)$$

Where the σ_i^2 represents the variance of stock (i), $\mathbf{X_j}$ are the weight invested in stock j and $\sigma_{i,j}$ are the covariance between stock (i) and (j). In other words you can say that the variance of a portfolio depends on the variance of the different stocks and the

covariance between them. If two securities are perfectly negatively correlated it should be possible to find some combinations of these that have zero risk.

The objective of tangent portfolio is to maximize the excess return of the portfolio and minimize risk. In other words, to maximize the Sharpe ratio

$$\text{Sharpe ratio} = \frac{\text{Return Portfolio} - \text{Risk free rate}}{\text{Standard deviation of portfolio}} \quad (3)$$

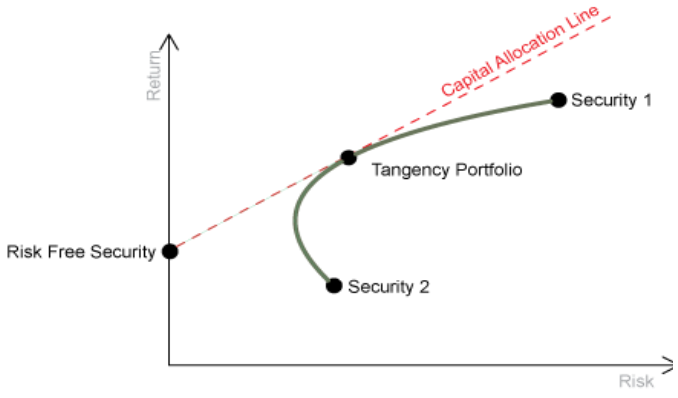
$$\text{Sharpe ratio} = \frac{\sum_{i=1}^{N} X_i(R_i - R_f)}{(\sum_{i=1}^{N} X_i^2 \sigma_i^2 \sum_{i=1}^{N} \sum_{j=1}^{N} X_i X_j \sigma_{i,j})^{\frac{1}{2}}} \quad (4)$$

Subject to:

$\sum_j X_i = 1, X_i > 0$

Our unknowns in the expression are the weights (Xi) that each asset should contain in our portfolio. Therefore we must find the derivative of this function with respect to all the asset weights in the portfolio. The tangent portfolio is often illustrated together with the efficient frontier and the capital allocation line.

Figure 2.2 Tangent portfolio



Source : www.krotscheck.net

The capital allocation line shows the possible fund allocation for a rational investor assuming that all investors have equal markets expectations and the same borrowing and lending rates. In this perfect world an investor will only hold a portfolio containing the tangent portfolio and a risk free asset.

If an investor is in the point of the tangency portfolio you have 100% of your fund allocated in the portfolio. In contrast the line from risk free rate to tangency portfolio reflects that you have some in a risk free asset and some in the tangency portfolio. The area above the tangency point means that an investor borrows money to invest in the tangency portfolio. As you see from the picture, an investor would not choose security two because the risk free rate has a higher return and zero risk. This logic also pertains to security one. A rational investor would obtain the same return as security one by gearing the tangency portfolio with debt. Accordingly, we see that the geared tangent portfolio will have less risk than security one. As a result, a rational investor will never choose security one alone.

2.2.4 Minimum Variance Portfolio

The minimum variance portfolio (MVP) is a well known theoretical portfolio model that aims to minimize the risk of a portfolio including risky assets. MVP maximizes the use of diversification to achieve the lowest risk possible for the portfolio. The portfolio model intends to hedge each investment with an offsetting investment. The name MVP comes from the mathematical expression of the outcome.

$$\text{Min } [\sigma_{\text{Portfolio}}] = \left[\sum_{i=1}^{N} X_i^2 \, \sigma_i^2 \sum_{i=1}^{N} \sum_{j=1}^{N} X_i X_j \sigma_{i,j}\right]^{\frac{1}{2}} \qquad (1)$$

Subject to:

$\sum_j X_i = 1, X_i > 0$

Where the σ_i^2 represents the variance of stock (i), X_j are the weight invested in stock j and $\sigma_{i,j}$ are the covariance between stock (i) and (j).

2.2.5 Lower partial moments

In a normal mean variance framework, we use the standard deviation as a measure of risk. However, the standard deviation incorporates both the positive and negative deviations from the mean. As a result, a high returns stocks with low probability of having negative returns may not be in the portfolio because of its high positive fluctuations above the mean. Markowitz, the founder of modern portfolio theory supported this idea and claimed that semi-variance is the right risk measure for portfolio.

To measure the downside risk I have chosen to implement the model called Lower partial moments first represented by W.V Harlow in his article "asset allocation in a downside framework". Mathematically Lower Partial Moments is described as:

Select X to minimize $LMP_n(\tau, x_i)$

$$LMP_n(\tau, x_i) = \sum_{Rp<\tau}^{\tau} p_p[\tau - R_p]^n \qquad (1)$$

Subject to; n=1 or n=2

$\sum_j X_j E(R_j) = R_p$ and $\sum_j X_j = 1, X_j > 0$,

p_p = probability of falling beneath target rate.

The (**τ**) symbolizes the target level of where an investor views the downside. In general this is sat to zero, where the portfolio return beneath this target rate is defined as the downside. Moreover, a positive portfolio return above the target return will have the deviation of zero.

In the LMP framework there are currently 3 frameworks. The first model LMP_0 measures the probability of going beneath the target rate. Second, LMP_1 represents the expected deviation of returns below the target. Consequently, LMP_2 symbolizes the target semi-variance or the squared of the deviation from the target rate of return.

Semi-variance captures the concept of downside risk and can be seen as the most relevant risk measure since an investor is often concerned about their losses relative to a threshold. Unlike the standard variance measure, semi-variance does not increase with

larger upside potential. Another advantage the LMP models is has less restrictive requirements to distributions and unique preferences like risk aversion and skewness. In accordance with Fishburn 1977, LMP_0 is only a suitable measure when investor is risk loving. In contrast, LMP_1 assumes that the investor is risk neutral. However, for risk averse investor LMP_2 seems to be the best fit. Moreover, LMP_2 are both intuitive and can easily be combined with the mean-variance framework of Markowitz.

2.2.6 Equal weighted portfolio

Equal weighted portfolio is not a very sophisticated model. The model aims to put equal weight of funds in every asset in the portfolio. Moreover expected return and risk is not incorporated in the model as it only aims to use equal weights in every asset. The portfolio usage is widespread because of its simplicity and as a reference point. Many portfolio managers use the portfolio to benchmark the performance of their personal portfolio. In general, if a portfolio has lower performance over time than the equal weighted portfolio the portfolio it is seen as low performing portfolio.

2.2.7 Bayes-Stein estimation (BS)

The Bayes-stein approach for portfolio analysis are a well-known estimation technique that aims reduce the degree of estimation error and the tendency for asset allocation to arrive in corner solution. Moreover, empirically the BS has proven to increase the performance of portfolios.

The background for the BS approach empirically success is that it comprehends with some of the problems related with tangency portfolio. One of these issues is the sensitivity of the asset weights to the mean, variance and covariance's. Especially the expected return is a parameter that is inflicted by much uncertainty. Some of the uncertainty is a result from the use of the sample mean to estimate expected return. The sample mean ignores much information contained in other series and may lead to biased estimates of the expected return. As a result the BS estimation aims to improve the estimates by use of a shrinking factor.

The expected return in BS Estimation is defined:

$$E\left(R_{portfolio}\right) = (1 - \widehat{w})\widehat{Y +}\ \widehat{w}1 \times Y_0 \qquad (1)$$

Where E(R portfolio) is the adjusted expected return, w is the shrinkage factor and Y is the original sample mean return. Moreover, Y0 symbolizes the minimum variance portfolio expected return. As we see the shrinking factor increases, more emphasis is put on the minimum variance portfolio. On the other hand, when the shrinking factor decreases towards zero, the tangency portfolio becomes more deterministic. The shrinking factor is described by the following equation:

$$\widehat{\mathrm{w}} = \frac{\mathrm{N+2}}{(\mathrm{N+2})+(\mathrm{Y}-\mathrm{Y_0})\grave{}\mathrm{T}\times\mathrm{S}^{-1}(\mathrm{Y}-\mathrm{Y_0})} \qquad (2)$$

Where “N” represents the number of assets and “T” describes the length of the time series. Moreover “S” symbolizes the adjusted covariance matrix for BST estimation. This matrix is adjusted for the instability of the covariance’s and variances. The adjusted covariance matrix is mathematically described the following way.

$$\grave{}\mathrm{S} = \mathrm{K} \times \frac{\mathrm{L}-1}{\mathrm{L}-\mathrm{N}-2} \qquad (3)$$

Where **K** represents the standard covariance matrix

Buy use of shrinking factor “$\widehat{w}$” we aim to improve our forecast of return. In order to do that we “shrink” the sample mean towards a common mean. One advantage of this

approach is its ability to unite and pool the information across the asset series. Furthermore, the use of a shrinking factor also decreases the effect extreme observations have on the expected return leading to more stabile asset weights. Empirically this adjustment has increased portfolio performance in out of sample testing.

2.2.8 Black litermann approach

Like the Bayes-Stein estimation the B&L approach also aims to resolve some of the optimization issues typical formed in classic mean-variance optimization. Especially the tendency that optimization models prescribes corner solutions with zero weights in many assets as well as unreasonable large asset weights in asset with small capitalizations. The problems generally stem from the sensitivity and the standard estimation of the expected return in ordinary optimization models.

To resolve these issues the B&L approach combines the mean-variance framework of with the standard CAPM model. By including the CAPM model the expected returns are in a global equilibrium and can be seen from a neutral point of view. Moreover, the model does not assume that the expected returns always are in a CAPM equilibrium, but rather that the expected returns tend to move back towards their equilibrium value when their values are out of balance.

The model distinguishes itself from other models by the fact that investor input their own views to in order to adjust to asset weights. Consequently, this means that an investor can use explicit knowledge about one asset movement as an input, in order to adjust the asset position to match this view. When the investor has no stated view about the individual asset the model falls back to the equilibrium.

Equilibrium expected return by the standard CAPM model

$$\text{CAPM model } E(\pi_i) = R_f + B_i(R_m - R_f) \qquad (1)$$

Where:

$E(\pi_{i)} =$ Expected Return of asset (i)

$$B_i = \frac{Cov(R_{i,}R_m)}{Var_m}$$

$R_f =$ Risk free rate and $R_m =$ Market return

2.3 Portfolio strategies

2.3.1 Simplified portfolio Insurance (SPI)/ CPPI strategy

The simplified portfolio insurance strategy or the CPPI is designed to be an easy understandable strategy with characteristics that makes it flexible under changing conditions. The portfolio utilizes two types of assets in order to succeed. One is the active asset while the other is called the reserved asset. The active asset is often stocks, while the reserve asset is a high ranked bond or a treasury bond. The principle of SPI starts with defining the minimum value of the portfolio. The difference between the portfolio market value and the minimum value is called the cushion. This represents the amount that fluctuates when market prices increases or decreases. When the minimum value is hit, the cushion will have the value of zero. In contrast, as the cushion increases your exposure will approach the maximum you can have in equities.

Second, we must choose the multiple that decides the pace of exposure to stocks. The higher the multiple is, the more volatile are our portfolio and the faster the minimum value is hit when stock prices decrease. In contrast, a high multiple will also lead to more participation and a higher return in a sustained increase in stock prices.

$$Exposure\ (e) = cushion\ (c) \times multiple \qquad (1)$$

As time goes and prices fluctuate, we must rebalance our portfolio to restore the relationship between the exposure and the cushion. When and how often you should restore the relationship depends on your tolerance for market moves. This can be described as the percentage move that will cause you to trade or a predetermined time limit. The smaller your tolerance is, the more often will you trade to restore the relationship.

To get a clear view of the SPI imagine that we have a portfolio of 100 million and we decide a minimum value of 80 million. At once, we see that our cushion becomes 20

million initially. Moreover, let's insert a multiple of 2.5. That means that our initial exposure in stocks will be 50 million. Our tolerance to exposure is set at a 2% increase or decrease in the market prices. As a result, when the market increases by 2% meaning that we would have a portfolio value of 101. Given no interest on our reserve asset, our cushion will now be 21 and our exposure will increase to 52.5.

The SPI strategy does not aim to beat an uninsured portfolio in all market movements. If you have all your wealth in stocks you can outperform the SPI strategy if the market increases, while you will lose more if the market decreases. In contrast to a constant mix of a reserve and active assets the SPI exposure are cyclical, meaning it would enlarge when market is increasing and reduce when market is decreasing. As a result, when the market increases substantially the SPI portfolio will outperform the constant mix strategy. However, the SPI are highly dependent on the volatility of the stock prices. High volatility in prices will increase trading costs and will decrease our wealth. Overall, we see that the SPI strategy is very simple and flexible under changing conditions. You can customize your own exposure depending on your risk aversion and easily change the strategy to fit changes in your circumstances.

2.3.2 Buy and hold strategy.

A buy and hold strategy is characterized by an initial mix of an active and a reserve asset (e.g. 50/50 stock to bills). As the reserve assets is often a nearly risk free asset the risk is contained in the active asset. When the active asset raise, the value of the assets increase at the pace sat by the initial mix. The payoff diagram of a Buy and hold strategy of 50% in stocks and 50 % in risk free bills is illustrated beneath.

Figure: 2.3 Illustration of the Buy and Hold strategy development

Since we our initial bills to stock ratio are 50% we have a guaranteed 50% of our initial wealth. In a portfolio worth 100 our intercept will therefore begin at 50 and have a slope of 0.5. Other features of a such strategy is that we have a linear relationship with the stock market, the upside potential is unlimited and the greater the initial percentage invested in stocks the better the performance the portfolio will have when stock market increases. When the stock market moves our ratio of bills and stocks will be altered to a match the corresponding movement. Therefore our initial 50% mix of bills and bonds will only be the ratio in the beginning or when the stock market are back at its opening value.

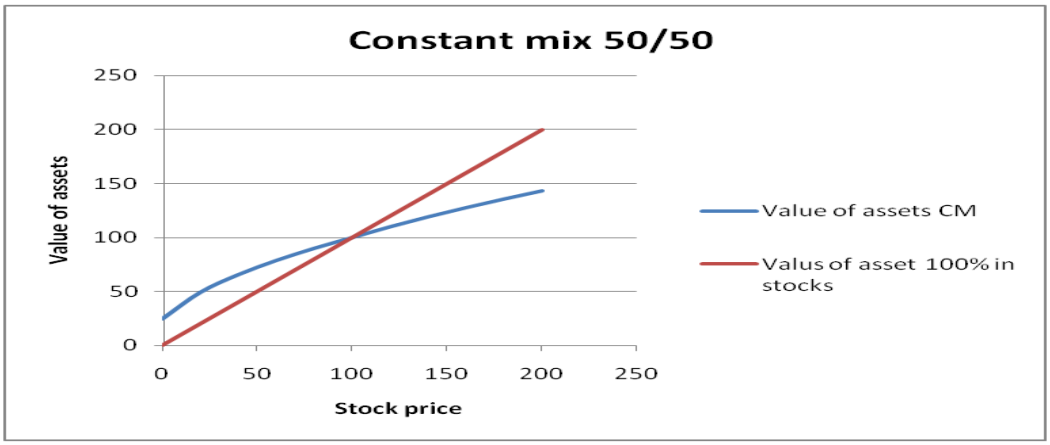
2.3.3 Constant mix strategy

The constant mix strategies aims to hold an exposure to stocks constant to the proportion of wealth. The strategy are a dynamic approach to investment decision making, meaning that a portfolio manager needs to trade continuously to keep the mix of bills and stocks constant. As soon as the relative values of assets change, sales and purchases are needed to obtain the desired mix. To illustrate the strategy imagine a

portfolio of 100 MDKK and a constant mix strategy of 50% in bills and stocks. After some time the stock prices increase by 10%. Given no interest on the bills, this means that we have 55 MDKK in stocks and 50 in bills. As a result our ratio of bills to asset value corresponds to 47,61%. Moreover, this means that the portfolio manager needs to sell stocks and purchase bonds to keep the initial determined mix. In this case the portfolio manager sells stock of 2.5 MDKK and purchases bonds for the corresponding amount and we can again see that the mix of bills to assets is 50%.

In general, rebalancing of constant mix strategy means that we must purchase the stocks as the fall in value, whereas the changes in value are measured in relative terms. Nevertheless, rebalancing whenever the stock market change, induce high transaction costs. As a result, portfolio managers use other approaches to avoid high transaction costs. One typical approach is to have predetermined limits to the relative change in the stock market (e.g. 10% change in stock market). Another is to have a predetermined time (e.g. monthly basis) that you always rebalance the portfolio. The payoff diagram of a constant mix strategy is illustrated beneath.

Figure: 2.4, Illustration of the Constant mix strategy development



In general when the market moves in one direction for some time the buy & hold strategy outperforms the constant mix strategy. However, we know that the stock market are volatile and does not always keep one direction. In these circumstances the constant mix strategy generally outperforms the Buy& hold strategy. Instead of keeping the same slope, the constant mix strategy changes the number of shares of stocks in the portfolio; hence the slope changes for every rebalancing. Imagine that the stock market

increases, and then fall back to its initial value. Since the strategy sells stocks when the market increases our loss in this market is less than a corresponding Buy& hold strategy.

2.3.4 Trigger strategy (TS)

Usually, portfolio managers have some view of the direction the market is going. Rationally, they will also have some preferences of portfolio strategies in different market conditions. When the future market prices are viewed with much uncertainty, portfolio managers tend to choose safe rather than risky assets. In contrast, when markets rise and the future look more certain, many portfolio managers increase their allocation in risky assets. As a result, we can conclude that portfolio manager's individual market view has a great influence on the portfolio performance. Some managers use macro-economic variables to predict the future market movement while others use historical prices and educated guess to determine their market view. Like a stop loss function in the financial market some portfolio managers use predetermined triggers in order to change their strategy.

In a portfolio context, the use of the technical analysis tools can be helpful to use as the triggers. Examination of the moving average (MA) is one example of how portfolio managers can determine their triggers. In general are MA used to assess the momentum of the index and identify areas of potential support and resistance. The signal of upward movement is generally trigger when the short term average crosses the long term average. Rationally this means that if the portfolio manager views the future as a potential economic upturn he will increase its balance in stocks and decrease the funds in bonds. In contrast, when the market decreases and meets its other trigger the portfolio manager reverses the previous transaction.

2.4 Performance measures

To evaluate the performance of the portfolio models and strategies described above we need to establish the framework for the assessment. In this thesis we will focus on the current three performance measures. To supplement the pre-described Sharpe ratio, we will also apply the well known Jensen's Alfa and the Information index. To better understand the performance measurements I have described the approaches beneath. One important issue to address before explaining the performance measures is that all performance measures are applied in a geometric mode rather than arithmetic. The use of the arithmetic mean rather than the geometric can produce misleading result. By use of the arithmetic mean we use the same weight of every observation and don't incur the previously obtained returns. Imagine a portfolio having two observations namely 30% at year 1 and -25% at year 2. The arithmetic average is then 1.25% inducing a positive return of the investment. Nevertheless using the geometric mean we actually get a negative average return of 1.25%. The reason is that the geometric mean incorporates that the investment has increased in value at year 1 meaning that we have now not only 100% invested but 130%. Consequently, we need to take into consideration the increased wealth and therefore I will pursue the geometric information ratio rather than the arithmetic. The general description of geometric mean and standard deviation is:

$$\bar{R}_{Gj} = (1 + R_{1j})^{\frac{1}{N}}(1 + R_{2j})^{\frac{1}{N}} \dots (1 + R_{Nj})^{\frac{1}{N}} - 1 \qquad (3.1)$$

$$Geo\ Stev\ (\sigma_g) = e^{\left(\sqrt{\frac{\sum_{i=1}^{n}\left(\left(\ln(1+R_i)-\left(\ln\left(1+\bar{R}_{Gj}\right)\right)\right)^2\right.}{n}}\right)} \qquad (3.2)$$

2.4.1 Sharpe Ratio

The Sharpe ratio is well known performance measure made by William Sharpe in 1966 that aims to capture the excess return per unit of risk. The higher the Sharpe ratio, the better are the performance of the portfolio. In general the Sharpe ratio is described as:

$$\text{Sharpe ratio} = \frac{\text{Return Portfolio} - \text{Risk free rate}}{\text{Standard deviation of portfolio}} \qquad (3.3)$$

2.4.2 Jensen Alfa

The Jensen`s Alfa is a performance measure created by Michael Jensen in the 1970`s that aimed to evaluate the mutual funds managers performance. Like Eugene Fama, many academics believe the portfolio managers cannot create a positive Alfa repeatedly over time. They claim that that financial market seems to be to efficient to constantly outperform the neutral expected return. Nonetheless, Alpha is still commonly used to evaluate portfolio managers and mutual fund performance.

The Jensen's Alfa performance measure incorporates the expected return of the portfolio using the CAPM model and views the real return obtained in comparison with our expectations. In Finance, the CAPM model by Sharpe and Litner are one of the most commonly used models to decide the required return on one investment. The model builds upon the foundation of Markowitz portfolio theories and diversification. The CAPM model states that the only relevant risk measure is the non-diversifiable risk, meaning that any individual asset risk that can be eliminated should not induce more required return. Consequently this means that the CAPM model is risk adjusted meaning that it incorporates the relative riskiness of the asset rather than the stand alone risk of the asset. In general, a positive Jensen`s Alfa means that the portfolio has created more return per risk than we expected. Jensen Alfa is mathematically described as:

$$\alpha_j = R_{Portfolio} - [R_f + B_i(R_m - R_f)] \quad (3.4)$$

Where

$B_i = \frac{Cov(R_i, R_m)}{Var_m}$

R_f = Risk free rate , R_m = Market Return, $R_{Portfolio}$ = Return of the Portfolio

2.4.3 Information ratio

Another performance measure is the information ratio. Like the Jensen`s Alfa this measure are also a risk adjusted performance measure that aims to capture the excess return of a portfolio in comparison to a benchmark. Unlike the Jensen`s Alfa the information ratio incorporates the tracking error the unique fund has towards the benchmark. The general expression of the information ratio is the following:

$$IR = \frac{E(R - R_b)}{\sqrt{var(R - R_b)}} = \frac{\alpha}{w}$$

The calculation of the modified information ratio is done using the procedure below:

1. Like the Jensen`s Alfa we first need to calculate the beta between the portfolio and the benchmark.
2. Next we normalize every return with the use of Beta as multiplier.

   Normalized Return (NR_t) = Portfolio Return $_t$ − Beta × Market Return$_t$

3. Calculate the geometric mean of the Normalized return.

4. Find the variability of Normalized Returns using the geometric standard deviation.

5. At last use divide the Geometric mean (α) with the Geometric standard deviation (w)

2.5 Econometrics

2.5.1 Ordinary Least Squares

Ordinary least squares method are a common way to test for linear relationship in the parameters of a model. The method intends to minimize the sum of squared residuals to best fit a linear relationship of the parameters (1.2). Mathematical the model are described as (1.1). We assume that the independent variables are non-stochastic variables with a fixed value. Moreover, the number of observations must exceed the number of parameters in the model.

$$Y = \alpha + \beta_1 X + \beta_2 X + \ldots + \beta_n X \qquad (1.1)$$

$$Y_i = \alpha + \beta_1 X_{1,i} + \beta_2 X_{2,i} + \ldots + \beta_n X_{n,i} + \varepsilon_i \qquad (1.2)$$

$$\min_{\beta_1 \beta_2 \ldots \beta_n} \left(\sum_{i=1}^{m} \varepsilon_i^2 \right) = \min_{\beta_1 \beta_2 \ldots \beta_n} \left(\sum_{i=1}^{m} (Y_i - \alpha - \beta_1 X_i - \beta_2 X_i - \ldots - \beta_n X_i) \right)^2$$

Overall, the models value and quality depends heavily on the behaviour of the residuals. Consequently, this means that we need to check whether residuals behave as the OLS assumptions require.

Assumptions of OLS

1: Expected error term is zero

$$E(\varepsilon) = 0$$

As our goal of OLS is to minimize the sum of error terms our expectations needs to be that the error terms have a value of zero.

2. No correlation between the error terms

$$cov\left(\varepsilon_i, \varepsilon_j\right) = cov\left(Y_i, Y_j\right) = 0 \;\; ; \;\; for\ all \quad i \neq j$$

The second assumption states that the error terms at different time stages are uncorrelated. This is necessary to maintain an unbiased variance of the betas, thus trust our t- test and our estimated R^2.

3. Zero covariance between μ_i and X_i

$$E(\mu i\ Xi) = 0$$

The third assumption states that the explanatory variable and the error term are uncorrelated. This is necessary for capturing the individual effects they may have on the dependent variable.

4. *No problem with Multicollinerity*

When we have more than one explanatory variable and these variables are highly correlated we have a problem with mulitcollinerity because we will not be able to separate the effects of the individual variables.

6. Constant variance in error terms

$$var\ (\varepsilon) = var\ (Y) = \sigma^2$$

Our sixth assumption states that the variance of error term is constant. This is required to have a trustworthy estimated variance, thus confidence in our t-tests and R^2.

7. The error terms are normally distributed

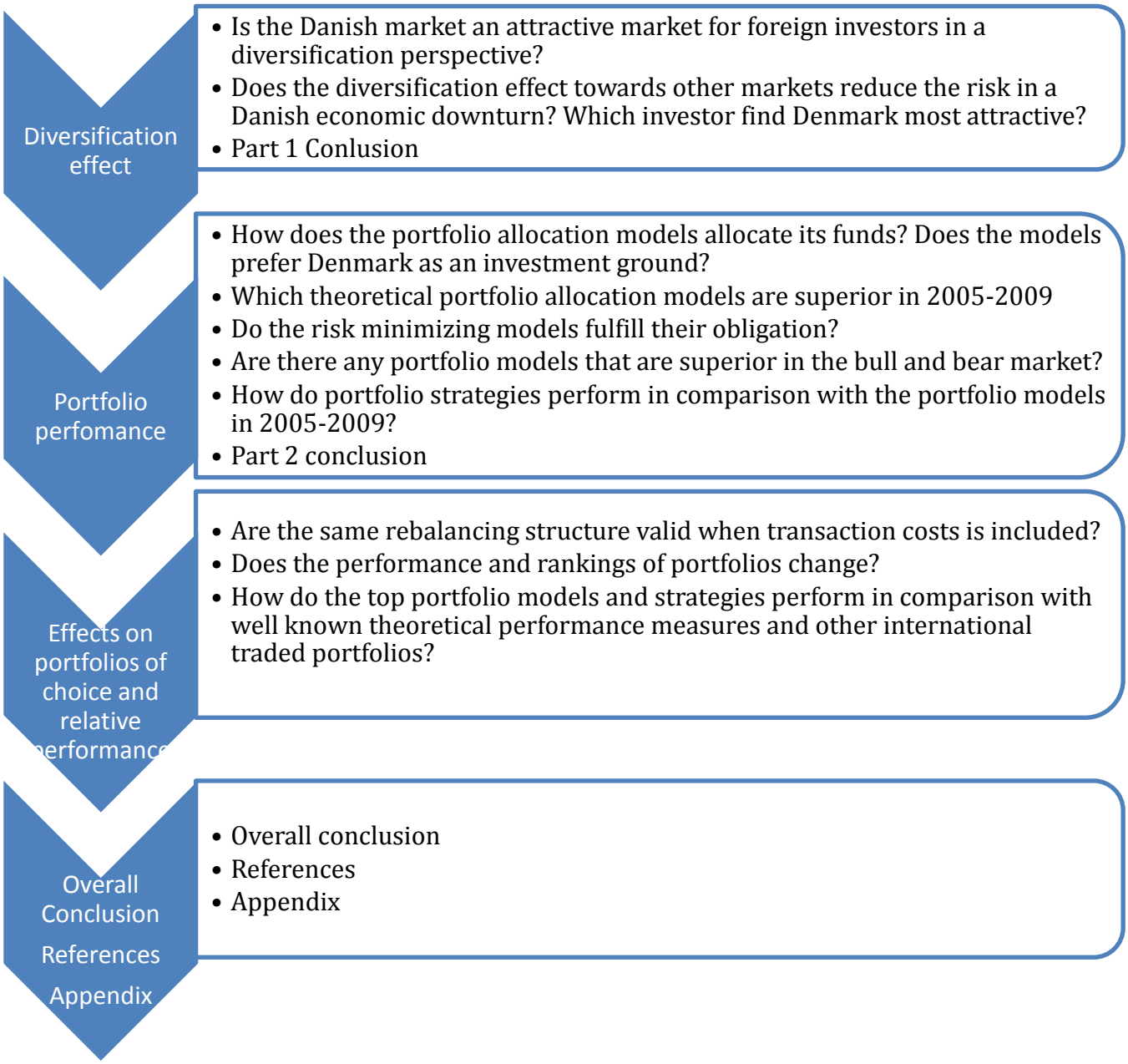
In order to relate our variables to their true values we need to capture the distribution of the random variable. When a continues random variable X has the following probability density function it is claimed to be normally distributed.

$$f(x) = \frac{1}{\sigma\sqrt{2\Pi}} \exp\left(-\frac{1}{2}\frac{(x-\mu)^2}{\sigma^2}\right) \quad ; \quad -\infty < x < \infty$$

where $\mu \; and \; \sigma^2$ are the mean and variance of the distribution

3.0 The empirical approach

The empirical approach of this thesis is divided into 4 main parts.



3.0 Diversification effect

3.1.1 Attractiveness of the Danish Market

Already established the positive aspects of diversification, this part will highlight the diversification effect the Danish market has towards other markets. Accordingly, this will reveal the attractiveness of the market for any investors interested in diversifying its local investment. In view of that, this means that we assume that a local investment is the market index of the respective country.

From table 2.1 in the theoretical approach we saw that throughout the period of 1988-2004, Denmark had correlations under 1 of every country in the sample. Moreover, table 3.1 underneath shows that the mean correlation throughout the period was 0.48. Consequently this means that the Danish market is highly potential for foreign investors to invest in. Not surprisingly the highest correlation towards the Danish market is represented by Germany at 0.65. In contrast we see that Jordan only have a correlation of 0.17 inducing that this market has the highest potential diversification gain towards Denmark. Moreover, the emerging markets seems to have the lowest correlation towards the Nordic countries inducing that that investors from Mexico, Korea and Jordan will benefit the most of investing in Denmark.. However, seeing that Japan only have a correlation of 0.32 in average towards Denmark we should expect a presence of Japanese capital in the Danish market. Moreover, the general picture seems to support the opinion that countries located at greater distance also has a better diversification effect. Accordingly, we should therefore expect to see a significant part of long distance investor in the Danish market.

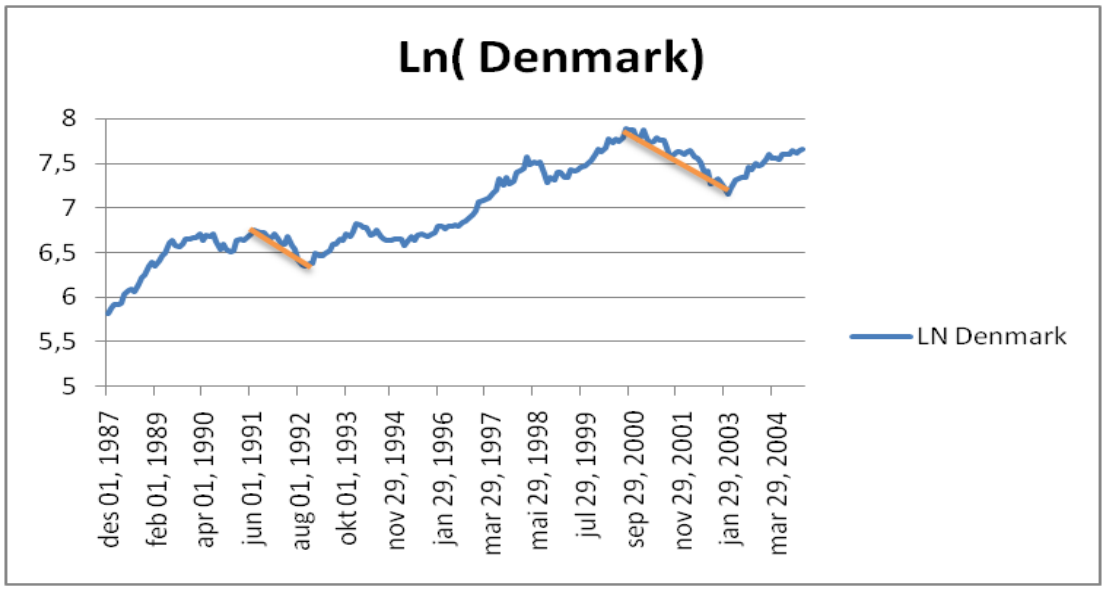
Table 3.1 Correlation between the Danish market and other markets

Denmark Correlations		*Descriptive statistic*	*Correlation*
Norway	0,61	Mean	0,479879
Sweden	0,58	Median	0,543358
France	0,60		
Italy	0,55	Standard Deviation	0,156077
Japan	0,32		
UK	0,56	Range	0,484762
Germany	0,65		
Canada	0,54	Minimum	0,16804
USA	0,54		
Jordan	0,17	Maximum	0,652802
Mexico	0,36		
Korea	0,28	Count	12

3.2 Diversification in Denmark in a down side Perspective.

Even though we have established that there is potential for risk reduction in Denmark for foreign investors, we still have not recognized the matter of risk reduction in an economic down turn. Many researches claim that the correlation increases in a recession, reducing the diversification benefits. If the correlation between the countries increases dramatically during a crisis, the goal of risk reduction through international diversification becomes diminished. In order to see this from a Danish perspective we first look at the graph illustrated beneath. The reason why figure 3.2 is illustrated in logarithmic scale is to better present the percentage changes in the index, thus the impact a change in the index has on the wealth of an investor at any given time.

Figure 3.2 Danish Stock market development



Through investigation of Danish economic history I have found two periods in the time period of 1988-2004 that we can state as an economic down turn. The first orange line represents the Scandinavian Bank crisis that lasted in Denmark from august 1991-October 1992. On the other hand, the second orange line represents the "dot.com bobble" that started august 2000 and ended February 2003.

In order to test whether the correlation are changing in a economic down turn, I collect the correlations that represents the economic down turn and compare them with the long term average.

Table 3.3 Descriptive statistics of the correlation in an economic down turn.

Denmark Correlations	***Bank crisis***	Dot.com Bobble	*Δ Bank crisis*	*Δ Dot.com bobble*
Norway	0,56	0,75	0,05	-0,14
Sweden	0,63	0,77	-0,04	-0,18
France	0,50	0,77	0,10	-0,17
Italy	0,31	0,70	0,24	-0,16
Japan	0,06	0,40	0,26	-0,08
UK	0,48	0,70	0,09	-0,13
Germany	0,63	0,82	0,03	-0,17
Canada	0,50	0,69	0,04	-0,16
USA	0,23	0,80	0,31	-0,26
Jordan	-0,24	0,29	0,41	-0,12
Mexico	0,49	0,78	-0,13	-0,42
Korea	-0,06	0,69	0,34	-0,41

The change represents the difference between the long term average and the crisis average. When the change is negative it means that the correlation has increased during the crisis. Accordingly, a positive sign leads to the interpretation that the respective crisis has reduced the correlation between Denmark and the respective market. Moreover, as we see from the table above, the bank crisis shows no sign of increasing correlations between the different markets. In contrast most markets seem to have a reduced their correlation towards Denmark during that crisis. On the other hand, the dot.com bobble seems to have increased the correlation significantly. One probable reason for this is that the dot.com bobble was a more worldwide crisis and long lasting crisis than the Bank crisis in Scandinavia.

Moreover, to examine whether the correlations change in Danish economic down turn I turn to the statistically tool Ordinary Least Square method. In order maintain stability in the correlation coefficients I choose to use 6 months correlations between the respective countries and Denmark. In total this reduces the observations from 205 to 34.

Moreover, a dummy variable is made and has the number of 1 when the observations are in an economic down turn and 0 when it is not.

The OLS regression is represented beneath.

$$Y_i = \alpha + \beta_1 D_{1,i} + \varepsilon_i \qquad (1.2)$$

Where:

Y_i =Is the 6 months correlation between Denmark and a given market.

$D_{1,i}$ = Represents the dummy that has 0 in normal conditions while having 1 in an economic down turn.

Our hypothesis is represented below:

H0: β_1 =0

H1: β_1 > 0

When testing the assumptions that OLS relies on, I first find that the normality assumption is rejected in almost all regressions. As a result, I change the independent variable to the exponential of Y_i instead of Y_i.

$$\exp(Y_i) = \alpha + \beta_1 D_{1,i}\, \varepsilon_i \qquad (1.3)$$

Moreover, testing for Heteroscedacity using the Whites test, shows that all regressions residuals have no indication of heteroscedicity. At last, we test for autocorrelation. Using the LM test with 4 lags, we find that Norway, UK, Japan and USA regressions are border line cases while the others show no sign of autocorrelation. A consequence of having autocorrelation in the error terms may be that the usual T-values of significance becomes invalid, thus are likely to lead to serious misleading conclusions. However, none of our regressions seems to have a great magnitude of autocorrelation in the error terms. As a result, we bring to a close that we don't have a serious problem with autocorrelation, thus we conclude that the OLS assumptions are fulfilled.

3.2.1 Model elaboration

After the corrected the functional form of the models to fulfill the OLS assumptions the result is described in table 5.4.

Table 3.4 Regression Results

	T value dummy, 5% level; Critical Value 1.697	Hypothesis Conclusion	Estimated Correlation in a Crisis Y(i)
Norway	1,21	H0: Accepted	0,59
Sweden	2,52	H0: Rejected	0,80
France	1,71	H0: Rejected	0,74
Italy	1,06	H0: Accepted	0,49
Japan	1,81	H0: Rejected	0,55
UK	1,87	H0: Rejected	0,72
Germany	0,71	H0: Accepted	0,62
Canada	2,33	H0: Rejected	0,72
USA	1,85	H0: Rejected	0,68
Jordan	-1,51	H0: Accepted	0,39
Mexico	2,27	H0: Rejected	0,69
Korea	2,47	H0: Rejected	0,68

In all regressions the intercept is clearly significant different from zero. In contrast, not all regressions dummy`s are significant at a 5% level. This means that some countries do not experience a change in correlation towards Denmark in an economic down turn. One of these countries is Italy that surprisingly has one of the estimated lowest 6 months correlations in Danish economic down turn. This means that Denmark can be a useful place to diversify some local systematic risk from an Italian Investor point of view. On the other hand we can also claim that Italy seems to a good place to diversify a Danish local investment.

Nonetheless the analysis shows that the mean has gone from 0.48 to 0.64 in a crisis, inducing that a crisis does have a real impact on attractiveness of the Danish market. Moreover, we see that Sweden has the highest estimated correlation leading to the conclusion that Denmark is not the best suitable place to exploit for a Swedish investor to diversify its local investment. Overall we see that no differences between developed countries and Emerging countries. Jordan has the estimated lowest correlation in the two crisis`s towards Denmark yielding at 0.39, while both Mexico and Korea has significant coefficients leading to a relative high estimated correlations.

3.2.2 Model discussion

To discuss the issue of the sustainability of the correlation in an economic down turn, we can first conclude that our analysis has an equivocal result. We see that 9 of the 13countries have significant coefficients at a 5% level, meaning that we can prove a structural break in the correlation. However, the OLS data set has some pitfall it is worth notice. First, the analysis is only based on the 34 data points inducing that this number can be too small to conclude anything. Second, we use the 6 months correlation that is observed from 12 data points. The stability of the 6 months correlation can be an issue because 12 data points may be too little to have a supportive stability of correlations. Accordingly, the use of monthly data can also be an issue since it may underestimate the correlations between the countries, thus some countries may actually have a significant increase in correlations if the same analysis was made with daily data. One last issue may be that the autocorrelation that is present in some regressions residuals may be too serious to neglect thus, leading to wrong conclusions.

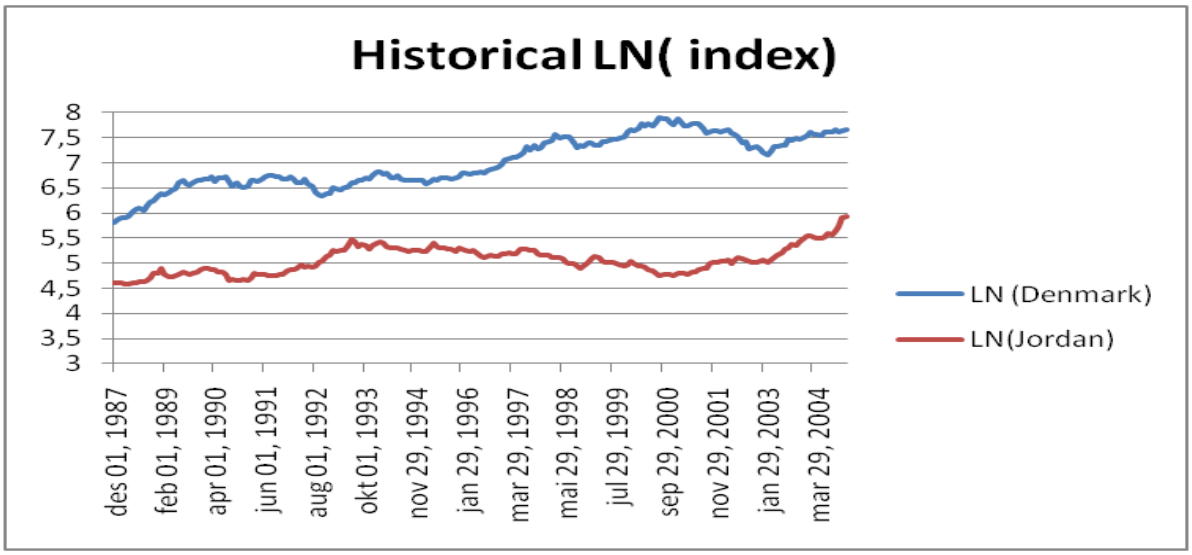
However, the analysis is only meant to be a quantitative tool in order to claim some kind of support of the hypothesis that correlation change in an economic down turn. We also find support for this, using the descriptive statistics in table 3.2. From the table 3.2 we found that all correlations had increased in the dot.com bobble while the bank crisis was more or less equivocal.

3.2.3 Conclusion:

In this part of the thesis we have looked into the attractiveness of the Danish market and the diversification effect that Denmark present internationally. We have investigated the relationship between other international markets and found that the Danish market has clear diversification benefits and that a foreign investor has clear advantages of investing in Denmark. Consequently we can also claim that a Danish investor with a local investment has the same benefits of investing overseas. However, we also find support that some markets increase their correlation towards Denmark in Danish economic down turn. Our estimates summons that the correlation between the countries and Denmark goes up to an average of 0.64 in a Danish crisis. This is an increase of 0.16, inducing that the diversification benefits of investing in Denmark decreases. An investor

should therefore be careful to invest in the Danish market without looking into the economic down turn correlations. Surprisingly, we find that Italy has one of the best diversification effects in a Danish downturn of perspective. Moreover, the country with the lowest correlation towards Denmark in all circumstances is Jordan. Overall, it has the 0.17 in correlation over the period 1988-2004, while having an estimated 0.39 (6 months correlation) in an economic down turn. Using the descriptive statistics by table 3.2 we see that the correlation between Denmark and Jordan is negative in the period of the Scandinavian Bank crisis while only increasing by 0.12 in the dot.com bobble. Accordingly, this supports our hint that any investors from Jordan should consider Denmark as investment ground, thus the Jordanian market could also be considered for Danish investor for diversification purposes. At last we see from graph beneath that Jordan has almost a counter movement towards Denmark. Accordingly this also supports our conclusion that Jordanian market has the best diversification effect towards Denmark, thus any investors with local investments in Jordan should consider the Danish market. Nevertheless, this analysis does not comprehend with risk types like political and environmental risk. As a result, this analysis does not capture all risk of an investment thus are not completely trustworthy for investment purposes.

Figure 3.5 Historical development of Denmark and Jordan



4.0 Portfolio performance

Already established that investing in Denmark does have diversification benefits, we now focus on international diversification, including all countries. Consequently, this section we will focus on the internationally diversification effect and truly aim to exploit all the correlation between the countries. Therefore we assume that the investor has no preferences for investing in Denmark. Accordingly this means that some portfolio models may not include the Danish market as an investment ground. Moreover, we will investigate the attractiveness of Denmark compared with the other Nordic countries and how the capital is invested.

<u>This section we aim to answer the following questions:</u>

- How do the portfolio allocation models allocate its funds? Do the models prefer Denmark as an investment ground?
- Which theoretical portfolio allocation models are superior in 2005-2009
- How do portfolio strategies perform in comparison with the portfolio models in 2005-2009?
- Are there any portfolio models and strategies that are superior in the bull and bear market?
- Portfolio models conclusion

4.1 From theory to practice, Portfolio models

Before we show our result from the portfolio allocation models we need to illustrate the practical application of the theoretical models. Some assumptions and ground rules are valid for all models, while others are only applicable in the models that are specified. All models are discussed in a practical setting expect from the equal weighted portfolio because of its simplicity and straightforwardness.

4.1.1 All models

For all the theoretical models we restrict the sum of the country portfolio weights to 100% of investment. This means that we do not allow gearing up our investment or investing less than 100%. Moreover, we restrict us the possibility of short sales, meaning that none of the country weights can have a negative value.

Another assumption is that the risk free rate is set at 3.3% per annum .This is collected from national banken.dk and is a 10 year, Danish government bonds yield. The reason for the use of the 10 year rather than a 4 year rate is that the Denmark only issues bonds with 10 year maturity. Accordingly, if the yield curve has an upward slope, the rate of 3.3% per annum should be a little bit larger than the rate we should have used in the proceeding 4 year period. However, an investor in 2005 stands in front of the same issues as we are now and therefore the best alternative for him is to use a 10 year government bond. As a result our monthly effective risk free rate will yield at 0.2709 % throughout this thesis.

4.1.2 Tangent portfolio and Minimum variance portfolio

The tangent portfolio and the minimum variance portfolio are calculated pretty straightforward. For the tangent portfolio, I firstly collect the returns of the countries from 1988-2004 where I use their respective arithmetic mean as the expected return.

Table 4.1 Expected return and standard mean-variance approach

	Norway	Denmark	Sweden	France	Italy	Japan	UK	Germany	Canada	USA	Jordan	Mexico	Korea
E(Return)	0,9 %	1,1 %	1,3 %	0,9 %	0,8 %	0,0 %	0,6 %	0,8 %	0,7 %	0,9 %	0,8 %	2,8 %	0,9 %
Exsess return	0,7 %	0,8 %	1,0 %	0,6 %	0,5 %	-0,3 %	0,3 %	0,5 %	0,4 %	0,6 %	0,5 %	2,5 %	0,7 %
STDEV	6,5 %	5,4 %	7,4 %	5,8 %	6,6 %	5,7 %	4,3 %	6,4 %	4,3 %	4,1 %	4,5 %	8,7 %	10,1 %
Sharpe	10,2 %	14,4 %	14,0 %	10,7 %	7,4 %	-5,2 %	7,7 %	8,3 %	9,3 %	14,6 %	10,7 %	29,0 %	6,7 %

Moreover, I use the function “covar” in exel in order to collect the covariance matrix. Our goal of the tangent portfolio is to maximize the return to risk ratio. To do this, I will utilize the solver function is Exel to obtain the maximum return to risk ratio with respect to the portfolio asset weights. Accordingly, we use the same aspect for the minimum variance portfolio. In contrast to the tangent portfolio, will the goal here be to minimize the portfolio variance with the respect to the asset weights.

4.1.3 Lower partial moments

The lower partial moment’s model has a different perspective on risk than the minimum variance model. Before you can start use the LMP approach we need to choose a target level. It is generally most common to choose either zero or the risk free rate as their target rate. The reason for the selection of zero as target rate is pretty obvious. As investors are afraid of decreasing wealth and losing some of its investment it is natural to set the target level to only see the down side. In contrast, the risk free rate is a guaranteed sum of money. An advantage of the choosing the risk free rate is that it incorporates the inflation and is the minimum rate of return after tax. However, I will use the zero as target rate, because this incorporates the possibility of a loss rather than the probability of a return lower than the risk free rate. Moreover, I will apply the historical returns from 1988-2004 as the respective observation without any risk premium corrections as described in W.V Harlow in his article “asset allocation in a downside framework”.

Alternatively the LMP formula can be written as:

Choose X to minimize

$$LMP_n(\tau, x_i) = \frac{1}{T-1}\sum_{Rp<\tau}^{\tau}\left[(\tau - \sum_{t=1}^{N} R_p)^n\right] \qquad (1)$$

Subject to; n=1 or n=2

$\sum_j X_j E(R_j) = R_p$ and $\sum_j X_j = 1, X_j > 0$,

T= Number of return observation

By adjusting (n) derive different aspect of the same story. However, deriving only the probability of having a loss does magnitude of every deviation from target at every observation and is only valid for risk loving investors. Both the two other models (n=1 and n=2) are more comparable to the mean variance framework. Accordingly, I find it more natural for me to use the target semi variance (n=2) measure because it lies closer to thought process you have obtained during the study at CBS and the mean-variance framework.

To obtain the asset weights I first input some initial guess of portfolio weights. These weights are currently the minimum variance weights. Secondly I create a function in Excel that calculates the deviation from 0 only if the deviation is negative. To obtain the target semi-variance I square the target short fall expression. At last I summarize the total of the variances ordered in time and minimize the weighted average expression with the respect to the asset weights.

The lower partial moment's model does not comprehend with correlation the same way as the minimum variance portfolio. Instead, it orders the returns in time so that one negative asset return in one point in time can be counter balanced by another asset positive return. Because of the ordering in time, the LMP approach actually takes into account some co-movement of the different assets.

4.1.4 Bayes stein estimation

In theory a rational investor will invest in a portfolio lying on the efficient frontier and hold the tangency portfolio. Nevertheless, the optimization of the tangency portfolio is highly dependent on the expected return. Moreover, the expected return is a very uncertain measure that is given more weight in an optimization than the covariance's and variances. As a result the BS estimation technique tries to handle with this problem by including the minimum variance portfolio to obtain a more robust and better forecast of returns. Mathematically BS estimation is illustrated beneath:

$$E(R) = (1 - \widehat{w})Y + \widehat{w}1Y_0 \qquad (1)$$

To calculate the new expected return vector, we have to find the weight ($\widehat{w}$) that represents how much emphasis we should place in the minimum variance portfolio. The BS estimation uses the following formula already explained in the theory part:

$$\widehat{w} = \frac{N+2}{(N+2)+(Y-Y_0)`T \times S^{-1}(Y-Y_0)} = 0{,}354 \qquad (2)$$

By using our shrinkage factor we obtain new expected returns of the countries that are more robust than the sample mean of historical return.

Table 4.2 Expected return Bayes Stein approach

	Norway	Denmark	Sweden	France	Italy	Japan	UK	Germany	Canada	USA	Jordan	Mexico	Korea
E(Return) BS	0,83 %	0,91 %	1,08 %	0,81 %	0,72 %	0,21 %	0,62 %	0,75 %	0,66 %	0,79 %	0,72 %	2,04 %	0,84 %
E(Excess R) BS	0,56 %	0,64 %	0,81 %	0,53 %	0,45 %	-0,06 %	0,35 %	0,47 %	0,39 %	0,52 %	0,45 %	1,77 %	0,57 %

4.1.5 Black Literman approach

In the BL approach we can do one of two things to obtain the expected return of the countries. One is to do use a reverse optimization. Another and the one I will use is the CAPM model, with the beta as the measure of risk. The MSCI world index will be used as the benchmark for the market return. The MSCI is a weighted capitalized index that aims to represent the world's capital market development.

For all countries the expected return are calculated the following way:

$$\text{Expected exsess return country (i)} = \text{Beta}_{\,i}(\text{Return}_{\text{world index}} - \text{Risk free rate}_{f}) \qquad (1)$$

In the CAPM setting the expected return in equilibrium mode, meaning that this is in theory what an investor should in return for their investments. Moreover, in BL approach an investor has the opportunity to set some views on the different assets. For example , can an investor claim that he believes Norway will over perform Denmark with 2% over a given period. As a result the expected returns will be altered to fit this subjective view. However, in this thesis I will not in calculate a subjective opinion about the different asset classes because this can ruin the neutrality and objectivity of the research.

Table 4.3 Expected return and systematic risk Black Literman approach

	Norway	Denmark	Sweden	France	Italy	Japan	UK	Germany	Canada	USA	Jordan	Mexico	Korea
E(Return)	0,59 %	0,54 %	0,69 %	0,61 %	0,59 %	0,57 %	0,54 %	0,64 %	0,52 %	0,56 %	0,33 %	0,63 %	0,61 %
Beta	1,04	0,86	1,35	1,10	1,01	0,97	0,85	1,19	0,81	0,91	0,18	1,15	1,08

First of all we see that the expected return deviates much from the averages given in table 4.1. In general we see that the markets I have chosen has over performed in comparison to the neutral CAPM expected return. The BL approach claims that the neutral setting will give a more stability over the expected returns and therefore arrive less in corner solutions. Using the new expected return we again aim to maximize the Sharpe ratio to obtain the asset weights.

Table 4.4 The initial asset weights for all models.

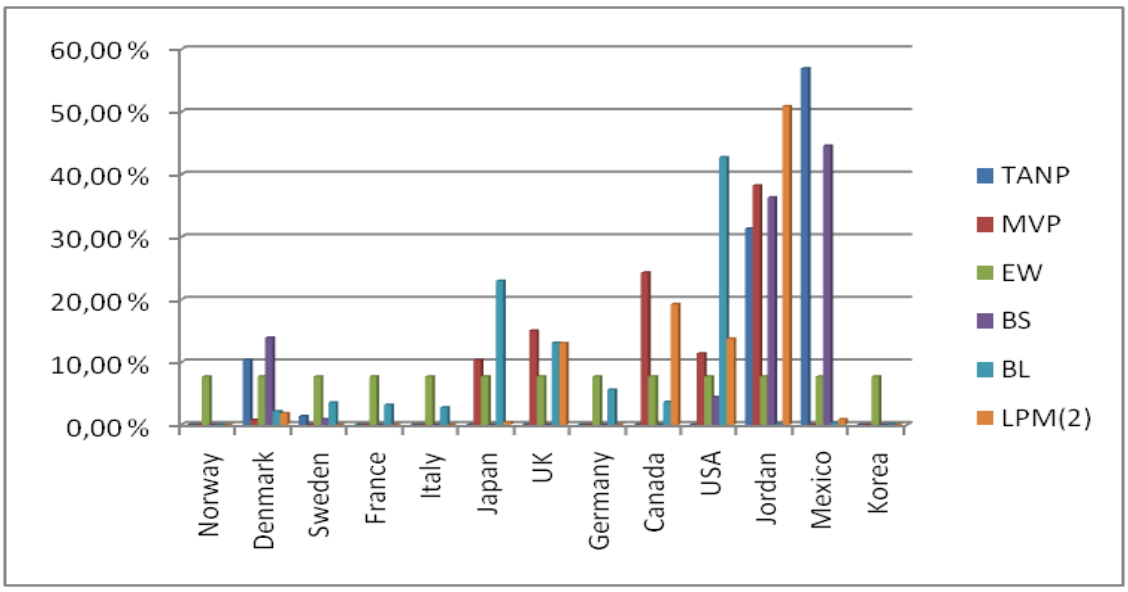
	TANP	MVP	EW	BS	BL	LPM(2)
Norway	0,00 %	0,00 %	7,69 %	0,00 %	0,00 %	0,00 %
Denmark	10,35 %	0,74 %	7,69 %	13,91 %	2,13 %	1,82 %
Sweden	1,36 %	0,00 %	7,69 %	0,85 %	3,53 %	0,00 %
France	0,00 %	0,00 %	7,69 %	0,00 %	3,15 %	0,00 %
Italy	0,00 %	0,00 %	7,69 %	0,00 %	2,74 %	0,00 %
Japan	0,00 %	10,36 %	7,69 %	0,00 %	22,96 %	0,41 %
UK	0,00 %	15,04 %	7,69 %	0,00 %	13,06 %	13,04 %
Germany	0,00 %	0,00 %	7,69 %	0,00 %	5,61 %	0,00 %
Canada	0,00 %	24,28 %	7,69 %	0,00 %	3,61 %	19,25 %
USA	0,00 %	11,39 %	7,69 %	4,38 %	42,71 %	13,72 %
Jordan	31,35 %	38,19 %	7,69 %	36,29 %	0,12 %	50,90 %
Mexico	56,94 %	0,00 %	7,69 %	44,57 %	0,31 %	0,86 %
Korea	0,00 %	0,00 %	7,69 %	0,00 %	0,07 %	0,00 %
Sum	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %	100,00 %
E(EXESS RETURN)	1,68852 %	0,37626 %	0,68117 %	1,07 %	0,29725 %	0,48480 %
E(Return)	1,95944 %	0,64718 %	0,95210 %	1,34 %	0,56817 %	0,75572 %
E(STDEV)	5,55486 %	3,02411 %	4,19438 %	4,99 %	3,85791 %	3,13834 %
Sharpe	30,40 %	12,44 %	16,24 %	21,42 %	7,70 %	15,45 %

The first thing to notice is that the weights deviates a lot from each other depending on the portfolio of choice. Surprisingly, Denmark and Mexico are in chosen for every portfolio model. Seeing from a mean variance perspective we should therefore expect that the Danish stock market should have a significant number of international investors. Comparing to the other Nordic countries we see that the Danish market is clearly the most selective one, inducing that it should contain more international investor than the other. In contrast we see that Norwegian market does only capture funds at the equal weighted portfolio while Sweden only are selected with a very small portion of wealth. One reason probable reason for the Danish allocation in the portfolio models is that it generally has a low standard deviation while having a high average return. According to this initial allocation of capital we can therefore claim that Denmark should be the best investment ground compared with the other Nordic markets. In contrast to Denmark, we see that Mexico captures a significant of wealth in every portfolio model. As a result, Mexico seems to be the most attractive place to invest only looking at the allocation of capital of these portfolio models. A more graphic illustration of the initial weights is illustrated beneath.

Looking at the expected return, we see that only two models has a expected return over 1% per month, namely the tangent and the Bayes stein estimation. Not, surprisingly the

tangent has the highest Sharpe ratio with Bayes stein estimation close by. In contrast, we see that the lower partial moment's model has a low Sharpe ratio. However, it might not be relevant to compare Sharpe ratio since models like the LMP does not aim to maximize the Sharpe ratio and has a different perspective on risk.

Figure 4.5 Initial asset weights distribution



Notice from the graphic illustration that it seems that the highest weights are to the right in the picture. It seems that the Emerging markets have higher weights in almost all portfolio models than the Developed and Scandinavian markets. Especially Jordan and Mexico has high weights in almost all models. Seeing the two models that aim to minimize risk, we see some similar behavior. Both invest in the same countries expect from one country namely Mexico. However, LMP model seems to invest a huge amount of weight in Jordan while Minimum Variance has a more uniform asset weights. Accordingly we can also see that the BL approach fulfills its obligation of having a more diverse asset allocation. In total the BL approach invests in a total of 12 out of 13 countries. In comparison we see can see that the tangent portfolio only uses 4 countries to allocate in.

4.2 Performance of portfolio models

To measure the performance of the models I collect the returns from 2005-2009. In the matter of rebalancing of portfolio asset weights we can use one of two ways. One way could be to calculate new asset weights every time you add one observation. Another is to keep your initial asset weights constant. I will proceed with a combined solution because I believe that new observation has some information and therefore will an investor seek to in calculate these observations into the asset allocation models. Consequently, this means that I will keep the asset weights constant in 12 months and then rebalance new asset weights to capture any new behavior of the observations.

Table 4.6 Portfolio models performance

Return	TANP	MVP	EW	BS	BL	LPM(2)	World index
"Return" 2005	51,10 %	40,41 %	31,86 %	51,09 %	18,36 %	44,24 %	13,74 %
"Return" 2006	5,70 %	-4,46 %	13,09 %	2,57 %	12,25 %	-10,37 %	13,52 %
"Return" 2007	13,98 %	8,69 %	7,20 %	14,51 %	0,70 %	12,22 %	2,83 %
"Return" 2008	-33,53 %	-35,57 %	-40,44 %	-34,46 %	-39,49 %	-34,99 %	-40,11 %
Monthly Average	0,40 %	-0,13 %	-0,10 %	0,32 %	-0,44 %	-0,12 %	-0,48 %
Standard Dev	5,12 %	4,79 %	4,93 %	5,11 %	4,56 %	5,24 %	4,43 %
Sharpe ratio	2,48 %	-8,38 %	-7,57 %	0,87 %	-15,57 %	-7,49 %	-16,88 %
Probability of negative retur	39,58 %	43,75 %	41,67 %	39,58 %	41,67 %	45,83 %	41,67 %
Average Negative return	-3,95 %	-3,75 %	-4,01 %	-3,93 %	-4,02 %	-3,87 %	-3,97 %
Negative outcome	-1,56 %	-1,64 %	-1,67 %	-1,56 %	-1,67 %	-1,77 %	-1,66 %
Jensen alfa	0,81 %	0,22 %	0,43 %	0,71 %	0,06 %	0,18 %	
IC	0,28	0,09	0,39	0,24	0,11	0,06	

From the table 4.6 we see that the Tangent portfolio has the highest average monthly return yielding at 0.4% throughout the period of 2005-2009. At second place we see the Bayes stein estimation that yields a monthly return of 0.32%. In comparison the World index has a negative performance throughout the period. Surprisingly, we see that all portfolio models have a higher monthly return than the world index.

Moreover, seeing the bull market of 2005 we see that the tangent portfolio and Bayes Stein estimation has superior performance. By investing 1 DKK in the tangent portfolio in the beginning at 2005 it would have increase your wealth to 1.51 DKK at the end of 2005. However, looking at 2006 who we also define as a bull market, we see that the performance decreases and none of the portfolios manage to outperform the market. As

we approach the financial crisis of 2008 we see that the all portfolios except the equal weighted portfolio outperform the world index. Surprisingly, the tangent portfolio once again has the highest annual return. In overall, the results are more or less equivocal. In a bull market the highest performing portfolio are changing in each in each year. However, in total the tangent portfolio is the highest performer in the period of 2005-2007 while also having the highest return in the bear market of 2008. Nevertheless, the difference between the best performer and the second best is very small, thus leading to an equivocal result.

On the other hand we see that the models that aim to minimize risk seem not to fulfill their obligation of risk reduction. Looking at the probability of a negative return we see that the LMP and the MVP has the highest probability of getting a return below zero. Moreover, looking at the magnitude of risk represented by average negative return we see that LMP does not seem to have a significantly lower magnitude of risk. In contrast, MVP seems to have the lowest average negative return inducing that it may have some risk reduction effect. However, seeing the negative outcome who is the probability of negative return multiplied with the average negative return we see that none of the risk reduction models has the lowest negative outcome. Moreover, both show no indication of a significant lower standard deviation than any other models. In contrast we see that the BL approach and the equal weighted portfolio have the lowest standard deviation. One thing that these two models have in common is its ability to allocate its investment within many assets. Consequently this may be an indication that the best risk reduction alternative is to spread your investments as much as possible. In perspective we can conclude that the risk reduction model does not seem to have any significant effect on risk reduction at all.

Last, we can view our performance measurements. Seeing the Sharpe ratio we observe that only the tangent and the Bayes stein approach has a positive number. This is mainly due to the fact that the tangent and the BS estimation create positive return, while all other models have a negative average return.

Moreover, examining the Jensen's alfa we see the tangent portfolio has the highest additional return of around 0.81%. This means that over the period of 2005-2009 the tangent portfolio has circa 10% better performance than the CAPM model should require in annual terms. Surprisingly, all models have a positive Alfa meaning that all

models over performed the CAPM expected return. However, the Black Litermann approach only manages to have 0.06% better than the monthly expected return.

In addition we see from table 4.6 that the equal weighted portfolio has the highest information ratio of 0.39. The equal weighted has a very low tracking error, since it almost replicates the world index and therefore a very low geometric standard error. Looking at the other models, we see that LMP has the worst performance while Tangent and Bayes stein have pretty high index numbers. In general the higher the information ratio is the better the manager. According to Wikipedia the top quartile of manager's achieve information ratios of circa one half. Comparing this with our result we see that the equal weighted portfolio is pretty close even though it`s probably the least sophisticated portfolios.

4.3 From theory to practice, Portfolio strategies

Having stated the result of the portfolio models, we know turn to the portfolio strategies in hope of achieving even better than before. The models I will pursue in this thesis are the CPPI, Buy and hold, constant mix and a technical trigger strategy. Before going directly to the results I will show the practical application of the models. To make the application of the models more easy to understand I assume a start capital of 100.000 DKK. Moreover, in all strategies my active asset will be the Bayes stein estimation portfolio while the reserve asset will be the Danish government 10Y bond yielding at 0.2709% per month. The choosing of the Bayes stein estimation is based on the empirical result of Jorion.P in 1985.

4.3.1 CPPI/SPI

Our first matter in the CPPI model is to define where our minimum value 80.000 with a multiplier of 3. Consequently our cushion becomes 20.000 and our initial exposure at 60.000. This is the same initial value invested in the active asset as the other portfolio models. The rebalancing of the strategy will be based on a monthly basis rather than at a given tolerance level.

4.3.2 Buy and Hold

The buy and hold strategy is probably the most straightforward and simple strategy an investor can use. In this thesis I will employ the same ratio of stocks and bonds used in article of Sharpe and Perold (1994) namely 60% in stocks and 40 % in bonds. The only criteria for the Buy and Hold strategy are that you have an initial mix of bonds and Stocks. After determine the initial mix the process is determined by the market where your exposure extends to the amount invested in stocks.

4.3.3 Constant mix

The constant mix strategy aim to keep the ratio of bonds and stocks constant at all times. We find it natural to rebalance every month and the ratio of bonds to stocks is set to 40/60. This is the same as the initial ratio of the Buy and hold strategy. The amount of exposure is a constant set to 60% of the investment at all times. In contrast to the Buy and Hold strategy that has a rising exposure as stock prices increases, the CM have a constant percentage exposure of wealth. The constant mix strategy purchase stocks as they fall in value and sells stock when they increase to always maintain the relationship of stocks and bonds.

4.3.4 Trigger Strategy

The trigger strategy is a strategy that aims to capture the movement of the indices before the changes happen. To do this I collect a well known technical analysis tool called moving average.

My first goal is to find the moving average model that has performed best in a historical setting and has given us a trade hint before the crisis set in. A trade hint in this context can be when a short term average goes crosses long term moving average. In other words, we shift to a more reserve position when the short term average is below the long term and more active when the opposite happens. In this thesis I will change to the bond when the technical tool hints of a decrease in prices and use the active asset when the tool indicates an increase in prices. The reason for my choosing of the World index is that the Danish investors we have chosen have international perspective. Therefore it will be of more significance to investigate the world index rather than the Danish. To capture the movement I have chosen two simple moving average standards. The first standard is the simplified moving average which weighs each observation equal, meaning that old observations are equal weighted with new observations. In contrast, this thesis also investigates the exponential moving average that put more weight to new observation, thus is more rapid to capture any sudden movement.

The models that I tested out on the world index are described underneath.

Table 4.7 Performance with a trigger 1988-2004

MA; Models	Trigger Return World index	EMA	SMA
7M,3M		0,72 %	0,54 %
7M,4M		0,68 %	0,52 %
7M,5M		0,67 %	0,71 %
6 M, 3M		0,75 %	0,61 %
6 M, 4M		0,70 %	0,52 %
6 M, 5M		0,70 %	0,47 %
5M,3M		0,72 %	0,57 %
5M,4M		0,74 %	0,52 %

After testing several long and short term averages and the two models, I found that the exponential generally performs better than the simplified moving average. Moreover, I found that the best fit was a 6 month long exponential average towards a 3 months short

term exponential average. As we see from the table 4.7, the combination of the 6 months exponential average and the 3 months yields a return of 0.75% per month in the time period of 1988-2004. Before taking the final decision I will investigate whether the trigger is statistically significant at a 5% level.

In order to test this, I will apply the following OLS regression

$Y_i = \alpha + \beta_1 D_{1,i}\, \varepsilon_i$

Where:

$Y_i = Exp(World\ index)^2$,

$D_{1,i}$ = a dummy variable that marks the trigger strategy signal.

Accordingly we aim to find out whether the signal the trigger strategy produces has some effect on return. If we find support for this, we can in god faith trust the signal the trigger strategy gives us. In total the trigger strategy only produces two signals, where the first is hold a active asset and the other is hold a reserve asset. These signals are mutual exclusive, meaning that we can only do one of the two things. The reason why I have chosen to use the functional form described above is to fulfil the assumption of OLS. However, the residuals still shows some signs of heteroscedasticity inducing that our standard errors may not be accurate. As a consequence it may conclude the relationship to be statistically significant when it is in fact too weak to be for sure distinguished from zero. Consequently this means that we ought to use the White corrected standard errors. Our result shows that our dummy becomes insignificant at a 5% level while are still significant at 10% level. The regression results are illustrated beneath.

$R^2 = 0.0227$

$Exp(Y_i)^2 = \quad 0.9967 \quad + \quad 0.025 D_{1,i}$

P-value: <.0001 0.0579

First we see that the intercept are significant at any level. As a result our estimated return when the dummy is insignificant is negative 0.16%. In contrast, if we apply a 10% significance level both coefficients are significant. Consequently, the estimate of the World index when the dummy is 1 is 1.09%. In other words, can we state that our average monthly return when if follow the trigger strategy is 1.09%. In contrast, the World index only obtains negative 0.16% when we hold the risk free bond. Consequently, this conclusion is supported by some descriptive statistics. The average return of the world index, when we hold a bond rather than the index is (-0.4%) per month. In contrast, our average return when we actually hold the world index is 0.98%.

Overall, I am pleased with the results the 6 months long exponential average and the 3 months exponential average has delivered based on historical data. Consequently, this self combined strategy seems be a good alternative towards the more established strategies. Moreover, I am really looking forward to see if this model can outperform the standard models and strategies that I have stated above.

4.4 Performance of Strategies

Table 4.8 Performance of strategies

Return	CPPI	B&H	Constant Mix	Trigger Strategy
2005	42,90 %	31,97 %	30,10 %	51,09 %
2006	2,57 %	2,80 %	3,04 %	2,57 %
2007	14,51 %	10,98 %	10,00 %	14,51 %
2008	-34,62 %	-23,40 %	-20,67 %	3,30 %
Monthly Return	0,19 %	0,30 %	0,33 %	1,27 %
Stdev	4,95 %	3,33 %	2,98 %	2,93 %
Sharpe ratio	-1,56 %	0,80 %	1,90 %	34,13 %
Jensen alfa	0,58 %	0,46 %	0,45 %	1,18 %
IC	0,21	0,27	0,30	0,50

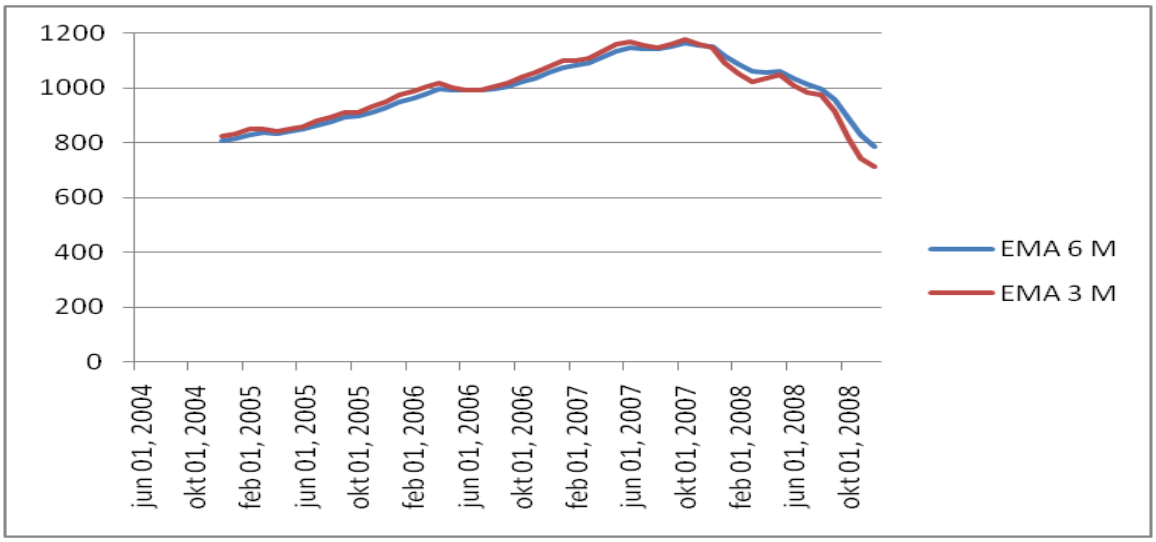
The overall picture seems to be that all strategies expect for the CPPI looks pretty good. In overall the CPPI is the only strategy who does not manage to beat the BS portfolio in one of the three performance measures. Moreover, knowing that the return of the BS portfolio was 0.32% per month the CPPI is the only strategy that is far away from that estimate. Not, surprisingly almost all strategies have a lower standard deviation than the portfolio models. This is the generally the case when we introduce a reserve asset. However, the CPPI strategy seems to have a relative high standard deviation. The main reason for this is that it maintain 100% in the active asset in 38 of the 48 months and since the portfolio are not near the limit of 80 it will always have an significant portion in stocks. As a result the CPPI will have many of the same fluctuations as the Bayes stein portfolio.

Surprisingly, the Trigger strategy seems to be the definite winner in comparison with all strategies and models. In comparison it has a Sharpe ratio of 34.13% and the next best was the tangent portfolio at a 2.48%. More impressing is that if we had guessed the optimal portfolio for the period of 1988-2004 we have had a Sharpe ratio of 30.40% while we now have a higher Sharpe ratio in this ex ante perspective. At second place of

strategies goes to the constant mix strategy. Comparing with the BS estimation the Constant mix strategy actually performs better in all performance measures.

Furthermore looking at the other performance measures we see that Trigger strategy is superior in all. Looking at the information index we see that the strategy actually performs around the top quartile managers at an index number at circa one half.

Additionally, the Jensen Alfa seems to induce the same result. The trigger strategy over performs and is the only strategy that gives positive return in 2008. One main reason for the superiority of the trigger strategy is that it shifts focus in almost perfect timing towards the financial crisis. In almost the whole financial crisis the strategy holds the Danish risk free Bond. The shift in strategy is illustrated beneath.



As long as the long term average (the blue line) is underneath the short term average (the red line) we allocate our stocks in the BS portfolio. As soon as the red line crosses the blue we shift our strategy to holding the Danish government bond and receive the coupon rate at 0.27% per month. Seeing that both averages decreases noteworthy after the lines crosses in end 2007 induce that we benefit of having our funds in a bond and that the strategy seems to an extremely good fit in this type of environment.

4.5 Conclusion

By the use of the theoretical application of the models without taking into account transaction costs our best portfolio model is the tangent portfolio, while our best portfolio strategy is the trigger strategy.

Moreover, the trigger strategy seems superior in all performance measures towards all models and strategies. The main reason descended from its ability to avoid the much of the financial crisis. While all other models and strategies become inflicted by the global down turn the Trigger strategy holds a risk free asset. Even though many have criticized the tangent portfolio of not being able to work in practice this thesis shows that it performed relative good compared to other models. One probably reason may be that the long time series of history makes the expected return more stabile and trustworthy.

Moreover, as we viewed the portfolio models that aimed to minimize risk we found no such evidence that these models actually fulfill their obligation. In addition, none of the portfolio models seems stand out in either a bull or a bear market. In overall, the tangent portfolio has the best performance of the portfolio models in two out of four years. However, neither portfolio model nor strategy can compete with the trigger strategy as it has a superior performance in a bear market of 2008.

5.0 Effect of transaction costs and the relative performance

This section we aim to answer the following questions:

- Do the conclusions change if transaction cost is included?
- How does our top 3 portfolios of choice perform to real life global funds?
- Part 3 conclusion

5.1 The effect of transaction costs

In this section I have divided the effect from transaction costs into two parts. The first concerns the effect transaction costs have on portfolio models while the other focuses on the effect on portfolio strategies. This is because we use the BS approach further in the strategies and therefore need to find its transaction costs before we go find the transaction costs of strategies.

5.1.1 The Effect of Transaction Cost to Portfolio Models

In order to make this thesis more applicable to reality we need to include some of the aspects that are present for a portfolio manager. One of these is transaction costs.

In practical setting there is always a tradeoff between the rebalancing of the portfolio and transaction costs. If you choose to rebalance often, the cost of trading will consume a significant part of your return. In contrast to little rebalancing may cause you portfolio to deviate from your goal and your portfolio of choice.

Previous in this thesis I have chosen to rebalance the portfolio every 12 months. However, one critical assumption I have taken in the previous section is that the asset weights are constant in between the rebalancing. This is assumption are under the transaction costs setting not valid because it causes the transaction costs to be extremely high. The reason for this is that when one country index move in one direction your weight in this asset also moves in the same direction. As a result, the goal to keep asset weight constant at all times means that you probably will need to rebalance the portfolio every trading day. Moreover, assuming that we have transaction costs of 0.15% per trade we see that the total transaction costs of our models will amount to significant sum that will not be in the best interest of investor. Just imagine that an investor holds the Minimum Variance Portfolio with a constant of 6 assets in the portfolio. In 250 trading days the transaction costs will consume a total of 37.5%.

As a result I will assume that the asset weights are not constant and will only be rebalanced at time 12 months, 24 months, and 36 months with the respective new asset weights.

To ensure that the reader follow my rebalancing structure I have made a structure to follow:

1. Our first goal is to collect the respective initial asset weights.
2. Second we multiply these weights with the respective country return obtained at that time and find how much our portfolio has grown or decreased.
3. We calculate each separate asset weight through this formula:

$$Asset\ weight_{t+1} = \frac{Asset\ weight\ _t * (1 + asset\ return_t)}{(1 + Portfolio\ Return_t\ )}$$

To make it clear, imagine an initial portfolio containing only of Norway and Denmark with respective asset weights of 50% of each in a portfolio. Moreover, envision that we see that Denmark has earned 10% return while Norway only 5% at the end of the day. The total return is then 7.5%

Then our new asset weight for Denmark is.

$$Denmark\ asset\ weight_{t+1} = \frac{0.5 * (1 + 10\%)}{107.5\%} = \ 0.5116$$

While the same calculation for Norway yield to 0.4884.

Moreover, when we reach the 12 months benchmark, we rebalance our portfolio the 13 month with new asset weights including the 12 new observations.

In total we see that some portfolios allocate throughout all countries while some only use three or four countries. This induces different transaction costs for the models. When the rebalancing is scheduled the models who allocate more diverse will have extra trades leading to higher transaction costs. While, some portfolio theory claim that a more spread investments will create less risk, this analysis will reveal the negative effect of having a high number of assets. For example the Black Literman model that aims to have a more diverse asset allocation than the tangent, will not benefit from this new setting. The models are transaction costs described beneath:

5.1.2 Tangent portfolio

The tangent portfolios are the model who allocate within the least countries. It only applies a maximum of 4 countries in the initial allocation while reduces to only holding the countries Denmark, Jordan and Mexico for the following rebalances.

5.1.3 MVP

The minimum variance portfolio has broader allocation than the tangent portfolio holding a constant of 6 countries at all times.

5.1.4 EQ

The equal weighted portfolio is the only portfolio model that holds all 13 countries at all times. Consequently, this means that the equal weighted portfolio will have the highest transaction costs compared to all models.

5.1.5 BS

The Bayes stein approach does claim an initial allocation through 5 countries. However, as we reach our first rebalance this is reduced to only 4 countries. Further on, we see that these 4 countries are applied after the 3rd and the 4th rebalancing.

5.1.6 BL

The Black Literman approach applies 12 out of 13 countries in its allocation at all times. Consequently, this means that the model has quite high transaction costs compared to the other models.

5.1.7 LMP

The lower partial moment's model does apply 7 countries in its allocation at all times inducing a more spread investment ground than the MVP. However, looking at the asset allocation we see that many of the same countries applied in the MVP are also used in the LMP allocation.

5.2 Portfolio performance of the models inclusive transaction costs

Return	TANP	MVP	EW	BS	BL	LPM(2)	World Index
"Return" 2005	48,26 %	39,43 %	29,34 %	48,31 %	16,91 %	43,41 %	13,74 %
"Return" 2006	10,02 %	-3,39 %	11,84 %	6,60 %	10,26 %	-8,95 %	13,52 %
"Return" 2007	12,81 %	7,56 %	5,28 %	13,13 %	-0,91 %	10,68 %	2,83 %
"Return" 2008	-34,56 %	-36,83 %	-42,03 %	-35,62 %	-40,77 %	-36,44 %	-40,11 %
Monthly Average	0,39 %	-0,18 %	-0,26 %	0,29 %	-0,58 %	-0,18 %	-0,48 %
Standard Dev	5,16 %	4,89 %	4,99 %	5,18 %	4,63 %	5,38 %	4,43 %
Sharpe ratio	2,26 %	-9,31 %	-10,64 %	0,45 %	-18,36 %	-8,33 %	-16,88 %
Δ Sharpe ratio	-0,22 %	-0,92 %	-3,06 %	-0,41 %	-2,79 %	-0,83 %	
Jensen alfa	0,80 %	0,17 %	0,28 %	0,69 %	-0,08 %	0,12 %	
Δ Jensen alfa	-0,009 %	-0,057 %	-0,154 %	-0,019 %	-0,135 %	-0,054 %	
IC	0,27	0,07	0,23	0,22	-0,12	0,04	
Δ IC	-0,01	-0,02	-0,17	-0,01	-0,24	-0,02	

Not surprisingly we see that all performance measures decreases in comparison with the model without the transaction costs.

Yet again the highest performers in all both Sharpe ratio and Jensen's Alfa are the tangent portfolio with the Bayes stein approach close by. Seeing the Sharpe ratio we see that only the tangent and the Bayes stein approach has have a positive number. In total we see that both the tangent and the BS estimation create positive return, while all other models have a negative average return.

Comparing the changes in Sharpe ratio, we see that the models with many trades like the equal weighted and the Black Literman approach has the highest decrease. However, the LMP who has more trades than MVP has less decrease in Sharpe ratio. One probable explanation to this is that the new rebalancing schedule is more beneficial for LMP than MVP.

On the other hand, the information index highest number is now the tangent portfolio. The main reason for this change stem from the unlike transaction costs the models obtain. As transaction costs of the equal weighted portfolio are significant bigger than the tangent we see that the equal weighted portfolio changes more than the tangent portfolio. This is seems to be a clear cut example of the effect of the transaction cost. By using the theoretical model without comprehending transaction costs we could have concluded that the best model according to the information ratio was the equal

weighted portfolio. As a result this could have lead to a wrong decision in a real life scenario.

When comparing the performance ratios with the non transaction costs model, we see that the model with the general lowest change in all performance measures is tangent portfolio followed by the BS approach. Clearly, this comes as no surprise since these models are the ones with the lowest costs.

The general picture for all models is that the transaction costs models decrease the Sharpe ratio with 1.37% while the Jensen Alfa and the information ratio go down with 0.071% and 0.08 respectively.

However, since we included transaction costs as an issue we also needed to change the rebalancing outline. In some models this new rebalancing framework can be a benefit while other times a disadvantage. Nevertheless, looking at the transaction costs and the rebalancing outline separate is not the issue an investor stands in front of. An investor needs to take into consideration the thin line of both rebalancing and transaction costs. As a result, it will be more realistic to see the performance of portfolios in including both the new rebalancing outline and transaction costs.

5.3 The Effect of Transaction Cost to Portfolio Strategies

Most of the strategies included in this thesis have completely different trading focus. Some trade only once and will probably benefit of the new setting, while other almost continuously trade and will decrease more in performance. Underneath I will go through the how I interpret the transaction costs in the different strategies. Again the use of the BS approach is used as the active asset in all strategies. This of course claims a total of 2.55% in transaction cost for all strategies. Throughout the thesis the transaction costs are deducted at the given month the trade occur to preserve the most realistic picture. However, to get a perspective on the effect of transaction costs and their respective consumption we choose to illustrate the isolated effect of every strategy.

5.3.1 CPPI/SPI

First of all, since the limit of 80% of initial value is never reached the CPPI strategy always has some funds in the active asset. As a result we this will deduct an initial 2.55% in transaction cost, that is the total consumption using the BS approach. Second, as we have determined that the CPPI should trade each month, this gives us a total of 7.2% in transaction costs. As a result the total transaction costs for the CPPI are 9.75%.

$$CPPI\ transaction\ costs = 48\ months \times 0.15\% + 2.55\%$$

5.3.2 Buy and hold

The Buy and hold strategy maintain only one initial trade in the beginning to set the initial distribution of active asset and reserve asset. Moreover it also uses the BS estimation that needs rebalancing every 12 months. As a result we have the BS transaction costs of 2.55% and one initial trade of 0.15. The overall transaction costs will therefore be 2.7%.

5.3.3Constant mix

Like the CPPI the constant mix needs to trade each month to keep the constant ratio of stocks and bonds. As a result it will have the same costs as the CPPI namely 9.75 % in total.

5.3.4 Trigger strategy

First of all the trigger strategy uses only the active asset in 3 out of 4 periods. The whole last period from Dec 2007 to Dec 2008 it holds a reserve asset. Therefore we only claim an initial transaction cost of the BS estimation of 1.95%. Moreover, the only trade is when the strategy shifts from stocks to bonds in Dec 2007 and therefore only one trade is remarked at the cost of 0.15%. As a result the total transaction costs are 2.1%.

5.4 Portfolio performance of the strategies inclusive transaction costs

Return	CPPI	B&H	Constant Mix	Trigger Strategy	Average
Total transaction cost	9,75 %	2,70 %	9,75 %	2,10 %	6,08 %
2005	37,80 %	30,12 %	26,43 %	48,10 %	35,61 %
2006	4,71 %	5,56 %	3,59 %	6,60 %	5,11 %
2007	11,13 %	10,08 %	7,25 %	11,03 %	9,87 %
2008	-37,00 %	-24,28 %	-22,91 %	3,15 %	-20,26 %
Monthly Return	0,02 %	0,28 %	0,17 %	1,28 %	0,44 %
Stdev	5,02 %	3,36 %	3,02 %	2,93 %	3,58 %
Sharpe ratio	-4,98 %	0,33 %	-3,48 %	34,47 %	6,59 %
Δ Sharpe ratio	-3,42 %	-0,47 %	-5,38 %	0,35 %	-2,23 %
Jensen alfa	0,40 %	0,45 %	0,29 %	1,18 %	0,58 %
Δ Jensen alfa	-0,18 %	-0,01 %	-0,16 %	0,00 %	-0,09 %
IC	0,14	0,26	0,21	0,50	0,28
Δ IC	-0,07	-0,01	-0,09	0,00	-0,04

As we expected the trigger strategy is again the superior strategy. This is mainly because it performs extremely well in the financial down turn of 2008 and that it claims small transaction costs. Looking at the changes in performance measures we see that trigger strategy has the smallest change in all performance measures. Surprisingly, the Sharpe ratio of the trigger strategy has actually increased compared to the non transaction cost model. One probable reason for this is that the total return of the BS approach has increased from 2005-2008 due to the new rebalancing schedule.

In overall matters we see that the performance change in B&H and the trigger strategy are much less than the more tradable strategies like CPPI and Constant mix. Not surprisingly, the models with the highest transaction costs are also the models that decrease the most in performance. Looking at the Sharpe ratio we see that the constant mix has the biggest negative change in performance going from 1.9% to the negative 3.48%.

Seeing our second performance measure the Jensen's Alfa, we see as that the CPPI and the Constant mix strategy they have a decrease of 0.18% and 0.16% respectively. In

comparison we see that the Buy and Hold strategy and Trigger strategy only decreases with circa 0.01%. The message seems to be clear, transaction costs has a significant influence on the performances of portfolios. Without transaction costs the constant mix strategy seemed to be quite attractive while now we see that the transaction costs has taken the monthly return of 0.33% down to 0.17% and has a increased the standard deviation.

One remark it is important to notice in the Jensen's Alfa measure is that most models actually has a small decrease in cost of capital due to incorporation of beta with inclusive transaction costs. Logically, this makes sense because an investor will certainly be interested of capturing the asset real movement towards the market rather than using a theoretical one that is not applicable in real life.

Overall, it seems like the strategies has a higher decrease in performance measures than the BS stein approach itself. This comes of no surprise since the total transaction costs are higher in the strategies than in the model themselves. In comparison we see that the average decrease in Sharpe ratio due to transaction costs are 2.23% while the BS approach only has a decrease 0.41%. Moreover, seeing the information ratio the BS approach only decreases with 0.01 while the average decrease of the strategies are 0.04. This is supported by seeing the changes in the trigger strategy. While it has lower transaction costs than the BS approach it manages also has less negative changes in the performance measures. Nevertheless, in a more volatile market we where the trigger strategy is forced to trade more than once we would have probably seen a bigger decrease in performances than we see now.

5.5 The effect of transaction costs conclusion.

From the models and strategies we have now seen the effect of a new rebalancing structure and transaction costs. There is no doubt that the transaction costs have a clear negative effect on asset allocation and portfolio models. Many theoretical researches create new models and strategies that in theory seem to have high performance. However, these models often have a tendency to have a high rebalancing structure, meaning high transaction costs. Like the Constant mix that was seen to be a very good strategy in no transaction cost setting, now does not perform any better than the much simpler Buy and Hold strategy. Moreover, models like the Black Literman approach who intend to have a more spread investment ground do lead more transaction costs than for example the tangent portfolio. As a result, the negative changes in performance are higher in the Black Literman model than the tangent portfolio.

In real life an investor must consider the effect of transaction costs and therefore the only valid conclusion is to in calculate these effects. Nevertheless, the conclusion of the models towards the portfolio models seems to unchanged even when transaction costs are included. However, as we viewed the information ratio, the tangent portfolio does now become the top performer passing the equal weighted portfolio. In total the tangent portfolio is now ranked best in 3 out of 3 performance measures with the Bayes stein close by. As a result, it seems like the transaction cost models does not change the portfolios ranking or the portfolio of choice, but rather downgrades the performance in general for all models. This same seems to be valid for the strategies as well. Even though we don't see the same decrease in performance as the models, most of the strategies decrease in all performance measures. It is clear, that the models and strategies that have the lowest transaction costs are the one who performs the best.

6.0 How does our top model perform in comparison with real life funds?

In real life fund, investors continuously compare performance to find the best place to invest their money. Consequently this means that fund managers are constantly aim to improve their performance through new methods. In many cases these new methods are very complex, requiring an immense workload and high analytical skills. As a result investor tends to use established funds rather than making their own fund. Accordingly, we claim that none of this thesis portfolio models or strategy are too complex to understand and are clearly relative easy compared to the established well known funds. Consequently, this thesis will investigate how some of the general funds in the market perform in comparison with this thesis top strategy and portfolio model. As we have seen from our previous section the top portfolio model in three out of three performance measures is the tangent portfolio while our top strategy is the trigger strategy. Moreover, as we now present a real life example we need to take in real life applications like transaction costs. Therefore, we will compare the top model and strategy inclusive transaction costs. Further on we assume that all global funds included uses MSCI World index as benchmark.

Table 6.0 Comparison of Performance

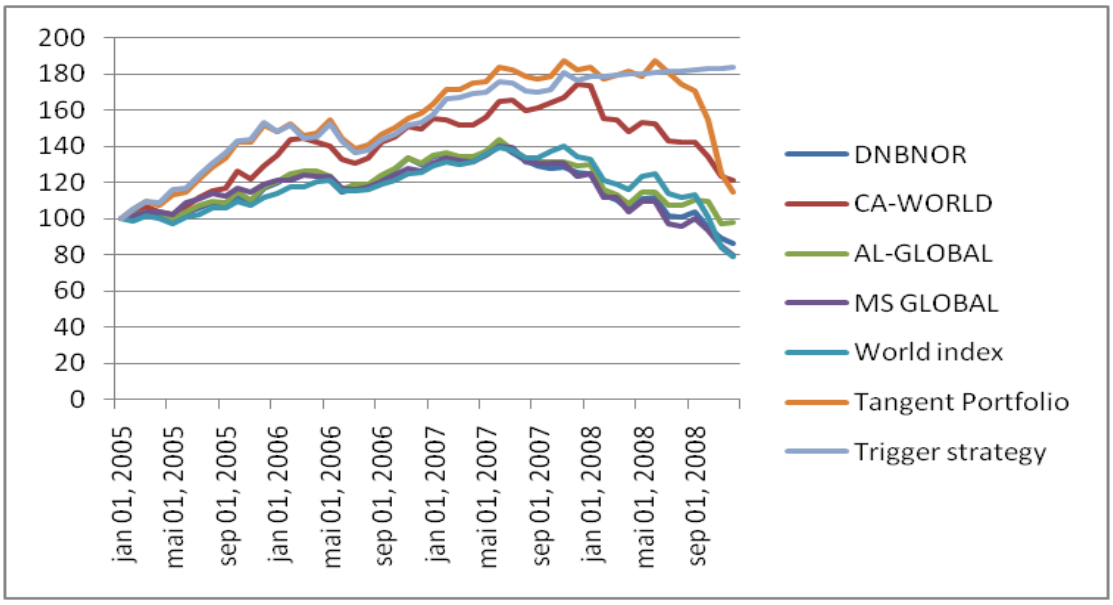
Company	DNBNOR	Carnegie	Alfred Berg	Morgan Stan	World index	Thesis model	Thesis strategy
Fund name	DK-GLOBI	CA-WORLD	AI-GLOBA	MS-GLVEA	MSCI World	Tangent Portfolio	Trigger strategy
"Return" 2005	20,11 %	35,02 %	20,29 %	21,04 %	13,74 %	48,26 %	48,10 %
"Return" 2006	11,67 %	15,25 %	12,11 %	8,18 %	13,52 %	10,02 %	6,60 %
"Return" 2007	-6,78 %	11,31 %	-3,54 %	-4,76 %	2,83 %	12,81 %	13,13 %
"Return" 2008	-29,42 %	-28,04 %	-22,93 %	-39,19 %	-40,11 %	-34,56 %	3,15 %
Total return	-11,76 %	24,64 %	0,27 %	-24,17 %	-20,49 %	20,42 %	84,22 %
Monthly Average	-0,26 %	0,46 %	0,01 %	-0,57 %	-0,48 %	0,39 %	1,28 %
Standard Dev	3,91 %	4,00 %	3,89 %	4,17 %	4,43 %	5,16 %	2,93 %
Sharpe ratio	-13,58 %	4,72 %	-6,82 %	-20,29 %	-16,88 %	2,26 %	34,47 %
Rank SR	5	2	4	7	6	3	1
Jensen alfa	0,04 %	0,74 %	0,27 %	-0,24 %	N/A	0,80 %	1,18 %
Rank JA	5	2	4	6		3	1
IC	0,04	0,33	0,15	-0,09	N/A	0,27	0,50
Rank IR	5	2	4	6		3	1

The first observation worth notice is that the trigger strategy seems to have superior performance in all performance measures. The strategy has the highest total return of 84.22% while Carnegie comes second at 24.64%. Accordingly, the only fund that has a return below the market is the Morgan Stanley fund. Moreover, as we see look at the risk of the portfolios, the trigger strategy has the definite lowest standard deviation. Surprisingly only three portfolios have a positive Sharpe ratio namely the trigger, tangent and the Carnegie fund.

In comparison we see that almost all funds have a positive Alfa meaning that they have a higher performance than the required cost of capital. However, the fund who does it worst on every performance measure namely Morgan Stanley seems to have all negative performance.

Seeing the last performance measure the information ratio we see that the best of public funds are the Carnegie fund followed by Alfred Berg. However, some funds may use other benchmarks than the world index. Accordingly, this means that these funds information ratio may be actually be higher than illustrated in this research. Nevertheless, all other performance measure shows the same ranking as the information ratio supporting our conclusion about the performance of the portfolios. To get an image of the development of the fund's performance we can look at the evolution of an index starting at 100.

Figure 6.1 Historic developments of funds



At figure 6.1 we see that in 2005 three funds separate from the others, namely the Trigger strategy, Tangent and the Carnegie fund. The evolution seems to very similar up to the point of 2008 where the financial crisis set in. At that point we see that the Carnegie fund first start to decrease while some months later the tangent starts a more rapid decrease actually going beneath the Carnegie fund. In contrast the trigger strategy has shifted from Stocks to the risk free Danish government bond and is still increasing. In contrast the other group containing DnbNor, AL-Global, MS global and the World index seems to have a very similar evolution. However, looking at the end of 2008 it seems like Alfred Berg deviates from the group almost crossing the tangent portfolio.

To sum up, we see that the Trigger strategy is definite winner in all performance measures while the Carnegie seems to have the best public fund available in the period of 2005-2009. However, given the resources of the funds available it is of big surprise that none of the funds manages to beat the Trigger strategy. Moreover, the criticism towards the tangent portfolio for it's out of sample performance seems not be accurate. Overall, we see that the very simple tangent portfolio beats the world index and 3 well know funds during the years of 2005-2009. As a result, we cannot support many of the research found claiming that the tangent portfolio has a problem in out of sample performance.

7.0 Conclusion thesis

Throughout this thesis we have looked at the diversification effect for the Danish market and have looked into several portfolio alternatives for a Danish investor to use when he pursues an international investment.

Our first goal was to find out the attractiveness of Denmark in a diversification perspective. Our result showed the Danish market has good diversification opportunities yielding a mean correlation 0.48 towards all countries. In contrast does the diversification potential seem to decrease when Denmark is in economic downturn. Comparing the average correlation before a crisis of 0.48 with the one estimated in a crisis of 0.64 we clearly see the reduced diversification opportunities, thus the attractiveness of Denmark as place to invest become diminished.

Moreover, the analysis showed that the Jordanian market had the best diversification effect against the Danish market. This supports the general opinion that markets located at a longer distance and the unlike market development had better diversification effect.

However, many researchers have maintained that correlations increased when countries are in an economic down turn. In contrast, we claim that this depends on the crisis. As seen from the descriptive statistics of crisis during the years of 1988-2005 we see that the more local banking crisis does not seem increase the country correlation towards Denmark. In contrast the more worldwide crisis of the dot.com bobble does have a positive shift towards an increased country correlation towards Denmark. As a result, we cannot assert that all crises do increase the correlation between countries and therefore not reducing the diversification opportunities that lies within international investments. Using our estimates of OLS regression we see again that in an economic down turn in Denmark the lowest correlation are against Jordan followed by Italy. This means that both Jordanian and Italian investors may have good diversification opportunities in Denmark and that any Danish investor seeking to diversify a local investment may see towards the Jordanian and the Italian market. In general, we see

that only four countries have not a significant increase in correlation in a Danish crisis, meaning that most countries actually have a reduced diversification benefit in a crisis.

Moreover, as viewed the allocation of capital in the portfolio models we saw that the Danish market did have a relative high market share of wealth invested. Compared to the other Nordic countries, Denmark was in general the one with highest proportion of wealth. Accordingly, we therefore should expect more foreign investors in Denmark than in Sweden and Norway.

Additionally, as we looked into the portfolio opportunities for a Danish investor to choose from when he wants to invest internationally, we see that the tangent portfolio seems to perform best of the portfolio models while a moving average trigger strategy does have the best overall performance. The general criticism towards the Tangent portfolio that surrounds its performance in an out of sample seems not to be accurate relatively compared. In contrast looking at the comparing the pre-estimated Sharpe ratio with the Sharpe in obtained in out of sample performance we see that the tangent only obtains circa 2% while we expects around 30%. Nevertheless, none of the other models has a higher Sharpe ratio in this 4 year sample period. Moreover, the Black literman model using CAPM estimated returns has the worst performance in two out of three performance measures inducing that the CAPM model does not seems to a good model for estimating future returns. Furthermore, we also have found no support that the models that aimed to minimize risk do have a lower risk than other models. In contrast, the probability of having a negative return is actually highest for the MVP and the LMP models while the standard deviation does not show any signs of being significant lower than the other models. Moreover, it does not seem to be any tendency that one specific model does perform better than the others in a bear or a bull market. By looking at the returns in the respective years we see that difference between the best model and the second best seems to very small inducing that the rankings of the top models could be a coincidence.

On the other hand, we look into the performance of the portfolio strategies included in this thesis namely the, CPPI, Buy and hold, constant mix and the trigger strategy. The overall picture seems to be that all strategies expect for the CPPI looks pretty good. Not, surprisingly almost all strategies have a lower standard deviation than the portfolio models. Seeing the performance of the portfolios the trigger strategy does have an

extremely good performance rated 1 in every performance measure. Moreover, having an information ratio of 0.5 ranks the strategy close to the top fund managers' goal. The main reason for its well functioning is its ability to change from an active asset to a reserve asset when the financial crisis sets in. Empirically, the use of an exponential moving average as a trigger seems to claim some support statistically. Testing the chosen moving average trigger it has some support at a 10% significance level but not at a 5%.

However, in a more volatile market we can experience a more rapid trading reducing performance significantly. As a result, we can state that the trigger strategy are very well functioning in a market that has a long positive upturn going into a long sustainable crisis.

To capture a more realistic approach this thesis considered one real life application namely the transaction costs in portfolios. Our first finding came as no surprise, inducing that our now present constant weights rebalancing schedule amounted to much transaction costs to be considered to be valid in real life. As a result, we introduced a new rebalancing schedule that would not amount to that high costs. The result, showed the combined effect of the rebalancing schedule and transaction costs on average reduced the Sharpe ratio of 1.37% while the Jensen's Alfa and the information ratio only was reduced by 0.071% and 0.08 respectively. Accordingly, we see that portfolio models with a more diverse asset allocation also have a higher decrease in performance. Consequently, this meant that the tangent portfolio with only 4 assets was still the best portfolio model surpassing the equal weighted portfolio in information ratio.

Furthermore, the portfolio strategies that claim a higher trading rate than the models do in general have a higher decrease in performance. However, by including transaction costs the rankings of the strategies does not change. The only real difference in rankings is that without transaction costs the constant mix was very close to the B&H strategy actually having a higher Sharpe ratio. By including transaction costs we see that the more tradable constant mix decrease more than B&H strategy changing the ranking in Sharpe ratio. In overall, this is a clear cut example on how an investor can make wrong conclusions based upon models without taken into consideration transaction costs. However, again the trigger strategy is the definite winner with a Sharpe ratio of 34.47%, Jensen's Alfa at 1.18% per month and information ratio at 0.50. Because of its low

tradability it is also the strategy with the lowest changes in performance. In overall matters this is clearly superior to the tangent portfolio as well.

The last event of this thesis shows how tangent and the trigger strategy perform compared to professional funds in the real world. The conclusion is surprising, showing that the trigger strategy clearly outperforms all funds throughout the period of 2005-2009.Seeing the other funds there is only one that beats the tangent portfolio, namely Carnegie fund. Again this is quite surprising given the resources the fund managers obtain and the simplicity of Markowitz tangent portfolio.

8.0 Bibliography & References

8.1 Data source

Morgan Stanley World market Indices

Webpage:

http://www.mscibarra.com/products/indices/international_equity_indices/gimi/stdindex/performance.html

8.2 Books

Shapiro, A (2006). Multinational Financial Management 8 edition, Wiley

Bacon, C (2008). Practical portfolio performance measurement and attribution 2nd edition, Wiley

Elton, Gruber, Brown, Goetzmann (2007). Modern Portfolio Theory and Investment Analysis 7 edition, Wiley

Gujarati.D (2003). Basic Econometrics 4 edition , McGraw- Hill

Verbeek M (2008). A Guide to Modern Econometrics 3rd edition, Wiley

Qian,Hua & Sorensen (2007). Quantitative equity portfolio management: Modern techniques and applications, Chapman& Hall/CRC

Prigent, J (2007). Portfolio optimization and performance analysis, Chapman& Hall/CRC

Hoboken, N.J (2007). Candlestick and pivot point trading triggers : Setups for stock, forex, and futures markets, Wiley

Eun & Resnick (2001) International Financial management, McGraw- Hill

Lederman & Klein (1994) Global asset allocation techniques for optimizing portfolio management, Wiley

Solnik, B (1993) International Investments, Addison Wesley

Brentani Christine, (2004). Portfolio management in practice, Elsevier Butterworth-Heinemann

8.3 Articles

J.O.Farestveit & Nuno Pereiria , (2003). Master thesis: Optimal International asset Allocation, CBS Library

Maria Moberg , (1999). Master thesis : Optimal porteføljesammensætning 1925-1998. CBS Library

Rúnarsson Einar Thorbjörn, (2009). Optimal portfolio investments of the Icelandic pension sector. CBS Library

Robin Brooks and Marco Del Negro, (2002). International Diversification Strategies, Working Paper Series (Federal Reserve Bank of Atlanta), Nov2002, Vol. 2002 Issue 23, p1, 35p;

Perold, André F., Sharpe, William F (Jan/Feb95). Dynamic Strategies for Asset Allocation. Financial Analysts Journal; Vol. 51 Issue 1, p149, 12p, 3 charts, 12

Steen Koekebakker &Valeri Zakamouline, (2008). Portfolio Performance Evaluation with Generalized Sharpe Ratios, SSRN Network of papers.

Bawa, V. S. (1978). Safety-First, Stochastic Dominance, and Optimal Portfolio Choice , Journal of Financial and Quantitative 13 (2), 255–271.

Fishburn, Peter C. (1977). "Mean-Risk Analysis with Risk Associated with Below-Target Returns". American Economic Review (American Economic Association) 67 (2): 116–126

Sortino, F. A. and Price, L. N. (1994). Performance Measurement in a Downside Risk Framework, Journal of Investing, 3 (3), 59 – 65

Ziemba, W. T. (2005). The Symmetric Downside-Risk Sharpe Ratio, Journal of Portfolio Management, 32 (1), 108–122.

Markowitz, H. (1959). Portfolio Selection. Efficient Diversification of Investments , Wiley

JP MORGAN , Nicola Mai , (2008) Lessons from the 1990s Scandinavian banking crises. Economic Research Global data Watch

Mattias Persson June 8, (2000)Lund University. Estimation Risk and Portfolio Selection in the Lower Partial Moment, SSRN Network of papers_id=233896

Jorion, Philippe, (September 1986), Bayes-Stein Estimation for Portfolio Analysis" , Journal of Financial and Quantitative Analysis, Vol. 21, No. 3, pp. 279-292.

Simon Stevenson Sydney, 23-27 January, 2001. Bayes Stein Estimators & International Real Estate Allocation, Journal of Real Estate Research Vol. 21, No. 1/2, pp. 89-104.

Jorion, Philippe, (1985). "International Portfolio Diversification with Estimation Risk, Journal of Business University of Chicago Press, vol. 58(3), pages 259-78, July.

Frost, P. A., and J. E. Savarino, (1986). “An Empirical Bayes Approach to Efficient Portfolio Selection,” Journal of Financial and Quantitative Analysis, 21, 293–305.

Philippe BERTRAND, (January 2002). Portfolio Insurance Strategies: OBPI versus CPPI, University of Cergy Working paper No.2001-30, SSRN Network of papers_id=299688

Guangliang He,Robert Litterman, (2002) THE INTUITION BEHIND BLACK-LITTERMAN MODEL, Goldman Sachs Asset Management, SSRN Network of papers_id=334304

Fischer Black and Robert Litterman 1991, Asset allocation: Combining investor views with market equilibrium, The Journal of Fixed Income, Vol. 1, No. 2: pp. 7-18

Fischer Black and Robert Litterman, (September-October 1992). Global portfolio optimization. Financial Analysts Journal pages 28–43

Fisher Black. (1989). Universal hedging: Optimizing currency risk and reward in international equity portfolios. Financial Analysts Journal, pages 16–22, July-August.

Warren Bailey, Alok Kumar, and David Ng. (2005) Foreign Investments of U.S. Individual Investors

Warren Bailey, Alok Kumar, and David Ng. (2005) Foreign Investments of U.S. Individual Investors, MANAGEMENT SCIENCE Vol. 54, No. 3, March 2008, pp. 443-459

Jay Walters, CFA, February 16, 2009, The Black-Litterman Model In Detail , blacklitterman.org; IEEE Computer Society; Boston University, Metropolitan College, Department of Computer Science, , SSRN Network of papers_id=1314585

Tom Idzorek, CFA (2004) , The Black-Litterman Model, Director of Research Ibbotson Associates, Corporate.Morningstar.com/blacklitterman.org/papers.html

Trond M. Døskeland 2007, Essays on Portfolio Choice, Department of Finance and Management Science, BI OSLO, www.Bora.nhh.no

Tien Fo sing and S. Ong. (2000). Asset allocation in down side risk framework, Journal of Real Estate Portfolio Management, 6(3), pp. 213-223.

Marcel Marekwica (2009). Lecture Notes Asset Allocation “CM F89” Copenhagen Business School.

W.V Harlow, (1991). Asset allocation in down side risk framework, Financial Analysts Journal, 1991, page 28—40.

Prof. Dr. Heinz Zimmermann (2007). Robust Portfolio Optimization, http://daniel.niedermayer.ch/uploads/File/papers/RobOptPresentation_niederma_basel.pdf

Ahearne, Alan G. & Griever, William L. & Warnock, Francis E., 2004. "Information costs and home bias: an analysis of US holdings of foreign equities," Journal of International Economics, Elsevier, vol. 62(2), pages 313-336, March.

Fisher Black and Robert Jones (1987). Simplifying portfolio insurance. Journal of Portfolio Management, 14 No. 1 (Fall): 48-51.

Dr. Werner Koch, CEFA (2005) . Consistent Return Estimates The Black-Litterman Approach, Frankfurt MathFinance Workshop 2005, PM High Alpha / Portfolio Construction

Copyright © 2006-2008 Modern Investment Technologies. Multi-period Asset Allocation, Smartfolio.com

Anders Karlsson and Lars Nordén, (2004). Home Sweet Home: Home Bias and Internation, al, Department of Corporate Finance, School of Business, Stockholm University, SSRN Network of papers_id=559947

Adler & Dumas. (1983), International portfolio choice and corporate finance, a synthesis, Journal of Finance pp 925-984

Black, Fisher, (1993). "Beta and Return", Journal of Portfolio Management, 20, , 8-18

De Roon, Nijman& Werker, (2000), Currency hedging for international stock portfolios, SSRN Network of papers_id=370817

Eun and Resnick (1998), Exhchange uncertainty, forward contracts and international portfolio, Journal of finance 43, issue 1, pp 197-215

Eun and Resnick (1997). International equity investments with selective hedging strategies, Journal of International Financial Markets, Institutions and Money , Volume 7, Issue 1, April 1997, Pages 21-42

Glassman & Riddick (2001). What causes home asset bias and how should it be measured?, Journal of empirical finance 8 , pp 35-54

Grubel H.G, (1968). International diversified portfolios, American ecnomic revive 58 pp 1299-1314

Liljeblom,Lofflund & Krokfors (1997). The benefits of international diversification for Nordic investors, Journal of Banking & Finance 21 469-490

Markowitz, Harry M (1952). Portfolio selection, Journal of Finance 7, pp 77-91

Merton R, (1980). On estimating the expected return on the market, Journal of financial economic 8 , pp 323-361

Solnik Bruno, (1974). An equilibrium of the international capital market, Journal of economic theory pp 500-524

Solnik Bruno (1974), Why not diversify international rather than domestically, Financial analysts Journal pp 48-54

Price, K, Price ,B & Nantell, T (1982). Variance and Lower partial moments measures of systematic risk, The Journal of Finance, Vol. 37, No. 3 (Jun., 1982), pp. 843-855.

Zhi Da, (2005). Teaching Note on Black-Litterman Model, Dow Jones & Company, Inc, http://www.nd.edu/~zda/TeachingNote_Black-Litterman.pdf

Henning Padberg, (2007), Portfolio Management Using Black-Litterman, University of Münster (Finance Center Münster), www.grin.com. Archive No:V79584, ISBN (E-book): 978-3-638-89783-9

Da Silva, Lee, Pornrojnangkool, 2009. The Black–Litterman Model for Active Portfolio Management

Alexandre S Da Silva, Wai Lee, Bobby Pornrojnangkool (2009). The Journal of Portfolio Management, Vol. 35, No. 2: pp. 61-70

Mishra & Rahman, (2001), Measuring Mutual Fund Performance Using Lower Partial Moment,Global Business Trends (Contemporary Readings) 2001 Edition ,published by the Academy of Business Administration, http://www.utiicm.com/Cmc/PDFs/2002/banikant%5E40.pdf

Dr. Dr. Heissmann (2005). On the optimization of a CAPM portfolio using lower partial moments as measure of risk and using the possibility of safeguarding its loss, Physica A: Statistical Mechanics and its Applications, Volume 378, Issue 2, 15 May 2007, Pages 423-426

8.3 WebPages

Wikipedia.org:

- Black literman
- Heteroscedacity
- Moment (statistics)
- Geometric mean
- Rate of return
- Information ratio
- Sharpe ratio
- Jensen's alfa
- Modern portfolio theory
- CPPI

Other webpages:

- gbr.pepperdine.edu/072/diversification.html
- http://www.iefs.org.uk/Papers/Papadamou.pdf

- info.firstinvestors.com/docs/pdf/think1st-0606.pdf
- http://www.csus.edu/indiv/s/schafferb/CH08MGMT1362002.ppt
- http://www.kelley.iu.edu/aukhov/Teaching/F303_Class_03.ppt
- http://www.kelley.iu.edu/aukhov/Teaching/F303_Class_03.ppt
- http://www.csus.edu/indiv/s/schafferb/CH08MGMT1362002.ppt
- www.blacklitterman.org
- www.mathfinance.cn/black-litterman
- riskinstitute.ch/00011998.htm
- www.mathworks.com/access/helpdesk/help/.../bqwamz4.html
- www.strategy-at-risk.com/tag/lower-partial-moment/
- www.andreassteiner.net › ... › Risk Measurement › Relative Risk
- http://www.buzzardsbay.org/geomean.htm
- http://www.automated-trading-system.com/geometric-information-ratio/#start
- www.effisols.com/basics/MVO.htm
- www.investorwords.com/.../minimum_variance_portfolio.html

Appendix:

CD-ROM

- Portfolio Performance without transaction cost- EXCEL
- Portfolio Performance with transaction cost-EXCEL
- Performance of Strategies inclusive testing trigger strategy : without transaction cost-EXCEL
- Testing assumptions of OLS of the trigger strategy – SAS Output
- Performance of Strategies with transaction cost- EXCEL
- Testing correlations for OLS regression diversification part- EXCEL
- Testing assumptions for correlations for OLS regression diversification part – SAS OUTPUT