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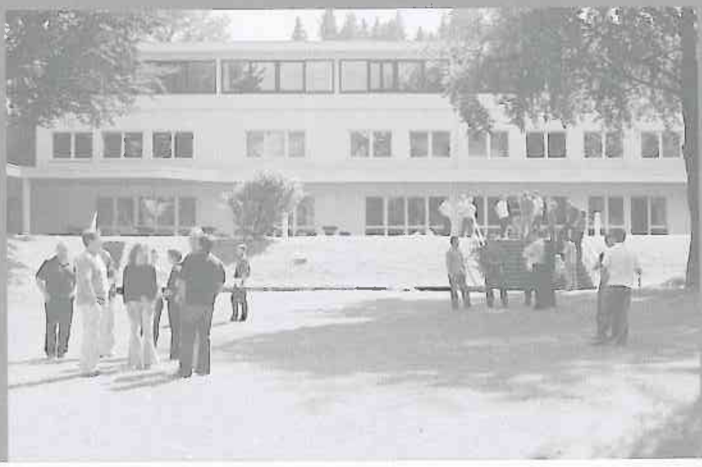

How did different Investment Strategies perform when applied to an International Portfolio?

Gerhard Wörtche and Tristan Nguyen

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Table of Contents

Abstract 1
Key words: 1
1 Introduction 2
2 Literature and Data 2
2.1 Literature Overview 2
2.2 Data 3
3 Applied Methodology 4
3.1 Risk, Return and Correlation 4
3.2 Portfolio Strategies 5
3.2.1 Equally Weighted Portfolio 6
3.2.2 Minimum Variance Portfolio 6
3.2.3 Certainty Equivalence Tangency Portfolio 6
3.2.4 James Stein Estimator 7
3.2.5 Black Litterman Model 8
4 Empirical Results 9
4.1 Risk, Return and Correlation 9
4.2 Strategy Performances 10
4.2.1 EQW, MVP and CET 10
4.2.2 James Stein Estimator 15
4.2.3 Black Litterman Model 18
4.3 Constraints of the observed Magnitudes 20
5 Conclusion 21
References 22

Abstract

This paper shows from the viewpoint of a European investor whether the final performance parameters of several investment strategies are mainly due to returns of foreign markets or through the exchange rate development. Besides the analysis in mean-variance terms, it will be evaluated how robust the results are over time. The empirical analysis indicates that – the relative young more sophisticated approaches are superior to the traditional strategies, the impact of the exchange rate development cannot be ignored in an equity portfolio and nearly no conclusion can be drawn in the context of a superior in- and out-of-the-sample period.

Key words:

Investment Strategies, Portfolio Optimization, International Portfolio Management, International Asset Allocation, Stock Market Returns, Exchange Rate Risk.

1 Introduction

A large amount of evidence indicates that international investment strategies are superior to those strategies which entirely invest in domestic markets (see for example French and Poterba (1991) or Coval and Moskowitz (1999)). Most of the studies regarding this topic are carried out from the view-point of a US investor. The authors did not find any recent evidence in the context of an international diversified portfolio which consists entirely of equities from the perspective of a European investor. For this reason, this analysis evaluates the performance of several investment strategies from a European point of view. The research questions are: With respect to performance and robustness, are there superior strategies in mean-variance terms? Which impact contributed the exchange rate development to the performance? Which out-of-the-sample length was optimal for each strategy?

The investment strategies which will be applied are the Equally Weighted Portfolio (EQW), the Mean Variance Portfolio (MVP), the Certainty Equivalence Tangency Portfolio (CET), as well as the James Stein Estimator (JSE) and the Black Litterman Model (BLM). In order to gain from the merits of low correlated markets, an international portfolio is set up which comprises ten indices from all over the globe that range from countries with low GDP per head to those with relative high levels.

In order to analyze the two risk drivers of an international diversified portfolio separately, the results of the investment strategies are calculated in two ways - with and without the exchange rate development. This method allows evaluating whether exchange rate movements are dispensable or if currency fluctuations are significant for international equity portfolios and therefore the exchange rate risk should be hedged.

The paper is divided into three major sections. Section 1 contains a literature overview the data selection. Section 2 explains the calculation of the portfolio risk- and return parameters and shows how the performance magnitudes of each investment strategy are calculated. Section 3 presents the empirical results of the analysis. In this section, the performance parameters with- and without the exchange rate development are presented separately.

2 Literature and Data

2.1 Literature Overview

A various amount of papers confirmed empirically that a broad portfolio diversification increases the expected return for a given level of risk, while on the other side, reduces the risk level for a given expected return, see Elton and Gruber (1977), Solnik (1995) or Gerke, Mager and Röhrs (2005). Several papers build upon Markowitz ideas and explain how the MVP and CET can be used as portfolio strategies; some important references are Sharpe (1970) and Merton (1972). Recent models that extend the framework of Markowitz provide solutions for its shortcomings. For example, on one side, Stein estimation methods help to obtain more accurate estimates, while on the other side, methods like the BLM allow the incorporation of additional information rather than just the first two moments.

The estimation literature shows that traditional portfolio optimization procedures can be improved. Portfolio optimization based on estimates of least-squares estimators lead to the problem of estimation risk which arises from the difference between the observed estimates and the true unobservable parameters; different studies such as Solnik (1982) or Board and Sutcliffe (1992) show that the problem of estimation risk is significant. Several articles demonstrated that the portfolio optimization is extremely sensitive to the estimates of the mean returns. For this reason, papers such as Best and Grauer (1992) and Chopra and Ziemba (1993) suggest applying more robust estimation methods. The James Stein estimation procedure is more efficient in the sense that the method is able to provide smaller mean squared errors. This is achieved by pooling information across different series and therefore leads to the so called *shrinkage estimator* that shrinks the individual assets means towards a global grand mean, see for example Jorion (1986), Grauer and Hakansson (1998) or Kempf and Memmel (2002).

The motivation of Black and Litterman (1992) was to introduce a new model which can be applied in practical asset allocation. Their model allows taking additional information into account and provides a solution which does not produce an extreme portfolio weight allocation. The model is based on Markowitz's (1952) mean-variance optimization, on Sharpe's (1964) CAPM, and on Black's (1989) global CAPM. The recent literature shows several papers which deal with the BLM in different ways. A few important references, which seem to be the most established ones in this relative young field, are Bevan and Winkelmann (1998), He and Litterman (1999) and Satchell and Scowcroft (2000). More substantial discussions which show how to implement the input variables are given by Walters (2008) or Idzorek (2002).

2.2 Data

The collected data consists solely of equity indices. The intake of bonds or derivatives would probably have had improved the performance, but however, the resulting parameters of the applied strategies would have to be divided between further factors. To analyze whether the portfolio weights are mainly composed of emerged markets or of developed markets, the equity indices range from countries with a relative low GDP per head to those which have a relative high GDP per head. The chosen sample consists of 2261-daily observations from the 31st December 1999 until the 1st September 2008 covering a period of more than 8 years. The 10 equity indices and their datastream mnemonic are: India (IBOMBSE 100), China (SHANGHAI SE), Brazil (BRIPX 50), South-Africa (DJSA 30), Chile (IG-PAGEN), Russia (MSCI RUSSIA), New Zealand (DJNZ), Japan (NIKKEI 225), Germany (DAX 30) and the United States (DOW JONES IND).

Several of the considered investment strategies require some kind of risk free rate of interest. Since the analysis is from the viewpoint of a European investor, the 3-Month Euribor has been chosen as the risk free interest rate. For the analyst forecasts of the BLM the IFO Business Climate Index has been taken. The forecasts are the unadjusted expectations about the business expectations for the next 6 month time.

3 Applied Methodology

3.1 Risk, Return and Correlation

The return at the end of a holding period is the average of the daily arithmetic returns which are calculated as in equation (1).

$$R_{t,i} = \frac{P_{t,i} - P_{t-1,i}}{P_{t-1,i}} \tag{1}$$

whereas P is the price of particular index i and t a certain point in time. In order to obtain the actual return for a European investor a composition has to be done between the stock market return and the currency return. This is demonstrated in equation (2), where $S_{t,i}$ is the exchange rate at a point in time of index i,.

$$R_{t,i,EUR} = \frac{P_{t,i} \cdot S_{t,i} - P_{t-1,i} \cdot S_{t-1,i}}{P_{t-1,i} \cdot S_{t-1,i}} \tag{2}$$

Equation (2) can be shown on its analogy in terms of asset- and exchange rate returns:[1]

$$R_{t,i,EUR} = (1 + R_{t,i}) \cdot (1 + e_{t,i}) - 1 = R_{t,i} + e_{t,i} + R_{t,i} \cdot e_{t,i} \tag{3}$$

Equation (3) shows that the return of a European investor can be decomposed in the local return of $R_{t,I}$ and the $e_{t,I}$ which is the exchange rate return of the local currency against the Euro that is calculated from the spot exchange rate $S_{t,i}$. Therefore, the expected total return is a joint result of the expected return of the local index plus the expected exchange rate return plus a cross term.[2]

---

[1] See Bugár and Maurer (1997), p. 66 for a more detailed discussion.

[2] Bugár and Maurer (1997) show the individual contribution of the three factors to the total return for an Hungarian investor.

The overall risk of an investment in another currency can be calculated from the individual risk of an asset and the risk which arises through the exchange rate. Equation (4) shows that variance of an asset in terms of another currency is the sum of four estimated parameters.[3]

$$Var(R_{i,EUR}) = Var(R_i) + Var(e_i) + 2Cov(R_i, e_i) + \Delta Var_i \tag{4}$$

In order to evaluate the performance of an international multi-asset portfolio it is necessary calculate the combined risk- and return parameters. Equation (5) demonstrates how the portfolio return parameter is calculated. It is the summation of the return of an asset times its portfolio weight.

$$R_p = \sum_{i=1}^{N} x_i \cdot R_i \tag{5}$$

where R_p is the total portfolio return, x_i is the weight which is allocated to index i and N represents the total number of included assets. The calculation of the portfolio variance is more complex since beside the allocated weight, the correlation between the individual assets has to be taken into account. As shown in equation (6) the portfolio variance increases as the correlation is positive and decreases as the included assets move countercyclical.[4]

$$Var(R_p) = \sum_{i=1}^{N} x_i^2 \cdot Var(R_{i,EUR}) + \sum_{i=1}^{N} \sum_{\substack{j=1 \\ i \neq j}}^{N} x_i x_j \cdot Cov(R_{i,EUR}, R_{j,EUR}) \tag{6}$$

3.2 Portfolio Strategies

Two restrictions have been applied to all considered strategies in the optimization process.

$$\sum_{i=1}^{N} x_i = 1 \text{ and } |x_i| \leq 3$$

The first constraint implies that the exact amount of the endowment is invested in at least one of the investment alternatives. The constraint forces that the system of equations is solved in a way that all endowment is invested even if the expected returns are negative. The second restriction excludes the possibility of short selling up to a certain extend. No short or long position can be greater in its absolute magnitude than 3 times the value of total endowment. If this restriction would be violated, the mathematically optimized solution would show extreme long and short positions. Even if in theory the portfolio performance might improve when the restriction is ignored, it is not feasible in reality because of the immense transaction costs which would be involved when changing the extreme portfolio weights and further, from a legal point of view there are restrictions as well.

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[3] For a derivation of the formula see Eun and Resnick (1994), p. 148. For a decomposition which shows by how much percentage the 4 components contribute to the total risk see Bugár and Maurer (1997) for a Hungarian investor or Maurer and Mertz (1999) for a German investor.

[4] Whereas x_j is the weight that is allocated to index j. See Elton et al. (2003), pp. 56, 57 for a derivation of the formula.

3.2.1 Equally Weighted Portfolio

Since this analysis contains 10 markets, each index contributes 10% to the total portfolio performance. The EQW can be considered as a portfolio, which achieves the benefit of international diversification without taking the information on expected return, variances and covariances into account. In the beginning of a period each asset in the EQW is worth *1/N*, however, through the stochastic element of a risky asset, the end of the period wealth is different. Assets which perform well relative to other assets in the portfolio are worth more than *1/N* at the end of a period. Therefore, the adjustment in each new period leads to an increase in the weight of the losers while at the same time the weight of the winners is reduced.

3.2.2 Minimum Variance Portfolio

The MVP is defined as the portfolio with the lowest possible variance.[5] It is the global risk minimum of the mean-variance efficient frontier. The MVP is suitable for a highly conservative investor whose risk aversion converges to infinity. In other words, in a $\mu - \sigma -$ diagram, the utility functions of MVP investors are straight lines which are parallel to the y-axis. The MVP approach is solely based on the second moments of the assets in the portfolio. By moving away from the MVP and entering a small amount of additional risk, a large amount of additional expected return is obtained. Therefore, the MVP has to be regarded as a purely hypothetical approach. The optimal weights of the MVP are calculated according to the following minimization problem.[6]

$$\min MVP = \sum_{i=1}^{N} \sum_{j=1}^{N} x_i \, x_j Cov(R_{i,CH}, R_{j,CH}) \tag{7}$$

3.2.3 Certainty Equivalence Tangency Portfolio

The CET is closer to reality than the MVP since a rational risk averse investor will always choose a portfolio which has a moderate slope of the efficient frontier and not extreme values which are close to zero or to infinity in the case of the MVP. The CET refers to the portfolio with the highest Sharpe Ratio.[7] Thus the CET identifies the combination of indices i and weights x_i that maximizes the Sharpe ratio. The CET is an extension of the MVP, since, besides the variance-covariance matrix, the optimal portfolio weights include the expected returns of the indices and the risk free rate of interest. The optimal weights of the CET are calculated according to the following maximization problem.[8]

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5 Markowitz (1952) was the first who introduced the idea of a unique MVP.
6 For an explanation of the MVP in matrix algebra terms see Campbell, Lo and MacKinlay (1997), pp. 184– 188.
7 See Eun and Resnick (1994), p. 148.
8 See Campbell, Lo and MacKinlay (1997), pp. 184 – 188.

$$\max CET = \frac{\sum_{i=1}^{N} x_i \left[E(R_{i,CHF}) - r_f\right]}{\sqrt{\sum_{i=1}^{N}\sum_{j=1}^{N} x_i\, x_j Cov(R_{i,CH}, R_{j,CH})}} \tag{8}$$

3.2.4 James Stein Estimator

The JSE measures the distance of the actual return estimates to the global mean and adjusts the outliers by shrinking them towards the global average. The more extreme the outlier, the greater the shrinkage of the returns towards their global mean. Therefore, the JSE can be seen as an approach which uses a mean reversal to provide better forecasts. Equation (9) shows the JSE for the sample mean:[9]

$$r_{JS} = \bar{r} + \alpha(r_i - \bar{r}) \tag{9}$$

where r_{JS} is the JSE expected return, $\bar{r}$ is the global sample mean which is the average of all sample mean ($r_1,...,r_n$), r_i the sample mean of asset i and α is the shrinkage factor. The shrinkage factor determines how much contribution will arise through the global mean and the means of the individual assets. α can take values from 0 to 1. The literature comprises several suggestions how to derive α, equation (10) follows an approach from Jorion (1986) which seems to be the most established one.[10]

$$\alpha_t = \min\left\{1, \frac{(N-2)}{k(\mu_t - \bar{r}_t \bar{1})'\Sigma_t^{-1}(\mu_t - \bar{r}_t \bar{1})}\right\} \tag{10}$$

As the shrinkage factor $\left\{(N-2)/(k(\mu_t - \bar{r}_t \bar{1})'\Sigma_t^{-1}(\mu_t - \bar{r}_t \bar{1}))\right\}$ becomes > 1, α_t becomes 1. N is the number of indices and $\bar{1}$ is just a vector of ones. The remaining terms are:[11]

$$\bar{r}_{i,t} = \frac{1}{k}\sum_{\tau=t-k}^{t-1} r_{i,\tau}, \qquad \mu_t = (\bar{r}_{1,t},...,\bar{r}_{n,t})', \qquad \bar{r}_t = \frac{1}{n}\sum_{i=1}^{n} r_{i,t}$$

Where k stands for the observations of the in- and out-of-the-sample period. Since in this analysis the estimation took place in a yearly, semiannually and quarterly interval, k = $\{260,130,65\}$.

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9 A mathematical derivation of the formula can be found in James and Stein (1961) or Jorion (1986).

10 The reader might think that the James Stein method, which produces in the first step the JS expected return parameters (rJS), and in the second step the optimal portfolio weights leaves scope for possible errors since an optimization process from the first to second step has to be chosen. In this case see Kempf and Memmel (2002) who introduce a one-step procedure which skips this space for errors and directly disgorges the optimal portfolio weights.

11 See Grauer and Hakansson (2001), p. 241.

From equation (9) and (10) we can see that the James Stein estimate of asset i's expected return is its sample mean subtracted by a fraction of the amount by which the sample mean exceeds the global mean. Hence α shrinks the sample mean toward the global mean. Higher variances, which enter the denominator of equation (10), imply that less confidence exists and therefore the individual means are not good estimates for the true expected return. Thus as the variance increases (decreases), α decreases (increases).

3.2.5 Black Litterman Model

The beauty about the BLM is the possibility to harmonically combine quantitative models and traditional portfolio management procedures. The main result of Black and Litterman's paper (1992) is following expected return equation (11).[12]

$$E(r|Q) = \Pi' + \tau\Sigma \cdot P' \cdot (P \cdot \tau\Sigma P')^{-1} \cdot (Q - P \cdot \Pi') \tag{11}$$

where r is a vector of the true unobservable return vector, Σ the variance-covariance matrix, Π is a vector of the historically estimated returns, τ a scalar between the uncertainty of the expected returns and the uncertainty of the variance-covariance matrix, Q the investor's subjective view vector and P an auxiliary matrix which is necessary to combine the subjective and objective expected returns. For a detailed explanation how to set up the input variables see Walters (2008) or Idzorek (2002).

In order to obtain superior expected returns, the BLM allows to incorporate subjective opinions about future returns. This paper uses the data which has not been applied in the context of the BLM yet. The additional information of the IFO Business Climate Index for Germany and for the World is incorporated into the model.[13] The data provides a proxy of the future economic situation and therefore, can be used as conditional information for the BLM. The difficulty arises by deciding how the data of the time series should be entered into the P and Q. In this analysis, the parameters are entered according to the following ideas.

If the current German business expectation is optimistic (pessimistic) then its value in Q is positive (negative). The larger the optimism, the greater its value and vise versa. As a result, if the overall business mood in Germany is positive, the weight of the German index in the portfolio will be higher relative to other countries. The procedure how the world data is incorporated into the model takes a different angle. When the overall world expectations are bullish then every country should experience the prosperous economic upswing but not to the same extend. There are countries which have index

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12 See Christodoulakis and Cass (2002), pp. 9-11, for a derivation of the formula.

13 The date can be found under the following links:
http://www.cesifo-group.de/portal/page/portal/ifoHome/a-winfo/d6zeitreihen/15reihen/_reihenkt, 10.12.2009
http://www.cesifo-group.de/portal/page/portal/ifoHome/a-winfo/d6zeitreihen/15reihen/_reihenwes, 10.12.2009

returns that are lower correlated to the world compared to other states. As a result one might expect that countries which have a relative low overall correlation to the world market might be less affected from the economic situation. Therefore, in situations in which the world business expectation is bullish (bearish), more (less) weights have been allocated to states with higher correlations.

4 Empirical Results

4.1 Risk, Return and Correlation

The following part shows the results of the overall risk- and return parameters and how strong the exchange rate has contributed to it. Beside the final values, the parameters are split up to provide detailed information about the contribution of each single factor that determines the overall result for a European investor.

	IND	CHI	BRA	STA	CHL	RUS	NWZ	JAP	GER	USA
	Absolute Return									
$R_{i,Euro}$	12.17%	7.55%	23.35%	5.65%	7.13%	16.02%	1.23%	-9.91%	2.13%	-2.09%
R_i	15.89%	9.24%	21.56%	9.35%	8.68%	19.01%	0.43%	-6.39%	2.13%	1.55%
e_i	-4.02%	-1.63%	-1.89%	-5.54%	-3.23%	-2.82%	-0.29%	-4.33%	0.00%	-3.85%
R_i x e_i	0.30%	-0.06%	3.67%	1.83%	1.68%	-0.17%	1.09%	0.82%	0.00%	0.21%
	Percentage Return									
R_i	130.54%	122.38%	92.35%	165.58%	121.67%	118.69%	34.72%	64.56%	100.00%	-74.31%
e_i	-33.02%	-21.54%	-8.09%	-98.04%	-45.22%	-17.62%	-23.16%	43.70%	0.00%	184.18%
R_i x e_i	2.47%	-0.84%	15.74%	32.46%	23.54%	-1.07%	88.44%	-8.26%	0.00%	-9.86%

Table 1: Average returns (p.a.) of different international equity markets over the sample period from a European point of view.

Table 1 shows the estimated returns on the 10 different markets. It is remarkable at the first glance that countries with a relative low GDP per head show higher return parameters than more developed markets. Comparing the local returns (R_i) of New Zealand, Germany, the US and Japan with the less developed countries, the return parameters of the developed states are relatively low. The highest local return, as well as the highest overall return ($R_{i,Euro}$), was available in Brazil. This is mainly due to the well-developed agricultural, mining and manufacturing sectors and through the enormous trade surplus from 2003 to 2007.[14] Interestingly that the local return of South Africa was slightly higher than in China but through strong depreciation of the South African Rand, the overall return parameter of South Africa is nearly 2% lower than the Chinese. The importance of the exchange rate can also be seen by looking at the parameters of the USA. The local return was positive but to due the weakening USD the return of a European investor was negative.

Comparing the variance parameters of the countries with a low GDP per head with developed states it can be noticed that the emerging markets tend to have a higher risk. The highest risk of a local market

($Var(R_i)$) was in Russia, while the largest overall risk parameter for a European investor ($Var(R_{i,Euro})$) was in Brazil due to a large positive correlation between the exchange rate and the local return.

	IND	CHI	BRA	STA	CHL	RUS	NWZ	JAP	GER	USA
	Absolute Variance									
$Var_{(i,Euro)}$	8.78%	7.34%	22.30%	13.09%	7.85%	16.21%	6.71%	8.87%	6.09%	4.34%
$Var(R_i)$	7.29%	6.53%	12.15%	6.62%	2.95%	15.70%	3.26%	6.04%	6.10%	3.01%
$Var(e_i)$	0.95%	0.93%	2.79%	2.79%	1.54%	0.85%	1.27%	1.20%	0.00%	0.92%
$2Cov(R_i,e_i)$	0.61%	-0.13%	7.35%	3.67%	3.36%	-0.34%	2.18%	1.63%	0.00%	0.41%
ΔVar	-0.06%	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	-0.01%	0.00%
	Percentage Variance									
$Var(R_i)$	83.03%	88.95%	54.49%	50.58%	37.58%	96.86%	48.60%	68.03%	100.17%	69.44%
$Var(e_i)$	10.78%	12.61%	12.53%	21.30%	19.63%	5.22%	18.96%	13.55%	0.00%	21.09%
$2Cov(R_i,e_i)$	6.91%	-1.71%	32.97%	28.04%	42.79%	-2.09%	32.44%	18.41%	0.00%	9.51%
ΔVar	-0.72%	0.15%	0.01%	0.08%	0.00%	0.02%	0.00%	0.00%	-0.17%	-0.04%

Table 2: Average variances (p.a.) of different international equity markets over the sample period from a European point of view.

The last three rows of table 1 and the last four of table 2 show the percentage contribution to the overall return- and variance parameters respectively. The exchange rate returns add a smaller part than the local returns (R_i) but its contribution to the overall return is on average 29.99%. By evaluating the risk, the overall variance consists on average of 63.73% of the risk of the equity market itself ($Var(R_i)$). This evidence shows the importance of the exchange rate changes to an international equity portfolio. Since stocks are normally subject to higher fluctuations compared to most other securities (excluding derivatives), it is even more interesting to observe the currency importance to such a large extent. Therefore, the impact of the exchange rate should not be ignored in an international portfolio.

4.2 Strategy Performances

4.2.1 EQW, MVP and CET

Table 3 presents the ex ante performance results of the EQW, the MVP and the CET. While the upper part of the table shows the parameters without the exchange rate, the lower part illustrates the results from the perspective of a European investor. Annually, Semiannually and Quarterly refers to lengths of the out-of-the-sample period. In order to minimize the disadvantage of the model's input sensitivity, the in-the-sample-period was not chosen to be shorter than one year.

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[14] See http://www.brasil.gov.br/ingles/economy/, 10.12.2009.

	Excluding Forex										
	Annually			Semiannually			Quarterly			Annually Semiannually Quarterly	
	EQW	MVP	CET	EQW	MVP	CET	EQW	MVP	CET	MSCI	EURIBOR
Return	14.82%	6.42%	12.91%	12.73%	6.12%	26.34%	9.90%	5.54%	14.25%	-3.52%	3.25%
Std.	13.50%	9.44%	42.47%	13.50%	8.89%	52.35%	13.61%	8.49%	33.27%	16.70%	0.02%
	Including Forex										
	Annually			Semiannually			Quarterly			Annually Semiannually Quarterly	
	EQW	MVP	CET	EQW	MVP	CET	EQW	MVP	CET	MSCI	EURIBOR
Return	12.78%	2.90%	38.05%	10.74%	0.09%	26.21%	7.38%	3.48%	18.68%	-3.52%	3.25%
Std.	17.56%	14.02%	72.30%	17.67%	13.03%	63.63%	17.80%	12.49%	63.06%	16.70%	0.02%

Table 3: Average EQW, MVP and CET ex ante risk- and return parameters (p.a.) over the sample period.

Compared to the MSCI, all strategies were able to achieve higher return parameters. In all cases the CET had higher returns than the EQW, while the EQW had higher return parameters than the MVP. Note, that the EQW and MVP, which do not use an optimization process that uses the first moment, resulted in lower return parameters when the exchange rate is taken into account, while the CET led to higher returns when the exchange rate is incorporated. Thus it seems that the CET was able to exploit the additional risk and therefore resulted in higher return parameters. Interestingly that the CET had an average annual return of above 38% when the out-of-the-sample period had the length of one year.[15]

The risk parameters show a similar behaviour.[16] All CETs had the highest risk, while the MVPs had in all cases by far the lowest. Moreover, the MVP standard deviation seems to be very stable. The variation of the lengths of the in-the-sample period does not enable the drawing of a clear conclusion in the context of risk. In order to analyze how stable the observed parameters are over time, the risk and return magnitudes for each respective time window are shown in the figures from 1 to 3.

[15] The results are in line with those from McClatchey and VandenHul (2005), who analyzed equity-, bonds- and money markets. They argue that mean-variance strategies dominate a naïve diversified portfolio because their results show either a significant lower risk or a significant higher estimated return, pp. 277-281.

[16] The fact that the CET had the highest risk and returns, while the MVP resulted in the lowest risk and return parameters indicates that there is some kind of robustness in the system and portfolio optimization makes sense since there is not a complete randomness.

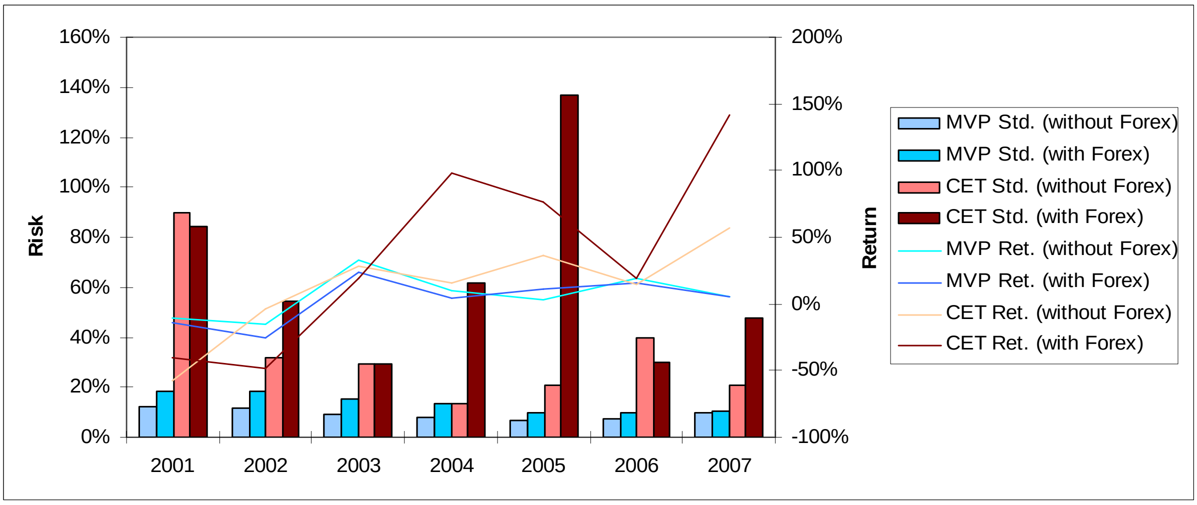

Figure 1: MVP and CET ex ante risk- and return parameters (p.a.) over the sample period. The length of the out-of-the-sample period is one year.

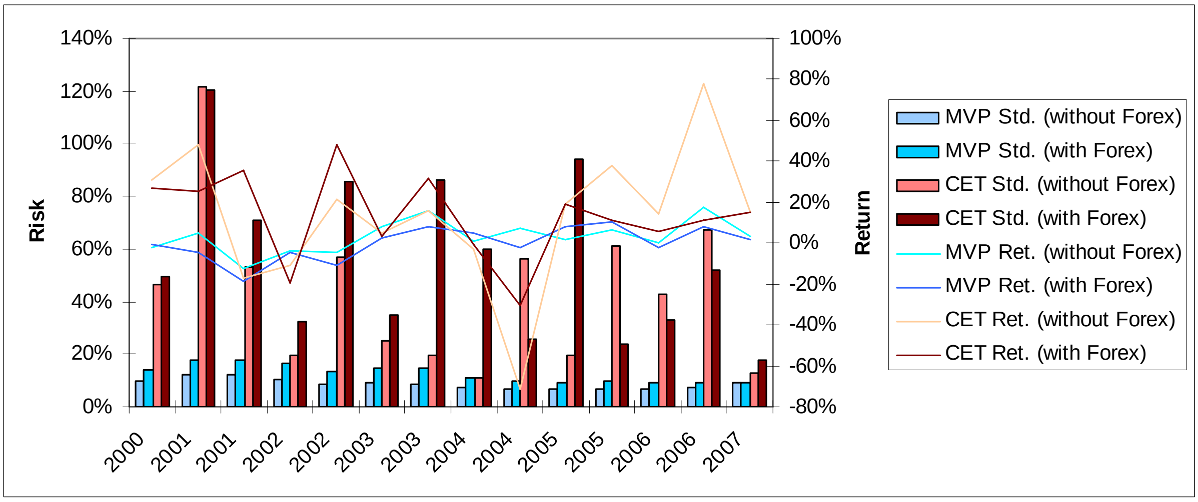

Figure 2: MVP and CET ex ante risk- and return parameters (p.a.) over the sample period. The length of the out-of-the-sample period is half a year.

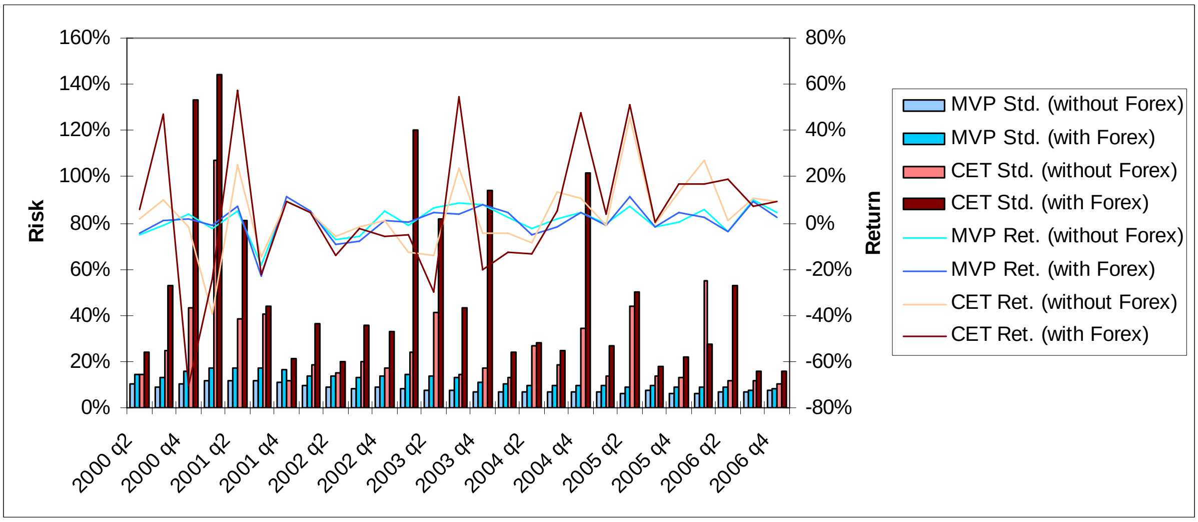

Figure 3: MVP and CET ex ante risk- and return parameters (p.a.) over the sample period. The length of the out-of-the-sample period is 3 months.

Figures 1 to 3 show that the returns of the MVP with- and without the exchange rate are rather stable, while the return parameters of the CET are highly volatile. The graphs show that the CET returns fluctuate in such wide range that the final average return parameters seem to be random. The amplitude of the estimated returns ranges in the case of an annual out-of-the-sample period from +150% to -50%. These fluctuations are clearly unacceptable for an investor. This evidence indicates the unsatisfactory behaviour of a CET portfolio.

Further, the risk parameters show that no matter which length for the out-of-the-sample period were chosen, the MVP's standard deviation is relative stable over time. The CET's risk is in most of the cases more than a double the risk of the MVP and from time to time the CET standard deviation parameter shoots up to more than 100%. Again, like the evaluation of the returns has indicated, the analysis of the risk supports the argument that the CET shows unsatisfactory behaviour.

In order to evaluate how smooth the portfolio weights are, the weight contribution of each index is calculated. This allows drawing a conclusion if the weights are nicely distributed or if corner solutions are a permanent component of the system. Moreover, to analyze whether the weight changes from period to period is well behaved or highly volatile, the changes of each period are calculated. The Figures 4 to 6 present the results.

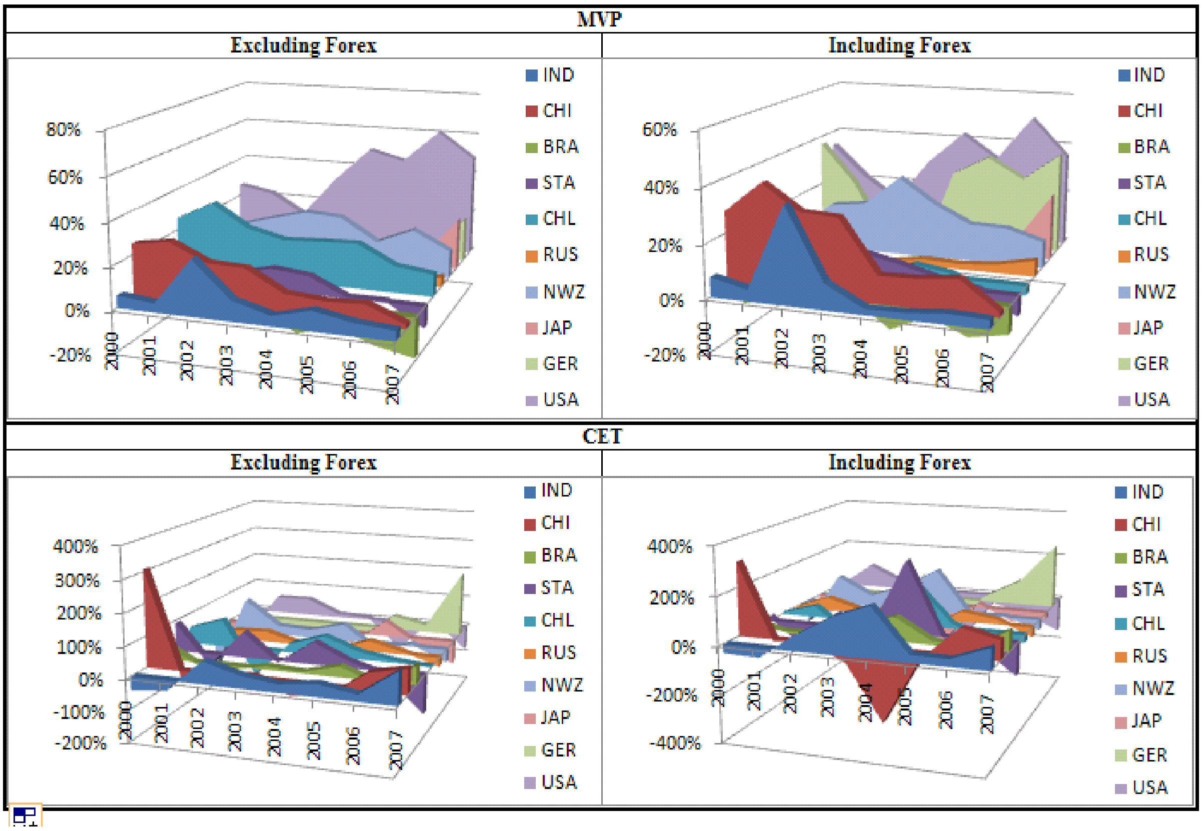

Figure 4: Portfolio weights of the MVP and CET. The length of the out-of-the-sample period is one year.

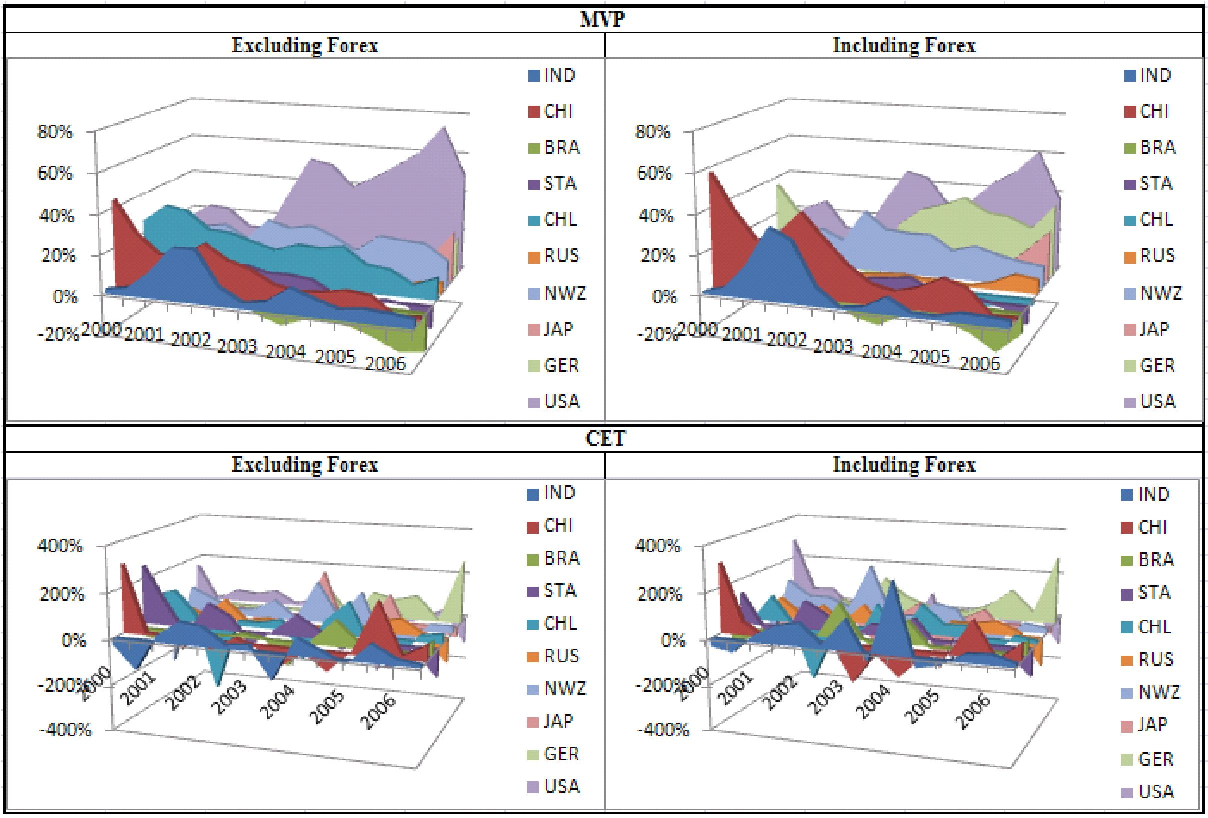

Figure 5: Portfolio weights of the MVP and CET. The length of the out-of-the-sample period is half a year.

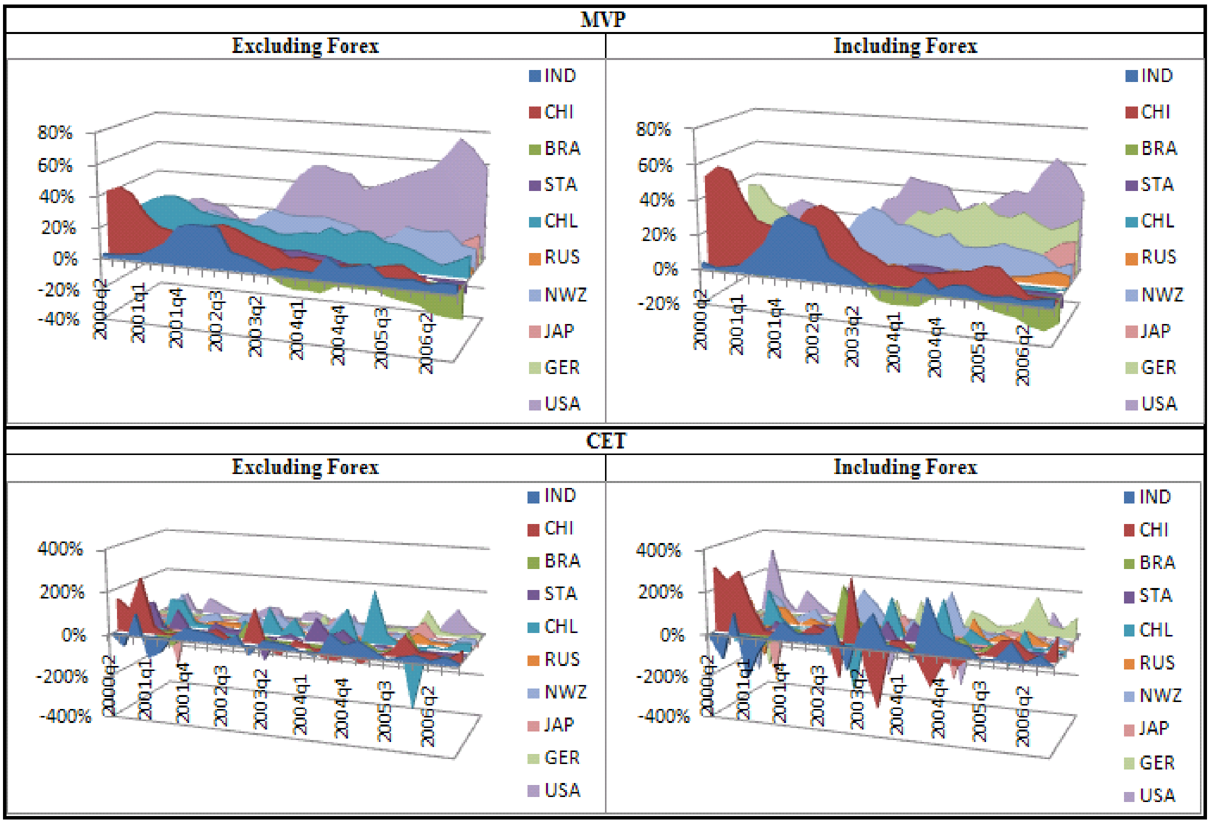

Figure 6: Portfolio weights of the MVP and CET. The length of the out of the sample period is three months.

The figures show that the MVP takes less extreme weights than the CET. The MVP weights are mostly under 50% and positive, solely in rare cases the weight of an asset is larger than 50%. However, the CET optimization often results in portfolio weights that contradict with the idea of diversification. In many periods, the CET portfolio consists of several short and long positions. Further, while the MVP weights have mostly the same size over time, the CET weights often change countercyclical from one period to the next. It is not unlikely that a position which is 100% short, is 100% long in the next period.

4.2.2 James Stein Estimator

Table 4 presents the ex ante results of the JSE. As mentioned before the in-the-sample period should be longer to increase the robustness. Therefore, all strategies have an in-the-sample period of one year. However, in the case of the JSE it figured out that the shrinkage factor α were in most of the cases 1 if the in-the-sample period was one year. To avoid an α of 1, the in-the-sample period was adjusted as well. While the upper part of the table shows the parameters without the exchange rate, the lower part illustrates the results from the perspective of a European investor. Annually, Semiannually and Quarterly refers to lengths of the in and out-of-the-sample period.

	Excluding Forex				
	JSE			Annually Semiannually Quarterly	
	Annually	Semiannually	Quarterly	MSCI	EURIBOR
Return	17.73%	18.96%	7.65%	-3.52%	3.25%
Std.	19.25%	29.36%	17.57%	16.70%	0.02%
	Including Forex				
	JSE			Annually Semiannually Quarterly	
	Annually	Semiannually	Quarterly	MSCI	EURIBOR
Return	13.90%	11.42%	13.06%	-3.52%	3.25%
Std.	21.72%	23.72%	23.83%	16.70%	0.02%

Table 4: Average JSE ex ante risk- and return parameters (p.a.) over the event window.

No matter if annually, semiannually or quarterly, in all cases the JSE returns were higher than the return of the MSCI. It is remarkable that the return- as well as the risk parameters are narrow together. Especially the risk parameters appear very stable.

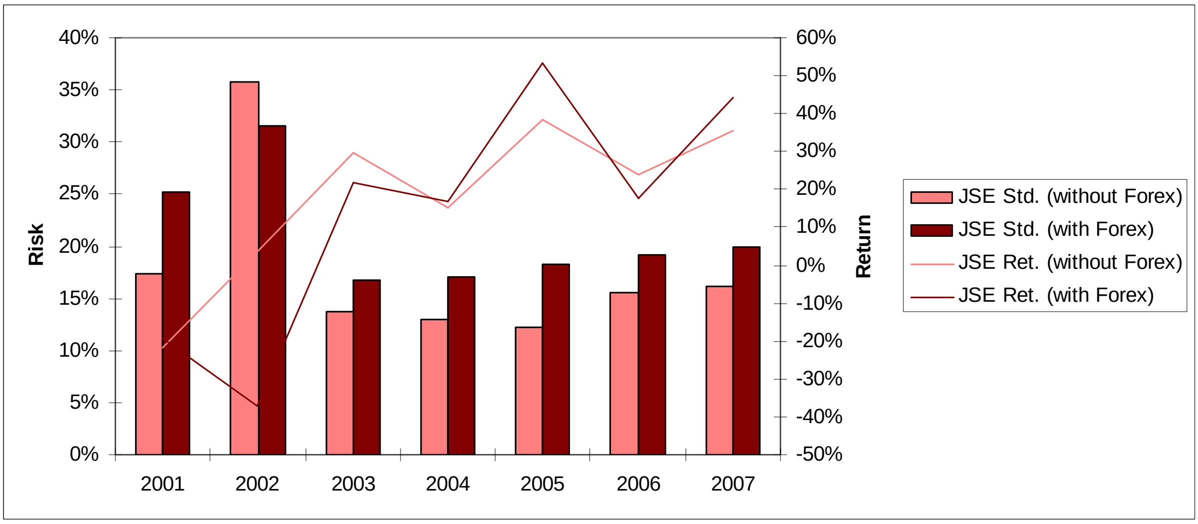

Figure 7: JSE ex ante risk- and return parameters (p.a.). The length of the in- and out-of-the-sample period is one year.

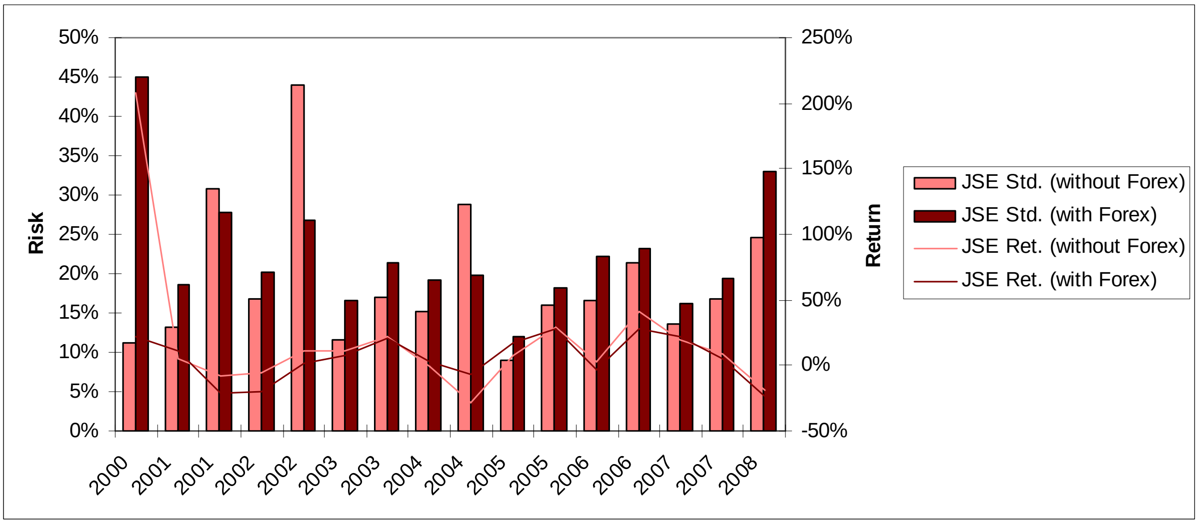

Figure 8: JSE ex ante risk- and return parameters (p.a.). The length of the in- and out-of-the-sample period is half a year.

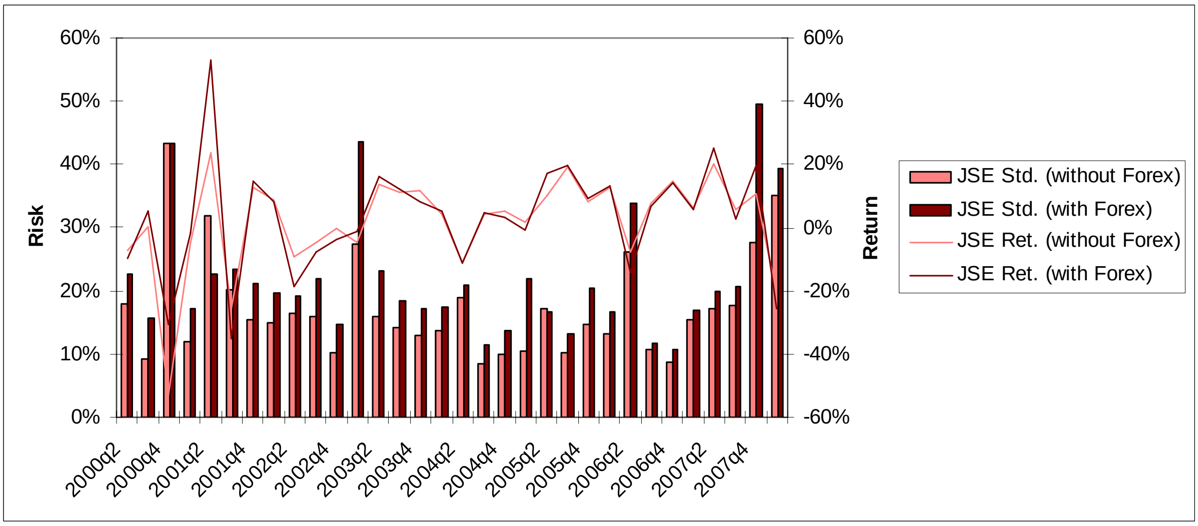

Figure 9: JSE ex ante risk- and return parameters (p.a.). The length of the in- and out-of-the-sample period is three months.

From the figure 7 to 9 it can be noticed that the risk- and return parameters are much more stable than those of the CET. The graphs show that the JSE returns fluctuate in much smaller range. Even if there are outliers of the estimated return parameters, the overall portfolio return as well as the risk is rather stable over time.

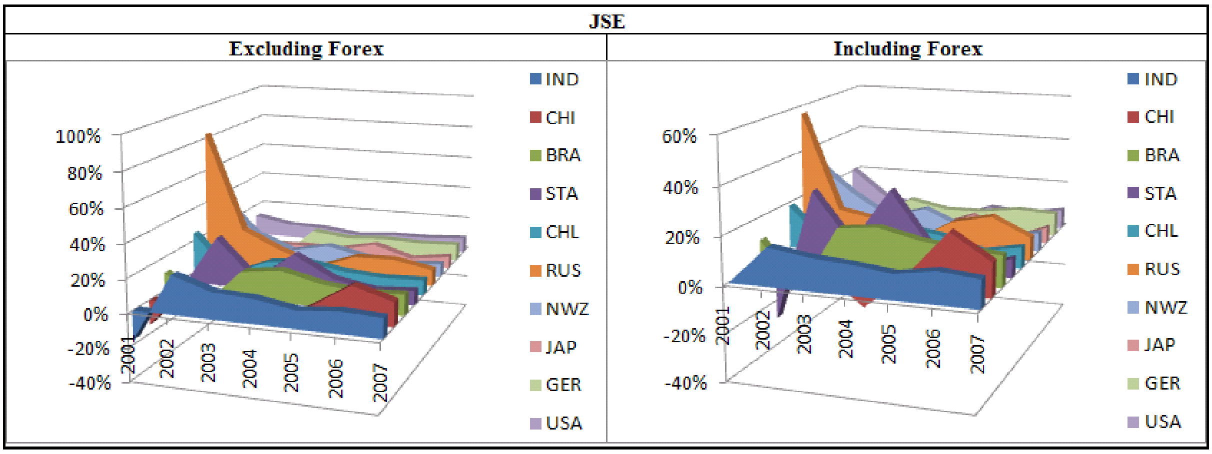

Figure 10: Portfolio weights of the JSE with an in- and out-of-the-sample period of one year.

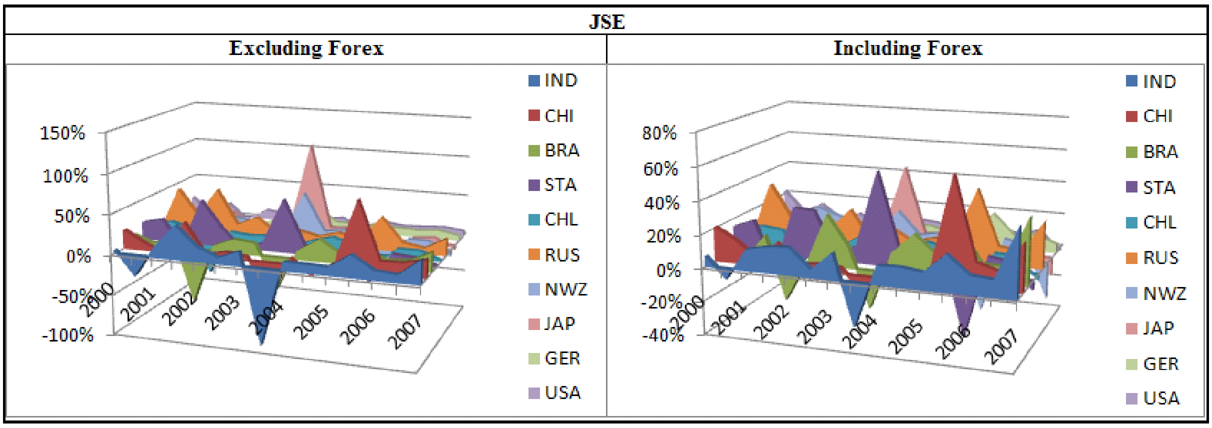

Figure 11: Portfolio weights of the JSE with an in- and out-of-the-sample period of half a year.

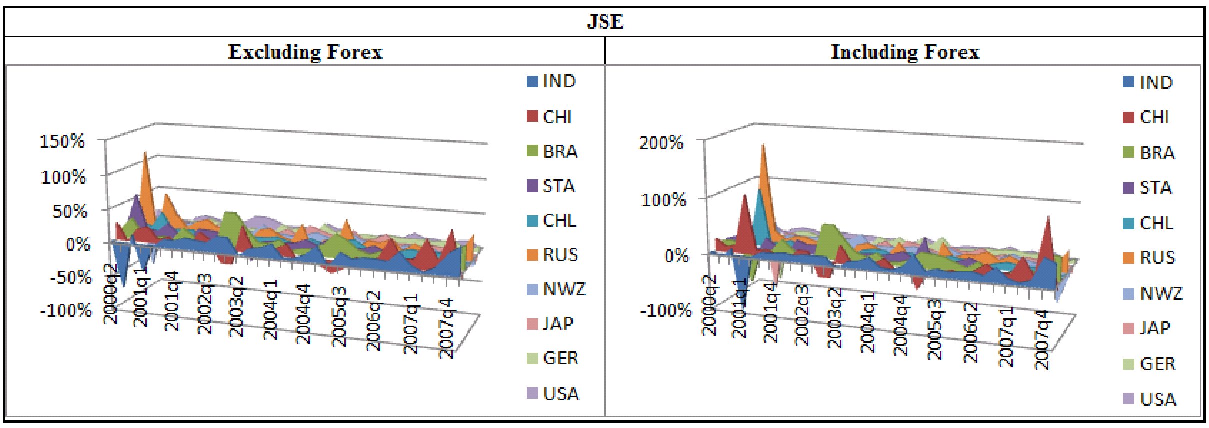

Figure 12: Portfolio weights of the JSE with an in- and out-of-the-sample period of three months.

The figures 10 to 12 show that the JSE portfolio weights have only a few outliers. Solely in rare cases the weight of one index is more than 50%. In most of the periods the weight contribution of each index is well behaved. Comparing these results to those of the strategies before, we can see that the JSE as portfolio strategy is more appropriate for an investor. The weight distribution is acceptable while the risk- and return parameters are more robust. For these reasons, it is possible to argue that the more sophisticated JSE shows an outcome which is clearly superior to the more traditional portfolio strategies.[17]

In the annual case the weight of a position does not change much over time, while on a semiannually and quarterly basis the positions are more adjusted. This is very interesting because even the shrinkage factor α was on average greater on an annually basis, which in turn means that less shrinkage towards the global mean took place and therefore the weights were to a larger extend determined by the individual returns. This evidence indicates that in a longer period the system is more stable. For this reason, and further because the performance was satisfactory on an annual basis, the in- and the out-of-the-sample period should have a length of one year or longer.

4.2.3 Black Litterman Model

Table 5 presents the results of the BLM. The table is based on an in-the-sample period of one year an out-of-the-sample period of 6 months.[18] The choice of a value for τ follows Black and Litterman themselves.[19] As they suggest, the τ -parameter was chosen to be 1%. While the upper part of the table shows the parameters without the exchange rate, the lower part illustrates the results from the perspective of a European investor.

	Excluding Forex		
	BLM	MSCI	EURIBOR
Return	21.22%	-3.52%	3.25%
Std.	27.20%	16.70%	0.02%
	Including Forex		
	BLM	MSCI	EURIBOR
Return	29.91%	-3.52%	3.25%
Std.	46.17%	16.70%	0.02%

Table 5: Average BLM ex ante risk- and return parameters (p.a.) over the event window.

17 Grauer and Hakansson (2001), pp. 243-246, who use the Bayes Stein and the James Stein estimation method in a various kind of industries, come to the same conclusion that historical strategies are dominated.

18 Another out of the sample length than 6 months would be misleading because the IFO Business Climate Index reflects the expectation of 6 months time. Therefore, the estimation results which are based on an out of the sample length of 3 months or one year could probably have been able to exploit the additional information of the IFO Index but to a less extend.

19 See Black and Litterman (1992), pp. 34

The BLM returns were about 21% without- and nearly 30% with the exchange rate. These returns are higher than those of the other strategies except for the CET which resulted in parameters that were more or less in the same range. By evaluating the risk, it can be noticed that the standard deviations were relatively high but comparing them with those of the CET they are also in the same range.

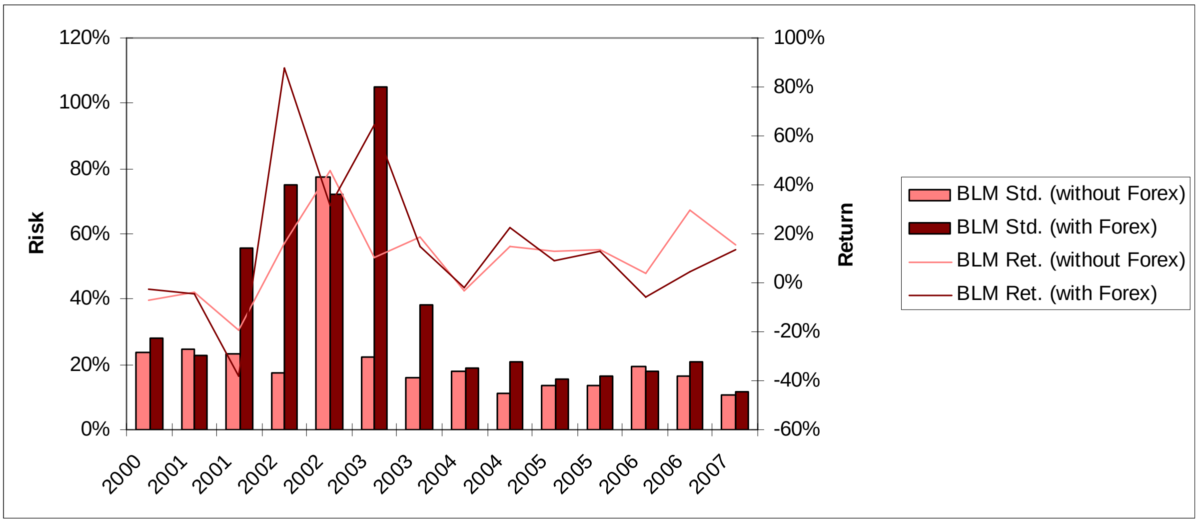

Figure 13: BLM ex ante risk- and return parameters (p.a.). The length of the out-of-the-sample period is half a year.

Figure 13 shows that in the first half of the sample period, the standard deviations as well as the returns were more volatile. These results are not as robust as in the case of the JSE, but nevertheless, compared to the CET, the risk- and return parameters were more stable over time.

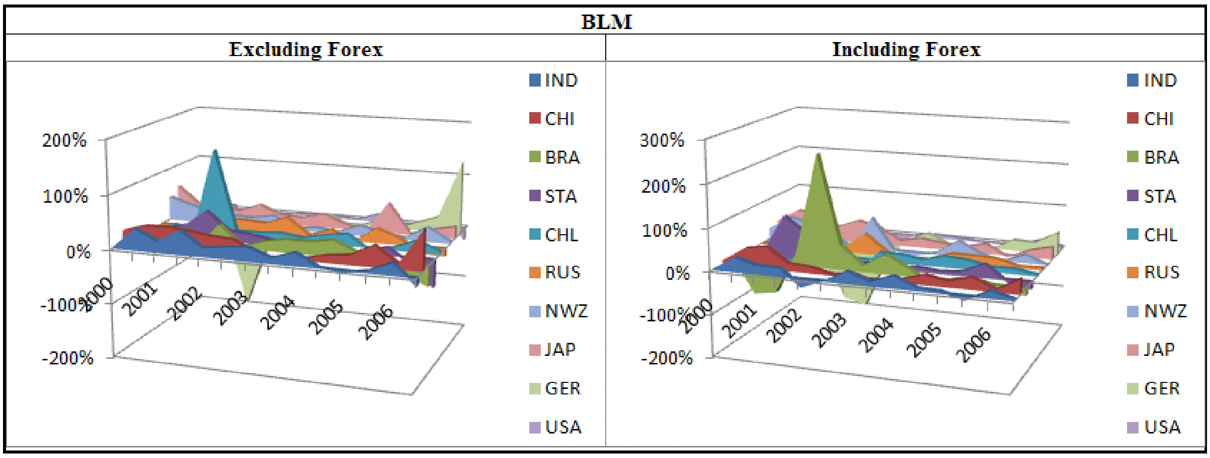

Figure 14: Portfolio weights of the BLM with an out-of-the-sample period of half a year.

Except for a few outliers, figure 14 shows that the portfolio weights are well behaved over time. In not many periods a position changes from a short- to a long position and vice versa. These results show that the BLM overcomes the shortcomings of the traditional portfolio strategies. The more sophisticated strategy incorporates the additional information of the IFO Business Climate Index and produces weights that are satisfactory. Further, the outcome does not contradict with the idea of diversification.

The return- and risk parameters indicate that the IFO information is appropriate for the BLM and that the results are superior to those of the traditional portfolio strategies. However, by solely analyzing the BLM on the basis of the presented findings, the judgment of the general usefulness of the model can be misleading. A small change of τ or a tiny change of the allocated confidence of a view has a large effect to final outcome. Indeed, for a given confidence and for a given τ, the system is more robust than traditional approaches, but however, the portfolio optimization process is extremely sensitive to τ and the confidence itself. The choice of the confidence and τ is absolutely essential. Since there is no method which allows choosing beforehand the optimal values for these variables, this can be addressed as one of the largest shortcomings of the model.

4.3 Constraints of the observed Magnitudes

All return parameters have been presented without considering transaction costs. No matter which of these approach is chosen, the return parameters might be noticeable lower when transaction costs are included. The analysis assumed perfect accessibility and liquidity of all indices. However, in reality this cannot be taken for granted. There are inefficiencies which do not allow an execution to be placed immediately. Even if indices of entire countries have been taken for this analysis, it might be the case that it takes time until an order is executed.

The presented results are consistent with prior evidence on international investment strategies. However, the return parameters are slightly lower compared to prior findings. The literature in the context of international portfolio strategies shows mainly studies which were carried out before the year 2000 and therefore, the sample length fall into periods which experienced a prosperous economic situation. Another reason for the fact that the observed parameters are lower compared to prior studies comes due to the relative appreciation of the Euro. During the event window from the beginning of 2000 to mid 2008 the Euro appreciated relative to all other currencies in the sample. This has a negative effect for a Euro investor who wishes to take advantages of international diversification.

These reasons demonstrate that the final result of an empirical analysis in the context of investment strategies strongly depends on the underlying economic situation of the sample period. Therefore, the presented results would be completely different if the market conditions would include for example a financial crises. Further, in this paper, several strategies have been analyzed and the choice of the one which performed best might come a long with a fitting-trap. It is likely that when many strategies are evaluated that one of them performed particularly well. However, there is a danger because the search and the later application of the best strategy, might not produce abnormal returns since the good performance could be coincidence.

5 Conclusion

The aim of this paper was to present how different investment strategies performed in an international portfolio. The analysis showed the performance without- and with the exchange rate from the viewpoint of a European investor and whether the results are mainly due to the local returns or through the exchange rate. Besides the discussion of the relevance of the exchange rate to an international portfolio, it was shown which underlying time parameters of the out-of-the-sample period were optimal and how robust the observed parameters are.

All presented strategies resulted in higher return parameters than the MSCI as the benchmark. Further, the MVP was even able to achieve lower standard deviations than the MSCI. The CET with a yearly out-of-the-sample period accomplished the highest return. The analyses of the robustness showed that the portfolio weight changes of the CET were highly volatile which in turn led to strong fluctuations of the risk- and return parameters. Therefore, it seemed that the overall CET parameters of the whole sample period are obtained by gamble which is clearly unacceptable for an investor.

The more sophisticated JSE and BLM were able to avoid this shortcoming of the CET and showed that their portfolio weights are well distributed among the indices and are more stable over time. The robust weights of the JSE and the BLM have shown that these approaches are an enhancement to the MVP and CET. The JSE shrinkage factor had on average the largest magnitude when the in- and the out-of-the-sample period was one year. On semiannually and quarterly basis the factor was smaller which in turn led to a greater shrinkage towards the global mean. The JSE was the only strategy which allowed to conclude that the in- and out-of-the-sample period should be one year or even longer. The BLM showed compared to the MVP and CET satisfactory performance parameters, but however, the model is extremely sensitive towards variables that require a subjective determination of the investor. Therefore, besides the advantages of the model, the extreme sensitivity of τ and Ω, which have to be pre-determined by the investor, is still a drawback.

The comparison of the performance parameters with- and without the exchange rate has shown that in most of the cases the risk is higher while the return is lower when the exchange rate is considered. This is due to the fact that during the sample period the exchange rate movement was not in favour of a European investor. The appreciation of the Euro against all other currencies which were included in the portfolio caused that foreign investments were worth less since they had to be exchanged against a stronger Euro. The exchange rate contribution to the portfolio risk and return were in all cases noticeable. Therefore, even in an equity portfolio, the risk of currency developments cannot be ignored.

References

Best, M. J. and Grauer, R P. (1992), *The Analytics of Sensitivity Analysis for Mean-Variance Portfolio Problems*, International Review of Financial Analysis, Vol. 1, Is. 1, pp. 17-37.

Bevan, A. and Winkelmann, K. (1998), *Using the Black-Litterman Global Asset Allocation Model: Three Years of Practical Experience Fixed Income Research*, Fixed Income Research, Goldman Sachs.

Black, F. (1989), *Universal Hedging: Optimizing Currency Risk and Reward in International Equity Portfolios*, Financial Analysts Journal, Vol. 45, Is. 4, pp. 16-22.

Black F. and Litterman R. (1992), *Global Portfolio Optimization*, Financial Analysts Journal, Vol. 48, Is. 5, pp. 28-43.

Board, J. and Sutcliffe, C. (1992), *Estimation Methods in Portfolio Selection and the Effectiveness of Short Sales Restrictions: UK Evidence*, Management Science, Vol. 38, pp. 11-31.

Bugár, G. and Maurer, R. (1997), *International Portfolio Diversification for European Countries: The Viewpoint of Hungarian and German Investors*, Mannheimer Manuskripte zu Risikotheorie, Portfolio Management und Versicherungswirtschaft (Universität Mannheim).

Christodoulakis, G.A. and Cass, J. C. (2002), *Bayesian Optimal Portfolio Selection: the B-L Approach*, http://www.globalriskguard.com/resources/assetman/bayes_0008.pdf, 19.09.2008.

Chopra, V. K. and Ziemba, W.T. (1993), *The Effects of Errors in the Means, Variances and Covariances*, Journal of Portfolio Management, Vol. 19, Is. 2, pp. 6-11.

Coval, J. D. and Moskowitz, T. J. (1999), *Home Bias at Home: Local Equity Preference in Domestic Portfolios*, Journal of Finance Vol. 54, Is. 6, pp. 2045-2074.

Elton, E. J. and Gruber, M. J. (1977), *Risk Reduction and Portfolio Size: An Analytical Solution*, The Journal of Business, Vol. 50, Is. 4, pp. 415-437.

Elton, E. J., Gruber, M. J., Brown, S. J. and Goetzmann, W. N. (2003), *Modern Portfolio Theory and Investment Analysis*, 6th Edition, John Wiley & Sons, Inc.

Eun, C.S. and Resnick, B.C. (1994), *International Diversification of Investment Portfolios: U.S. and Japanese Perspectives*, Management Science, Vol. 40, Is.1, pp. 140-160.

French, K. R. and Poterba, J. M. (1991), *Investor Diversification and International Equity Markets*, American Economic Review, Vol. 81, Is. 2, pp. 222-226.

Grauer, R. and Hakansson, N. (2001), *Applying Portfolio Change and Conditional Performance Measures: The Case of Industry Rotation via the Dynamic Investment Model*, Review of Quatitative Finance and Accounting, Bosten, Vol. 17, Is. 3. pp. 237-265.

He, G. and Litterman, R. (1999), *The Intuition Behind Black-Litterman Model Portfolios*, Investment Management Research, Goldman Sachs.

Idzorek, T. M. (2002), A *Step-By-Step Guide to the Black-Litterman Model*, http://corporate.morningstar.com/ib/documents/MethodologyDocuments/IBBAssociates/BlackLitterman.pdf, 10.12.2009.

James, W. and Stein, C. (1961), *Estimation with Quadratic Loss*, Berkeley Symposium on Mathematical Statistics and Probability, Vol. 1, pp. 361-379.

Jorion, P. (1986), *Bayes-Stein Estimation for Portfolio Analysis*, Journal of Financial and Quantitative Analysis, Vo, 21. Is. 3, pp. 279-292.

Markowitz, H. M. (1952), *Porfolio Selection*, Journal of Finance, Vol. 7, Is. 1, pp. 77-91.

McClatchey, C. A. and VandenHul, S. P. (2005), *The efficacy of optimization modeling as a retirement strategy in the presence of estimation error*, Financial Services Review, Vol. 14, Is. 4, pp. 269-284.

Merton, R. C. (1972), *An Analytical Derivation of the Efficient Frontier*, The Journal of Financial and Quantitative Analysis, Vol. 7, Is. 4, pp. 1851-1872.

Satchell, S. and Scowcroft, A (2000), *A demystification of the Black–Litterman model: Managing quantitative and traditional portfolio construction*, Journal of Asset Management Vol. 1, Is. 2, pp.138–150.

Sharpe, W. F. (1964), *Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk*, The Journal of Finance, Vol. 19, Is. 3, pp. 425-442.

Sharpe, W. F. (1970), *Portfolio Theory and Capital Markets*, McGraw-Hill, New York.

Solnik, B. H. (1982), *Optimal International Asset Allocation*, Journal of Portfolio Management, Vol. 9, Is. 1, pp. 11-21.

Solnik, B. H. (1995), *Why not diversify internationally rather than domestically?* Financial Analysts Journal, Vol. 30, Is. 4, pp. 48-54.

Walters, J. (2008), *The Black Litterman Model: A Detailed Exploration*, http://www.blacklitterman.org/Black-Litterman.pdf, 10.12.2009.

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