LUND UNIVERSITY

Commodity futures impact on equity funds portfolios

Oscar Mc Guire

Field of study: Finance

Level: C

Credits: 15 credits

Thesis Defence: Autumn 2014

Supervisor: Birger Nilsson

Department of Economics

Bachelor thesis in Finance

Abstract

In the light of the latest decade of structural change and growth in trade on the commodity markets it is natural to ask the question: Is it worth adding commodity futures to your portfolio? The objective of this paper is to find out if commodity futures does or does not add to the performance of portfolios consisting of equity funds. The theory used is basic portfolio theory, with Sharpe's ratio as the measure of performance. I simulate real time portfolio optimization on given data with expected returns calculated with 60 months historical data. The results ex-ante show a great enhancement of the Sharpe's ratio if adding commodity futures to a equity funds portfolios. The results also indicates that a less diversified portfolio gains more by adding the commodity futures, than does a well diversified one. Ex-post results, however, show a negative effect of adding commodity futures to both a well diversified portfolio and a less diversified one. My interpretation of this result is that, during a tumultuous decade, the method of calculating expected return with 60 months equally weighted averages do not yield sufficient precision in the forecasts.

Keywords: Commodity futures, Sharpe's ratio, equity funds, sector funds, portfolio optimization.

Preface

I would like to thank my supervisor Birger Nilsson for the help and pointers he has been giving me throughout this paper.

Lund, January 22, 2015

Contents

1. Introduction

1.1 Background

The commodity markets have grown markedly the last decade and the amount of derivates constructed on commodities and the availability of these have increased. The reason for this seems to be that the majority of the market wants to use them in purpose of diversification and hedging. A forward or future is no longer just a business for the farmer to hedge against future price falls. The by far largest part of all futures contracts today do never actually lead to a delivery of the underlying asset, instead the positions are usually closed out by holders taking an offsetting contract (p.36, Hull, 2012).

Because of the sudden increase and change of the commodity markets, the underlying mechanisms that drive the market have changed. For this reason I believe it is an important field to study, and gaining a deeper understanding of the topic will be vital for me in my professional life and it is for this reason that I have chosen this particular topic.

What I will do is simulate real time portfolio optimization with a given data. Although this has been done before, what I believe will make a difference between my paper and previous work is that I will not, as previous papers that I have read, use only one or two stock market indices and combine these with a commodity index. Instead I will be using 10 different sectors, and combine these with randomly chosen geographical markets, e.g. "Oil and Gas - Asian market" to create my own equity funds. The idea is that I will then lower the amount of correlation which stems from sector specifics and at the same try and avoid any correlation which might steam from geographical and/or national sources. I will also be using data from 10 separate commodities, instead of using one or two big commodity indices, which is common in previous research.

1.2 Literature and earlier studies

Papers written today on portfolio theory are theoretically often far more advanced than the present paper. This said however, I will use basic portfolio optimization theory, meaning theory from the Nobel laureate Harry Markowitz and especially from his paper "Portfolio Selection" published 1952 in the Journal of Finance. The two main books that will guide me when writing this paper, are "Investments" - by Zvi Bodie, Alex Kane and Alan J. Marcus, And "Options, Futures and other Derivatives" - by John C. Hull. The reason for diversification is that it you should limit the exposure you have on any one asset by allocating your weights in such an order that they minimize portfolio S.D. (Standard Deviation).To achieve this objective, preferably your assets should have a low correlation with each other.

What about diversification with the help of commodity futures? The reason for using commodity futures with your equity portfolio would then be that they have a low correlation between the assets in your equity portfolio, and should perform well together. Low correlation is shown to be the case in several studies, and is reasoned by **(**p.3, Jensen et al, 2009) to be ascribed by the different performances of the assets during times of inflation. Where commodity prices usually goes up if the inflation and interest rates goes up, equity portfolios tend to be negatively affected by the same (p.3, Jensen et al, 2009). The exposure of a long commodity future will then help to hedge your portfolio against inflation. (p.3, Jensen et al, 2009) refers to several earlier studies that discuss this reason for commodity futures being desirable in a portfolio. For example, Zvi Bodie published a paper in the Journal of Finance in 1983 named "Commodity Futures as a Hedge against Inflation" and in 2007 Robert Greer published “The Role of Commodities in Investment Portfolios” in which he argues that not only are commodities negatively correlated with equities but they are also positively correlated with inflation (p.35, Greer, 2007). On the other hand some researchers mean that the rapid increase in volume and liquidity has led to increased correlation between commodities and other finacial markets (p.42, Silvenoinnen & Thorp, 2013). At the same time others argue that the increase in both volume and liquidity has been a good thing, with benefits for the investors concerning price volatility, risk premiums and integration with other markets (p.393-394, Irwin & Sanders, 2012).

1.3 Objective and research questions

The objective of this essay is to investigate if a well diversified portfolio will benefit, in the terms of risk-adjusted return (Sharpe's ratio), from the addition of commodity futures. I will do this through established portfolio theory applied on 20 different assets, 10 commodity futures and 10 equity fund indices. The sample period is 2006-01-01 until 2014-06-30. I will create one portfolio using only future contracts, two portfolios using only equity funds and two portfolios that combine both the assets in different ways.

The major questions are: Will commodity futures enhance well-diversified portfolios, consisting of equity funds, Sharpe ratios? And will they enhance a smaller portfolio's performance more a bigger portfolio's performance?

Research question 1: Will a portfolio consisting of 10 equity funds and 10 commodity futures have a higher Sharpe's ratio than a portfolio consisting of 10 equity funds?.

Research question 2: Will a portfolio consisting of 5 equity funds and 5 commodity futures have a higher Sharpe's ratio than a portfolio consisting of 5 equity funds?

Research question 3: Which of the two equity portfolios have gained the most by adding commodity futures?

In order to connect to the real world, I would also like to test how good the expected weights do with the actual ex-post return, variances and covariances.
Is the equally weighted 60 months historical evaluation of expected return and variance effective on my data?

Research question 4: Will the ex-post Sharpe's ratios, calculated with the same weights as was optimized with expected numbers, follow the same hierarchy as the expected Sharpe's ratios?

2. Theory

2.1 Modern portfolio theory

The main part of MPT and of this paper is the relationship between return and risk. An investor wants high return and low risk, or in the words of Markowitz: "We next consider the rule that the investor does (or should) consider expected return a desirable thing and variance of return an undesirable thing" (p.77, Markowitz, 1952). When diversifying a portfolio, we try to maximize this relationship in the favour of return. The theory does not say that it is always better to diversify, because there could be an asset that has such a high return and low variance that it would beat all possible combinations with other available assets (p.89, Markowitz, 1952). This is highly unlikely, but less so the fewer assets you have at your disposal. With every pool of assets you will be able to create an effective-frontier, a line consisting of points which are all maximizing return for different levels of risk. For example you might be able to combine 10 assets to give you 5% return at the cost of 7% risk, and with the same 10 asset you can get 6% return but at the cost of 10% risk.

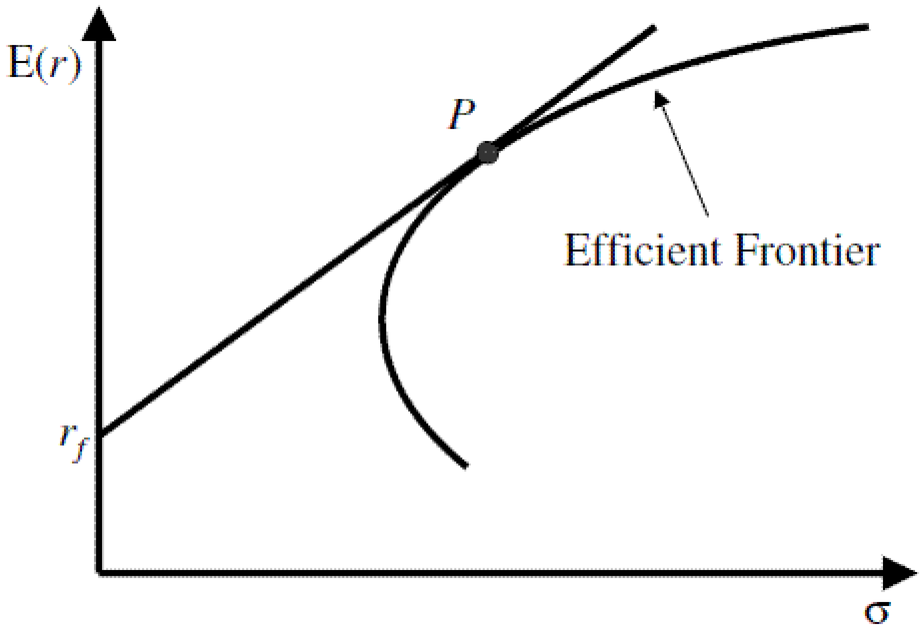


Figure 2.1 Efficient frontier.

The point I will be looking for in this paper is the point named P, seen in the figure 2.1 (Analystnotes, 2015) above, which I will be calling the Optimal risky portfolio.

This portfolio P is the combination of your assets that will maximize the Return-Variance relationship in the favour of the investor.

In this paper I will use the Sharpe's ratio to measure this relationship between return and variance. Sharpe's ratio was developed by William F. Sharpe who was awarded the Nobel Prize in economics 1990 (Nobel prize, n.d), together with Harry Markowitz and Merton Miller. I will use the Sharpe's ratio because it is very simple and was implemented by Sharpe during the 60's when he (among others) was developing the CAPM (capital asset pricing model) , which has its basis in the portfolio theory of Markowitz.

$$\max_{w_i} S_p = \frac{E(r_p - r_f)}{\sqrt{var(r_p - r_f)}} \qquad (1)$$

Here, the numerator is the expected portfolio return minus the T-bill return, the denominator is the standard deviation of the same quantity and the quotient is our Sharpe's ratio. Notice here that the standard deviation equals risk in this theory.

2.2 Short selling

I will allow short selling in my portfolios, meaning that you can go negative in asset weights. Concerning the futures contracts, this is merely taking a short position, which is done by one party of every futures contract.

Concerning the equity funds, it is a bit more complicated and short sales might not be possible for the equity funds as a whole. This will be further discussed under chapter 2.7 Assumptions.

A short sale is when you sell an asset that you do not own. You borrow the asset from someone, typically a broker and agree on a date to return the asset. You then sell the asset and hope that the price on the market will go down, so when it is time to return the asset to the broker you do not have to spend all the money you got from selling it, thus giving you a profit. This transaction is usually all done through a broker and the actual asset does not need to swap owners, instead an account is opened at the brokerage house, with a margin to cover eventual losses from the short selling and for placing eventual proceeds (p.80, Bodie et al, 2012). This is very similar to how the futures exchanges work.

I have set a minimum on each asset weight to -3 since I had some technical issues with weights in the region of -10000000, and even though this is theory I don't want to lose touch with reality.

3 Research Methodology

All the data will be priced in terms of US-dollars, therefore I will also use an American T-Bill to calculate my risk-free interest rate. Also the inflation will influence all the assets the same and will make it easy for me to either ignore it or to calculate real rate of return.

I will use historical data from 60 months back to calculate the expected return, variance and standard deviation on all the assets. The historical data will all be equally weighted, meaning I will not put a different value on the return depending on how far back or close it is in the 60 months. I will then try to create five optimized risky portfolios for each six months period in the time span 2006-01-01 – 2014-11-01 (17 periods). For every new period I will use updated data to calculate a new expected return and standard deviation of all the assets. I will also analyze the ex-post performance of all portfolios in every period, where I use the weights given when optimizing expected Sharpe's ratio. This is to see what would have been the result if I would have invested with the information given from the expected numbers. The different portfolios will have the following assets at their disposal when optimizing:

- The first portfolio will be able to use the 10 different equity funds.
- The second portfolio will be able to use the 10 different commodity futures.
- The third portfolio will be able to use 5 of the equity funds.
- The fourth portfolio will be able to use 10 of the equity funds and the 10 commodity futures.
- The fifth portfolio will be able to use 5 of the equity funds and 5 of the commodity futures.

When using the word optimizing, I refer to maximizing Sharpe's ratio e.g. adjusting asset weights in the portfolio to give the most percent of return per percent of risk (standard deviation) adjusted for risk-free interest. The sum of weights are under the constraint to be equal to one.

3.1.1 First step

Since I will use the Sharpe ratio in order to decide my weights in the portfolios I also have to calculate the expected return, and the standard deviation on this return.

When calculating the expected return for my time period, I will use historical data for 60 months back, with observations of the assets price in weekly intervals. I start by calculating the return for each week.

Return for each period:

$$r_t = \frac{S_t - S_{t-1}}{S_{t-1}} \qquad (2)$$

I then take the arithmetic average of these rates of returns to calculate an expected return for the upcoming 6 months (p.130, Bodie et al, 2012).

Arithmetic average of rates of return:

$$\bar{r} = \frac{1}{n}\sum_{i=1}^{n} r(i) \qquad (3)$$

where r_1 is the return from the first period from the assets historical data and r_n from the last period.

When I have obtained the returns I use them to estimate variance according to the equation below:

$$\hat{\sigma}^2 = \frac{1}{n-1}\sum_{i=1}^{n} [r_i - \bar{r}]^2 \qquad (4)$$

Here, the first part (outside the summation sign) is adjusted to give the unbiased degrees of freedom, and the parts within the summation is simply every observations value minus the arithmetic average of return on the observations (squared).

Number of observations improve the estimation on variance and standard deviation (p.134, Bodie et al, 2014). This is the reason for using weekly observations instead of monthly or even larger time spans.

Standard deviation is simply the square root of our variance:

$$\hat{\sigma} = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}[r_i - \bar{r}]^2} \qquad (5)$$

Before I go on and start optimizing my portfolios, I want to check for deviations from normality. Risk = Standard deviation when and only when, the excess return is normally distributed. I will therefore use the Skew and Kurtosis measures to see if the risk assessment is too high or too low (p.138, Bodie et al, 2014).

$$Skew = Average\left[\frac{(r-\bar{r})^3}{\hat{\sigma}^3}\right] \qquad (6)$$

A positive skew overestimates risk and a negative skew underestimates risk.

$$Excess\ Kurtosis = Average\left[\frac{(r-\bar{r})^4}{\hat{\sigma}^4}\right] - 3 \qquad (7)$$

Excess Kurtosis for a normal distribution is 0. A positive Kurtosis = fatter tails than a normal distribution, A negative kurtosis = thinner tails than a normal distribution.

I will not use these two measures in any way when I am optimizing the portfolios since that is beyond the scope of this paper and I assume that investors are mean-variance optimizers. I will however include these measures when I present the data statistics.

3.1.2 Second step

After I have obtained all the results from the calculations described above, I can go ahead and compute my first optimal risky portfolio (p.205, Bodie et al, 2014). As stated before I will hold each portfolio over a period of six months.

The expected rate of return of the portfolio is simply calculated as the weighted average of each asset multiplied with the assets expected return.

$$E(r_p) = \sum_{i=1}^{n} w_i E(r_i) \qquad (8)$$

The second part we need for optimizing the portfolio is the portfolio variance which is given by:

$$\sigma_p^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i\, w_j Cov(r_i, r_j) \qquad (9)$$

In lack of a better way to put it, I will quote (p.209, Bodie et al, 2014) "The variance of the portfolio is a weighted sum of covariance's, and each weight is the product of the portfolio proportions of the pair of assets in the covariance term".

3.2 Implementing theory: Steps in DataStream and Excel

I will now give a short, and hopefully concise description of how I put the theory in to practise, using DataStream and Excel.

1. Import the data that is stated above, using a DataStream add-in in Excel. Import and ask for weekly observations of the price on the data. In the T-bills case we ask for interest instead of price.

2. Use the weekly prices to calculate the weekly returns with equation (2).

3. Calculate average on the weekly returns for each asset, with equation (3).

4. Estimate weekly variance on each asset with equation (4).

5. Construct a variance-covariance matrix, this can be done in different ways, with the same result. I chose to use the covar-function in excel directly on the returns. "Covar(matrix1;matrix2)" where each matrix is the weekly returns on two assets over the same 260 observations/weeks (60 months).

6. At this point I assign bogus/random weights to each asset, I then calculate both expected return and variance for the portfolio using equations (8) and (9), and since they both are dependent on the asset weights they too will be bogus at first. I also set up the equation for the Sharpe's ratio equation (1), but since (8) and (9) are bogus, the Sharpe's ratio will at first be as well.
   Then I use the Solver-function in excel with the order to 1: maximize Sharpe's ratio, 2: by changing the asset weights, 3: with the constraints - sum of assets must be equal to 1 and no single asset can be less than -3 (max short sale per asset is set to 3). I now end up with the weights that optimize return and variance to maximize Sharpe's ratio.

7. Repeat step 5 and 6 for each of the 17 periods for every portfolio.

8. Repeat steps 2-5 for ex-post portfolios, which requires new returns and variances, since these portfolios will represent the actual outcome each period. Use the weights from ex-ante portfolios and calculate the Sharpe's ratios for every portfolio and period.

3.3 Assumptions

I will here try to make a summary of all the assumptions that will be made in this paper. Some will be general for the theory that I am using, some will be specific for this paper. This is made to clarify and help readers to easily see what assumptions are being made.

1. Return is good, Standard deviation is equal to risk and is bad. Investor are mean-variance optimizers and do not care about higher movements, e.g. skewness and kurtosis.

2. There are no costs when rebalancing. In other words, I will ignore any costs associated with selling or buying, such as brokerage costs or taxes.

3. When short selling the equity funds I am using, I assume there is an ETF (Exchange traded fund) for every equity fund. I assume that they follow my equity funds perfectly. The ETFs will be used when short selling instead of the equity funds. This is to avoid problems with short selling equity funds, such as availability on the market since they often are bought directly from a company and not on the exchange.

4. The minimum weight of each asset will be set to -300%, or in other words, the maximum of short sales on any given asset is three.

5. The T-Bill is risk free.

3.4 Methodology critique

I do not know if the 60 months equally weighted average method for calculating the expected return on my data is optimal, I chose it because it has been the standard on some of the courses I have taken. Of course I could have tested some different methods for estimating expected return and then run them with the actual returns to see if I could improve the estimations. This would have been very time consuming and would not add much to my paper, so I did not. Also using 60 months historical data during a decade with much turmoil on the financial markets might not be the best idea, as we will see later in chapter 5.4.

The lack of a control group, with randomly selected assets that were not commodity futures, that would have been able to serve a purpose to see the difference of adding the futures compared to random assets. Maybe it would not impact the 10 equity much, and the difference between adding 10 futures and 10 random assets would have been large. But the 5 equity portfolio might well have gained much from adding five random assets and the results might have been interesting.

Does the method answer the questions of the paper?

Yes.

Are the questions of the paper relevant and do the answers add new knowledge to the topic?

To my knowledge this exact data has not undergone this portfolio optimization before and would argue that the results could definitely be relevant, if maybe only to create interest for further research on the same data. The data are relatively up to date and the fact that the markets for commodities have been under big structural change during the time span of all my periods, gives further reason for relevance. New theoretical knowledge has not been added to the topic, but this was never the point of the paper.

4. Data

All the data is collected with the use of Thomson Reuters DataStream and is priced in US dollars or cents. I will collect data on three different assets. Equity funds, commodity futures and the Risk-free rate.

4.1 Equity funds / Sector funds

The data for equity funds I will use to make this simulation is 10 different sector funds, with randomized geographical adherence e.g. Oil and Gas companies - Asia, except for two cases where I will use "developed markets" and "Emerging markets" instead. I would of course prefer to have all different sectors for all of the geographical locations available, but this would result in too much data for me to be able to handle during the time-scope for this paper. Hopefully the choices I have made will result in a somewhat diversified portfolio to start out with (before we allow the use of commodity futures). The indices I use are created by DataStream and are to my knowledge not available to purchase on the market, but for this paper I will ignore this and use them as if they were highly liquid assets in the form of equity funds.

10 sector indices as follows:

Asia-Datastream Oil and Gas - Equity index - OILGSAS

Market: Asia

Contains: 64 different stocks on oil and gas companies in Asia. Five examples/Notables are: Pakistan State Oil, China gas holdings, Shell Pakistan, Indian Oil, Japan Drilling.

Europe-Datastream Basic Materials – Equity index - BMATREU

Market: European Union

Contains: 135 different stocks on basic material companies in the EU. Five examples/Notables are: Croda International, Akzo Nobel, Elementis, Holmen B, Linde.

North America-Datastream Industrials – Equity index - INDUSNA

*Marke*t: North America

Contains: 187 different stocks on Industrial companies in North America. Five examples/notables are: Boeing, Caterpillar, Lockheed Martin, General Electric,Canadian National Railway.

Latin America-Datastream Consumer Goods – Equity index - CNSMGLA

Market: Latin America

Contains: 59 different stocks on consumer goods companies in Latin America. Five examples/notables are: San Miguel B, Coca-Cola FEMSA L, Bimbo A, Kimber A, BRF Foods ON.

Asia-Datastream Health Care- Equity index - HLTHCAS

*Marke*t: Asia

Contains: 102 different stocks on health care companies in Asia. Five examples/notables are: Mitsubishi Tanabe Pharma, Asiri Hospital Holdings, Bumrungrad Hospital, Astellas Pharma, Takeda Pharmaceutical.

Europe-Datastream Consumer Services – Equity index - CNSMSER

Market: Europe

Contains: 322 different stocks on consumer services companies in Europe. Five examples/notables are: Hennes & Mauritz B, Tesco, Ryanair, ICA gruppen, Sodex

Latin America-Datastream Telecommunications – Equity index - TELCMLA

Market: Latin America

Contains: 12 different stocks on telecommunications companies in Latin America. Fice examples/notables are: AMX A, TELEF Brasil ON, TELECOM ARGN. B, OI PN, ENTEL.

Development Markets Excluding North America-Datastream Utilities – Equity index - UTILSEF

Market: Developed markets, excluding North America.

Contains: 111 different stocks on Utility companies. Five examples/notables are: AGL Energy, E ON, Tokyo electric power, CLP Holdings, Endesa.

Emerging Markets-Datastream Financials – Equity index - FINANEK

Market: Emerging Markets

Contains: 685 different stocks on financial companies. Five examples/notables are: Malayan Banking, Bangkok Bank, Banco Brasil ON, Turkiye IS Bankasi 'C', Suez Canal Bank

North America-Datastream Technology – Equity index - TECNONA

Market: North America

Currency: United States Dollar

Contains: 115 different stocks on technology companies. Five examples/notables are: Microsoft, Apple, Google A, Intel, Motorola Solutions**.**

4.2 Continuous futures contracts

A normal forward contract is a contract in which person A agrees to sell some underlying assets (for example gold) in the future, to a price which are agreed upon today. At the same time of course person B agrees to buy this underlying asset in the future, for a price set today. Payment and delivery happens after the set (in the future contract) date has passed. Size, delivery arrangements, date and price are all discussed and set between the two parties (p.5, Hull, 2012).

A futures contract is a standardized forward contract usually traded on exchanges. Size, delivery arrangements and date are set by the exchange. Price is determined by the demand and supply on the market. As in forward contracts there is a future date for payment and delivery of underlying asset, but very few of the contracts ever go into delivery. Instead they are closed out early. Futures contracts have a daily settlement where the differences are paid instead of waiting until the end date to see which of the parties have made a loss/profit in entering the contract (chap 2, Hull).

A continuous futures contract is several "stitched up" future contracts. It is constructed to be able to look at the return over longer periods than the span of one single futures contract. There are several different ways of "stitching up" the contracts, I've chosen for all my contracts to be "rolled" (swapped for a newer contract) on the first of the new month. All assets below have their own mnemonics, where the number at the end specifies roll methods, 0 being the type I've just described. The 0 before that tells us that we roll to the nearest position contract, we are swapping to the closest new contract e.g. if there is a new contract next month, we swap to that one, we don't skip it. CS tells us that we use all available contract months trading, for example we don't say "use only January, April, September and December".

NGC	+	CS	+	0	+	0	=	NGCCS00
Name	+	all available months	+	roll to nearest	+	roll on first of the month.		

(Datastream, 2010).

10 different Continuous commodity futures, as follows:

CMX-Gold 100 oz Continuous - NGCCS00

Contract Size:100,00

Contract Unit: Ounces

Market United States

Exchange New York Mercantile Exchange (COMEX Division)

NYMEX-Crude Oil Futures Continuous - NCLCS00

Contract Size 1000,00

Contract Unit Barrels

Market United States

Exchange New York Mercantile Exchange (NYMEX)

NYMEX-Henry Hub Natural Gas Futures Continuous - NNGCS00

Contract Size 10000,00

Contract Unit Million BTU

Market United States

Exchange New York Mercantile Exchange (NYMEX)

BMF-Arabica Coffee Continuous - BMACS00

Contract Size	100,00
Contract Unit	60 Kilogram Bags
Market	Brazil
Exchange	BM&F Bovespa

CMX-High Grade Copper Continuous - NHGCS00

Contract Size	25000,00
Contract Unit	Pounds
Market	United States
Exchange	New York Mercantile Exchange (COMEX Division)

LIFFE-White Sugar Continuous Second Future - LSWCS20

Contract Size	50,00
Contract Unit	Metric Tonne
Market	United Kingdom
Exchange	NYSE Euronext Liffe

CBT-Wheat Continuous Second Future - CW.CS20

Contract Size	5000,00
Contract Unit	Bushels
Market	United States
Exchange	eCBOT

CSCE-Cotton #2 Continuous - NCTCS00

Contract Size	50000,00
Contract Unit	Pounds
Market	United States
Exchange	ICE Futures US

Chicago Board of Trade(CBOT)-Corn Continuous - CC.CS00

Contract Size	5000,00
Contract Unit	Bushels
Market	United States
Exchange	eCBOT

CMX-Silver 5000 oz Continuous - NSLCS00

Contract Size	5000,00
Contract Unit	Ounces
Market	United States
Exchange	New York Mercantile Exchange (COMEX Division)

4.3 Risk-free rate

I will use a US Treasury Bill to calculate my risk-free rate. The T-Bill is the best option available since it is probably the closest thing there is to a risk-free rate. I will assume the risk to be 0, even though this is probably not totally accurate. The T-Bill is an instrument for the government to raise money; they borrow money from you and pay you back more money when the T-Bill matures. This difference is the profit you get, and is used to calculate your return.

I will use a T-Bill with a maturity of six months, since my periods are all six months. I will calculate the risk-free rate with the T-Bill rate given at the start date of each of my portfolio periods, or as close as possible if not available at exact date. Since all my other numbers are weekly reports, I will convert the six months rate into weekly rates as well.

Example: 2006-01-02: 6 months T-bill yearly return is 4.2%, weekly return then is

$$(1+0{,}042)^{\left(\frac{1}{52}\right)}-1=0{,}0007915$$

Which is the weekly risk-free rate used for the first period.

4.4 Descriptive statistics for the data

The numbers are calculated on the full period, from which I have been collecting data for the different period portfolios from, being (2001-2014). This is meant to give a brief summary of the characteristics of each asset. The colour scheme is just red-low, beige-high, and has nothing to do with if it is deemed as a good or bad value.

	Min	Max	Mean	SD	Skew	Excess Kurtosis
NGCCS00	-0,096	0,131	0,00258	0,02603	-0,268	1,527
NCLCS00	-0,268	0,273	0,00326	0,05061	-0,459	4,247
NNGCS00	-0,249	0,280	0,00159	0,07420	0,389	1,046
NSLCS00	-0,274	0,157	0,00323	0,04530	-0,967	4,463
BMACS00	-0,152	0,214	0,00236	0,04304	0,396	1,672
NHGCS00	-0,231	0,149	0,00266	0,03943	-0,596	3,486
LSWCS20	-0,151	0,142	0,00160	0,03534	-0,192	1,628
CW.CS20	-0,151	0,155	0,00193	0,04285	0,355	0,926
NCTCS00	-0,263	0,193	0,00141	0,04527	-0,050	2,749
CC.CS00	-0,226	0,208	0,00193	0,04398	-0,047	2,153
OILGSAS	-0,194	0,126	0,00274	0,03176	-0,438	3,680
BMATREU	-0,244	0,206	0,00231	0,04084	-0,453	4,909
INDUSNA	-0,176	0,136	0,00121	0,03025	-0,342	3,954
CNSMGLA	-0,391	0,210	0,00193	0,04196	-1,570	15,591
HLTHCAS	-0,192	0,060	0,00105	0,02025	-1,338	11,314
CNSMSER	-0,197	0,111	0,00104	0,02870	-0,874	4,994
TELCMLA	-0,224	0,186	0,00152	0,03765	-0,405	4,280
UTILSEF	-0,238	0,116	0,00103	0,02390	-1,572	15,118
FINANEK	-0,207	0,174	0,00240	0,03158	-0,646	5,766
TECNONA	-0,163	0,157	0,00100	0,03566	-0,144	2,109

Table 4.1 Data statistics.

5. Results and Analysis

I will start off with the Expected results of the five different portfolios and compare these to each other. I will answer the research questions and analyse the reasons for each answer. With question 4, I will go on with the actual results for the periods, when using the weights calculated with the help of expected return and variance. The colour scheme used for the tables are ordered so that, blue indicates a positive number for the Sharpe's ratio and red indicates a negative number. For example a high expected return is blue, because it helps the Sharpe's ratio to be higher. While a high expected standard deviation is red, because it works against the Sharpe's ratio being higher.

5.1 Expected results and analysis

Notice: Portfolio return and S.D. are both in weekly numbers.

Period	Start date						
1	2006-01-01	E(rp)	0,016051307	E(SD)	0,058081876	E(Sharpes	0,26272917
2	2006-07-01	E(rp)	0,015556091	E(SD)	0,062975519	E(Sharpes	0,23187928
3	2007-01-01	E(rp)	0,017177263	E(SD)	0,06301265	E(Sharpes	0,25796497
4	2007-07-01	E(rp)	0,009400188	E(SD)	0,030907602	E(Sharpes	0,27513247
5	2008-01-01	E(rp)	0,008311116	E(SD)	0,025247654	E(Sharpes	0,30378242
6	2008-07-01	E(rp)	0,015386094	E(SD)	0,053914703	E(Sharpes	0,27775442
7	2009-01-01	E(rp)	0,023078982	E(SD)	0,111360112	E(Sharpes	0,20678075
8	2009-07-01	E(rp)	0,018468295	E(SD)	0,101015381	E(Sharpes	0,18221832
9	2010-01-01	E(rp)	0,019745211	E(SD)	0,110818705	E(Sharpes	0,17782907
10	2010-07-01	E(rp)	0,021130445	E(SD)	0,125911881	E(Sharpes	0,16752939
11	2011-01-01	E(rp)	0,021598424	E(SD)	0,123932347	E(Sharpes	0,17396589
12	2011-07-01	E(rp)	0,021202701	E(SD)	0,12066586	E(Sharpes	0,17555487
13	2012-01-01	E(rp)	0,019284362	E(SD)	0,105981687	E(Sharpes	0,18185054
14	2012-07-01	E(rp)	0,015302926	E(SD)	0,077254112	E(Sharpes	0,19768761
15	2013-01-01	E(rp)	0,012299765	E(SD)	0,057343843	E(Sharpes	0,21408928
16	2013-07-01	E(rp)	0,012531142	E(SD)	0,05143156	E(Sharpes	0,24323586
17	2014-01-01	E(rp)	0,01329699	E(SD)	0,03966932	E(Sharpes	0,33475971

Table 5.1 Numbers for the 10 equity funds portfolio.

We see in table 5.1 that the expected Sharpe's ratio for the 10 equity funds portfolio start off good in the first six periods and then takes a plummet when the variance more than doubles from period six to period seven. This relatively low ratio goes on almost until the last period where we see the best ratio for all of the periods.

Period	Start date						
1	2006-01-01	E(rp)	0,004012788	E(SD)	0,020867161	E(Sharpes	0,15437096
2	2006-07-01	E(rp)	0,005139771	E(SD)	0,021663059	E(Sharpes	0,19325054
3	2007-01-01	E(rp)	0,004897784	E(SD)	0,021601586	E(Sharpes	0,18404098
4	2007-07-01	E(rp)	0,005491959	E(SD)	0,023953392	E(Sharpes	0,1918499
5	2008-01-01	E(rp)	0,005013749	E(SD)	0,021470386	E(Sharpes	0,20364919
6	2008-07-01	E(rp)	0,005778158	E(SD)	0,022522079	E(Sharpes	0,23830443
7	2009-01-01	E(rp)	0,004128026	E(SD)	0,026755967	E(Sharpes	0,15248966
8	2009-07-01	E(rp)	0,003779837	E(SD)	0,024592381	E(Sharpes	0,15120108
9	2010-01-01	E(rp)	0,003964548	E(SD)	0,023206567	E(Sharpes	0,16918158
10	2010-07-01	E(rp)	0,003994067	E(SD)	0,022927687	E(Sharpes	0,17261062
11	2011-01-01	E(rp)	0,004647442	E(SD)	0,024734263	E(Sharpes	0,18634143
12	2011-07-01	E(rp)	0,005144345	E(SD)	0,025486289	E(Sharpes	0,20109337
13	2012-01-01	E(rp)	0,003972767	E(SD)	0,02316518	E(Sharpes	0,17099942
14	2012-07-01	E(rp)	0,004024417	E(SD)	0,024457673	E(Sharpes	0,16328914
15	2013-01-01	E(rp)	0,004019653	E(SD)	0,029077649	E(Sharpes	0,13744541
16	2013-07-01	E(rp)	0,003714351	E(SD)	0,039157893	E(Sharpes	0,0943158
17	2014-01-01	E(rp)	0,003506833	E(SD)	0,024169998	E(Sharpes	0,14437456

Table 5.2 Numbers for the 10 futures portfolio.

In table 5.2 above we can see that the return for the 10 futures portfolio seems to be pretty constant and low compared to the other portfolios and the same goes for the standard deviation. The Sharpe ratios seems below the average of the portfolios, and only goes above 0,2 three times, period 5,6 and 12.

period	start date						
1	2006-01-01	E(rp)	0,019060731	E(SD)	0,090093052	E(Sharpes	0,20278176
2	2006-07-01	E(rp)	0,015798137	E(SD)	0,077239553	E(Sharpes	0,19219122
3	2007-01-01	E(rp)	0,009882572	E(SD)	0,041265266	E(Sharpes	0,21714061
4	2007-07-01	E(rp)	0,007898652	E(SD)	0,033006756	E(Sharpes	0,2121429
5	2008-01-01	E(rp)	0,008232411	E(SD)	0,030845427	E(Sharpes	0,24610095
6	2008-07-01	E(rp)	0,008652674	E(SD)	0,0377453	E(Sharpes	0,21834845
7	2009-01-01	E(rp)	0,014427392	E(SD)	0,098987087	E(Sharpes	0,14526515
8	2009-07-01	E(rp)	0,015383464	E(SD)	0,108707726	E(Sharpes	0,14094695
9	2010-01-01	E(rp)	0,013723595	E(SD)	0,109458638	E(Sharpes	0,12502596
10	2010-07-01	E(rp)	0,01182351	E(SD)	0,094821611	E(Sharpes	0,12430717
11	2011-01-01	E(rp)	0,013880512	E(SD)	0,109133437	E(Sharpes	0,12683637
12	2011-07-01	E(rp)	0,011535668	E(SD)	0,090795612	E(Sharpes	0,12683925
13	2012-01-01	E(rp)	0,023806071	E(SD)	0,229891905	E(Sharpes	0,10350315
14	2012-07-01	E(rp)	0,006289308	E(SD)	0,069778133	E(Sharpes	0,08969233
15	2013-01-01	E(rp)	0,004428637	E(SD)	0,051765422	E(Sharpes	0,0851065
16	2013-07-01	E(rp)	0,003791456	E(SD)	0,031242008	E(Sharpes	0,1206809
17	2014-01-01	E(rp)	0,004172492	E(SD)	0,022643124	E(Sharpes	0,18350791

Table 5.3 Number for the 5 equity funds portfolio.

The numbers for the 5 equity portfolio in table 5.3 seems to follow a similar pattern as the 10 equity portfolio, but with a lower Sharpe's in every period.

Period	Start date						
1	2006-01-01	E(rp)	0,013235851	E(SD)	0,042997677	E(Sharpes	0,28941905
2	2006-07-01	E(rp)	0,012266142	E(SD)	0,041452979	E(Sharpes	0,27290606
3	2007-01-01	E(rp)	0,008955018	E(SD)	0,026298141	E(Sharpes	0,30545166
4	2007-07-01	E(rp)	0,009514796	E(SD)	0,027197508	E(Sharpes	0,31687804
5	2008-01-01	E(rp)	0,007621487	E(SD)	0,020929323	E(Sharpes	0,33351128
6	2008-07-01	E(rp)	0,009696638	E(SD)	0,02845718	E(Sharpes	0,32630047
7	2009-01-01	E(rp)	0,024929968	E(SD)	0,093114796	E(Sharpes	0,26773369
8	2009-07-01	E(rp)	0,012786123	E(SD)	0,055504371	E(Sharpes	0,22925548
9	2010-01-01	E(rp)	0,008427463	E(SD)	0,033966321	E(Sharpes	0,24698109
10	2010-07-01	E(rp)	0,006530214	E(SD)	0,027282459	E(Sharpes	0,23801775
11	2011-01-01	E(rp)	0,00744646	E(SD)	0,029674723	E(Sharpes	0,2496413
12	2011-07-01	E(rp)	0,007694259	E(SD)	0,028535064	E(Sharpes	0,26896864
13	2012-01-01	E(rp)	0,006748163	E(SD)	0,026531012	E(Sharpes	0,25391523
14	2012-07-01	E(rp)	0,006457365	E(SD)	0,023404351	E(Sharpes	0,27459081
15	2013-01-01	E(rp)	0,007582189	E(SD)	0,028254551	E(Sharpes	0,26753656
16	2013-07-01	E(rp)	0,007424583	E(SD)	0,026260794	E(Sharpes	0,28191991
17	2014-01-01	E(rp)	0,009432901	E(SD)	0,025361725	E(Sharpes	0,37125239

Table 5.4 Numbers for the 10 futures + 10 equity funds portfolio

Here in table 5.4 we see high values on the Sharpe's ratio for every period of the 10+10 portfolio. We can see that the optimization has sometimes found it optimal with high return and high standard deviation, but for the most part has used medium-high return combined with a low standard deviation to reach a high Sharpe's ratio.

Period	Start date						
1	2006-01-01	E(rp)	0,009820328	E(SD)	0,039589903	E(Sharpes	0,22805876
2	2006-07-01	E(rp)	0,011365721	E(SD)	0,044110636	E(Sharpes	0,23605073
3	2007-01-01	E(rp)	0,009516716	E(SD)	0,035598506	E(Sharpes	0,24142892
4	2007-07-01	E(rp)	0,008748291	E(SD)	0,032962831	E(Sharpes	0,23820124
5	2008-01-01	E(rp)	0,007127352	E(SD)	0,025169758	E(Sharpes	0,25769139
6	2008-07-01	E(rp)	0,006736191	E(SD)	0,025419306	E(Sharpes	0,24883229
7	2009-01-01	E(rp)	0,017236911	E(SD)	0,100241962	E(Sharpes	0,17147403
8	2009-07-01	E(rp)	0,007278431	E(SD)	0,043121117	E(Sharpes	0,16736555
9	2010-01-01	E(rp)	0,0052486	E(SD)	0,030941578	E(Sharpes	0,16838755
10	2010-07-01	E(rp)	0,005101099	E(SD)	0,028945258	E(Sharpes	0,17497148
11	2011-01-01	E(rp)	0,005513374	E(SD)	0,028969553	E(Sharpes	0,18898981
12	2011-07-01	E(rp)	0,005161536	E(SD)	0,026472987	E(Sharpes	0,19424762
13	2012-01-01	E(rp)	0,005068569	E(SD)	0,028080178	E(Sharpes	0,18009265
14	2012-07-01	E(rp)	0,004118078	E(SD)	0,022844836	E(Sharpes	0,17891714
15	2013-01-01	E(rp)	0,003376486	E(SD)	0,021561557	E(Sharpes	0,15552783
16	2013-07-01	E(rp)	0,003556853	E(SD)	0,021799972	E(Sharpes	0,16218878
17	2014-01-01	E(rp)	0,004396408	E(SD)	0,01891161	E(Sharpes	0,23155658

Table 5.5 Numbers for the 5 futures + 5 equity funds portfolio.

The 5+5 portfolio in table 5.5 above show great similarities with the 10+10 portfolio, for example period seven, though always with a lower Sharpe's ratio.

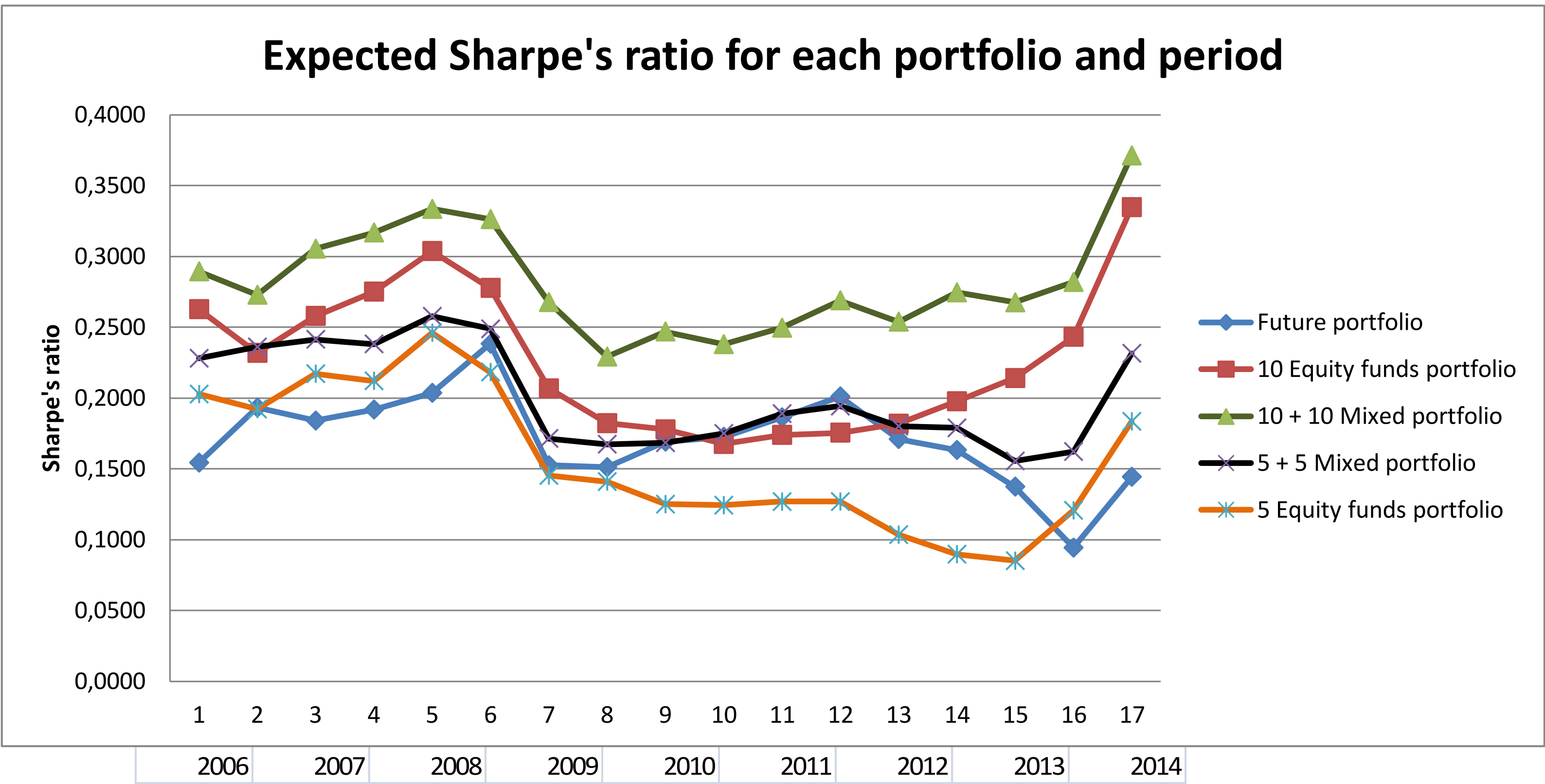


Figure 5.1 Expected Sharpe's ratio.

In figure 5.1 above I have created a graph of the Sharpe ratios from all of the portfolios and periods presented on previous three pages. This is done for ease of comparison of the results.

5.1.1 Research question 1: Will a portfolio consisting of 10 equity funds and 10 commodity futures have a higher Sharpe's ratio than a portfolio consisting solely of 10 equity funds?

We can see that the first research question is answered with a clear yes for the ex-ante 10+10 portfolio. This follows not only theory but also results from earlier studies discussed in chapter 1.2. The 10+10 beats the other three portfolios in every period. We can see that the equity fund portfolio is following the 10+10 from period 1 until period 9 where it deviates and a larger gap then previously can be seen. At this same moment we can see how the future only portfolio beats the equity portfolio for the first time. From period 9 until period 13 where equity once again performs better than the future portfolio, the 10+10 is clearly reaping the benefits from the stronger futures portfolio at the same time as the equity portfolio is performing less optimal. In periods

13-17 we see a decreasing gap between the 10+10 portfolio and the equity fund portfolio, at the same time the futures portfolio ratio is declining.

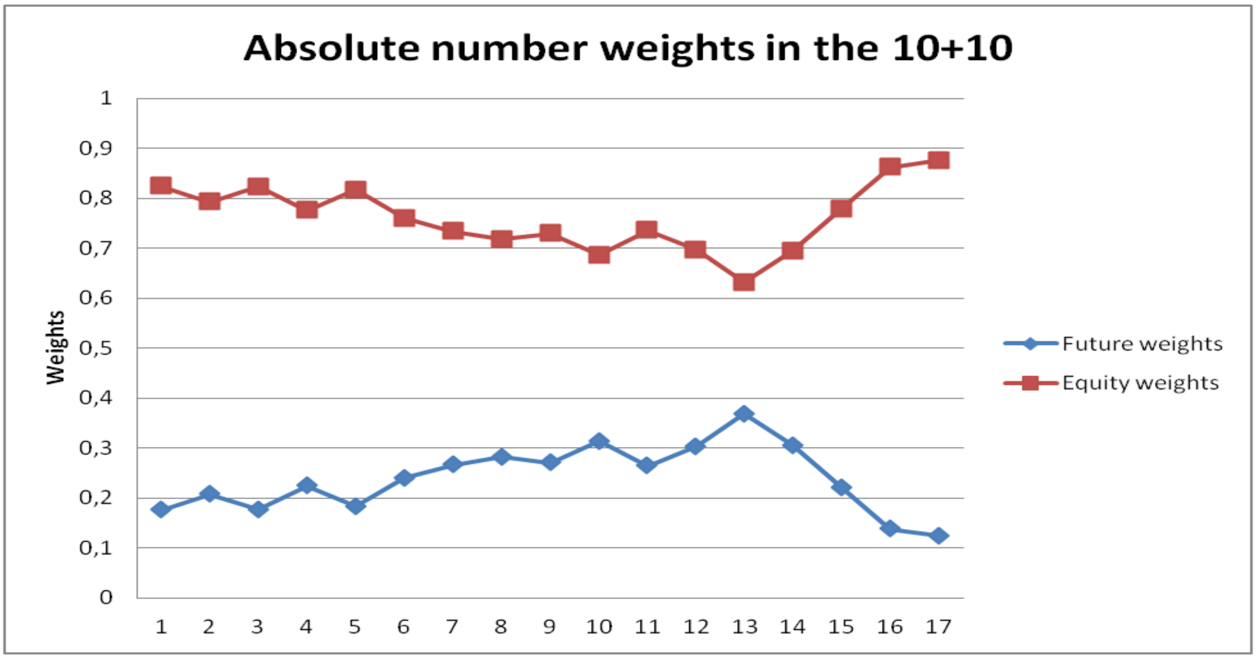


Figure 5.2 Absolute weights.

In figure 5.2 we see how the weights (taken from table 8.11) in the 10+10 has changed from period to period. The weights depicted are the sum of the absolute value of each weight. In other words, how much have each type of asset been used, ignoring if it was a short or long position. This graph follows graph in figure 5.1 reasonably well, we can see that when the gap between the 10+10 and the equity portfolio is low, the absolute weight (the use) of equity funds in the 10+10 are high and vice versa. However this graph doesn't allow us to see the interplay between all the assets, and for example why the future weight is at its peak during period 13, when according to figure 5.1, the futures portfolio is performing below the equity portfolio. To answer that question we will need to look at the weights in terms of real numbers as well. These will be depicted on the next page in figure 5.3. From the graph in figure 5.3 we can see that the sum of equity weights are negative in period 13 and the futures are positive. Since the portfolio weights are bound to be equal to one, this means that the 10+10 portfolio can go negative in all equity funds if desired, and balance this up by going positive in the futures. This is something the equity funds portfolio of course cannot do. This allows the 10+10 portfolio to be more versatile, and in times when no single equity fund is performing that well, it can allocate

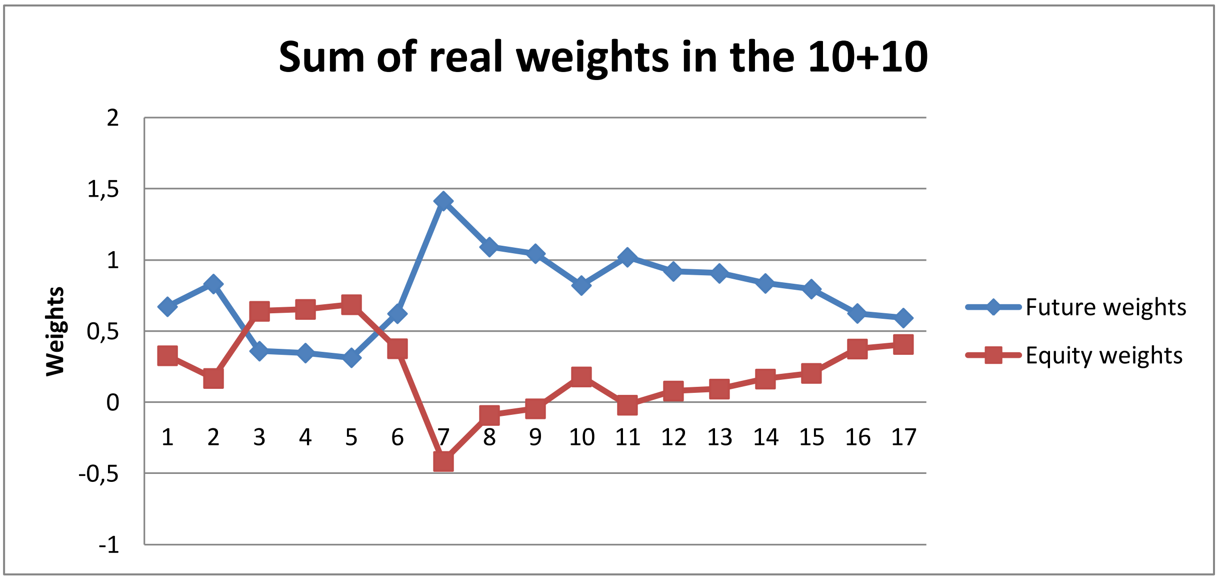


Figure 5.3 Real weights.

positive numbers to the futures and go short in the equities. One good example of this is in period 7, where the sum of the future weights are up at almost 1,5 while the equity weights are down at almost -0,5.

period	7	7
date	2009-01-01	2009-01-01
NGCCS00	220,10%	
NCLCS00	7,78%	
NNGCS00	13,17%	
NSLCS00	-78,84%	
BMACS00	15,58%	
NHGCS00	-43,41%	
LSWCS20	31,21%	
CW.CS20	44,38%	
NCTCS00	-72,63%	
CC.CS00	4,11%	
OILGSAS	-202,55%	-213,52%
BMATREU	75,41%	91,34%
INDUSNA	-245,40%	-300,00%
CNSMGLA	52,48%	89,60%
HLTHCAS	-3,27%	97,17%
CNSMSER	-300,00%	-300,00%
TELCMLA	23,40%	20,59%
UTILSEF	123,34%	134,31%
FINANEK	366,78%	425,38%
TECNONA	68,33%	55,14%

Table 5.6 Period 7 weights.

To the left are the weight allocations for period 7 (taken from tables 8.11 and 8.8). We can see that the two portfolios are both heavily negative in the same three equities, but to be able to do this they both have to be positive in other assets. The 10+10 portfolio is heavily long in gold and positive in future weights with almost 1.5. The equity fund portfolio has to go positive in, deemed by the 10+10, not optimal ways. For example we see that Healthcare Asia (HLTHCAS) is negative for the 10+10, but a high value positive for the equity fund portfolio.

The changing of an assets weight is always a trade-off, calculated from the assets return, variance and covariance with the other assets in the portfolio. I will not trace the exact numbers behind these allocations on the data I've been using, I will trust that the solver in excel has been correct and I will leave it at that.

5.1.2 Research question 2: Will a portfolio consisting of five equity funds and five commodity futures have a higher Sharpe's ratio than a portfolio consisting of five equity funds?

The answer is the same as it was for research questions 1, a clear yes. Every period the 5+5 portfolio has got a higher Sharpe's ratio then the five equity funds portfolio. This result is also in line with theory and earlier studies. Since this answer follows the same reasoning as question 1, I will keep it short and move on to the next question, where we will get more information about both of the mixed portfolios.

5.1.3 Research question 3: Which of the two equity portfolios have gained the most by adding commodity futures?

In order to answer this question, I will calculate the increase as the numerical value (difference) and as the increase in percent on the original value, between each mixed portfolio and its respective equity portfolio. Below is the first table 5.7, with values for the 5 Equity portfolio and the 5+5 portfolio.

Period		(5 equity) Before	(5+5) After	Increase	Increase in percent
1	E(Sharpes	0,2027818	0,2280588	0,025277	12,47%
2	E(Sharpes	0,1921912	0,2360507	0,0438595	22,82%
3	E(Sharpes	0,2171406	0,2414289	0,0242883	11,19%
4	E(Sharpes	0,2121429	0,2382012	0,0260583	12,28%
5	E(Sharpes	0,246101	0,2576914	0,0115904	4,71%
6	E(Sharpes	0,2183484	0,2488323	0,0304838	13,96%
7	E(Sharpes	0,1452652	0,171474	0,0262089	18,04%
8	E(Sharpes	0,1409469	0,1673655	0,0264186	18,74%
9	E(Sharpes	0,125026	0,1683876	0,0433616	34,68%
10	E(Sharpes	0,1243072	0,1749715	0,0506643	40,76%
11	E(Sharpes	0,1268364	0,1889898	0,0621534	49,00%
12	E(Sharpes	0,1268392	0,1942476	0,0674084	53,14%
13	E(Sharpes	0,1035031	0,1800927	0,0765895	74,00%
14	E(Sharpes	0,0896923	0,1789171	0,0892248	99,48%
15	E(Sharpes	0,0851065	0,1555278	0,0704213	82,74%
16	E(Sharpes	0,1206809	0,1621888	0,0415079	34,39%
17	E(Sharpes	0,1835079	0,2315566	0,0480487	26,18%
Average	E(Sharpes	0,1564951	0,2014107	0,0449156	35,80%

Table 5.7 Increase from adding five commodity futures to five equity funds.

Period		(10 equity) Before	(10+10) After	Increase	Increase in percent
1	E(Sharpes	0,2627292	0,2894191	0,0266899	10,16%
2	E(Sharpes	0,2318793	0,2729061	0,0410268	17,69%
3	E(Sharpes	0,257965	0,3054517	0,0474867	18,41%
4	E(Sharpes	0,2751325	0,316878	0,0417456	15,17%
5	E(Sharpes	0,3037824	0,3335113	0,0297289	9,79%
6	E(Sharpes	0,2777544	0,3263005	0,0485461	17,48%
7	E(Sharpes	0,2067807	0,2677337	0,0609529	29,48%
8	E(Sharpes	0,1822183	0,2292555	0,0470372	25,81%
9	E(Sharpes	0,1778291	0,2469811	0,069152	38,89%
10	E(Sharpes	0,1675294	0,2380177	0,0704884	42,08%
11	E(Sharpes	0,1739659	0,2496413	0,0756754	43,50%
12	E(Sharpes	0,1755549	0,2689686	0,0934138	53,21%
13	E(Sharpes	0,1818505	0,2539152	0,0720647	39,63%
14	E(Sharpes	0,1976876	0,2745908	0,0769032	38,90%
15	E(Sharpes	0,2140893	0,2675366	0,0534473	24,96%
16	E(Sharpes	0,2432359	0,2819199	0,0386841	15,90%
17	E(Sharpes	0,3347597	0,3712524	0,0364927	10,90%
Average	E(Sharpes	0,2273379	0,2820164	0,0546786	26,59%

Table 5.8 Increase from adding 10 commodity futures to 10 equity funds.

We can now answer research question 3. We see that the average numerical value is higher for the 10 equity portfolio (see bottom of table 5.7 and 5.8). In absolute terms, the Sharpe's ratio has increased more for the 10 equity portfolio than it has for the 5 equity portfolio, but not much. The difference between these two increases is only 0,009763, this is interesting. The Sharpe's ratio in the 5 equity increases with 82,14% of the increase in the 10 equity, but the 5 equity only gets 5 futures, while the 10 gets 10 futures. This might be explained with that the 5 futures added to the five equity funds portfolio is the ones that are most used in the 10+10 portfolio, while the rest contribute minimally to increase the Sharpe's ratio. Another probable explanation is that a 5 sector equity fund gains more diversification by adding five assets, then what a 10 sector equity fund (which already is pretty well diversified) gains by adding 10. A combination of above stated explanations is probable.

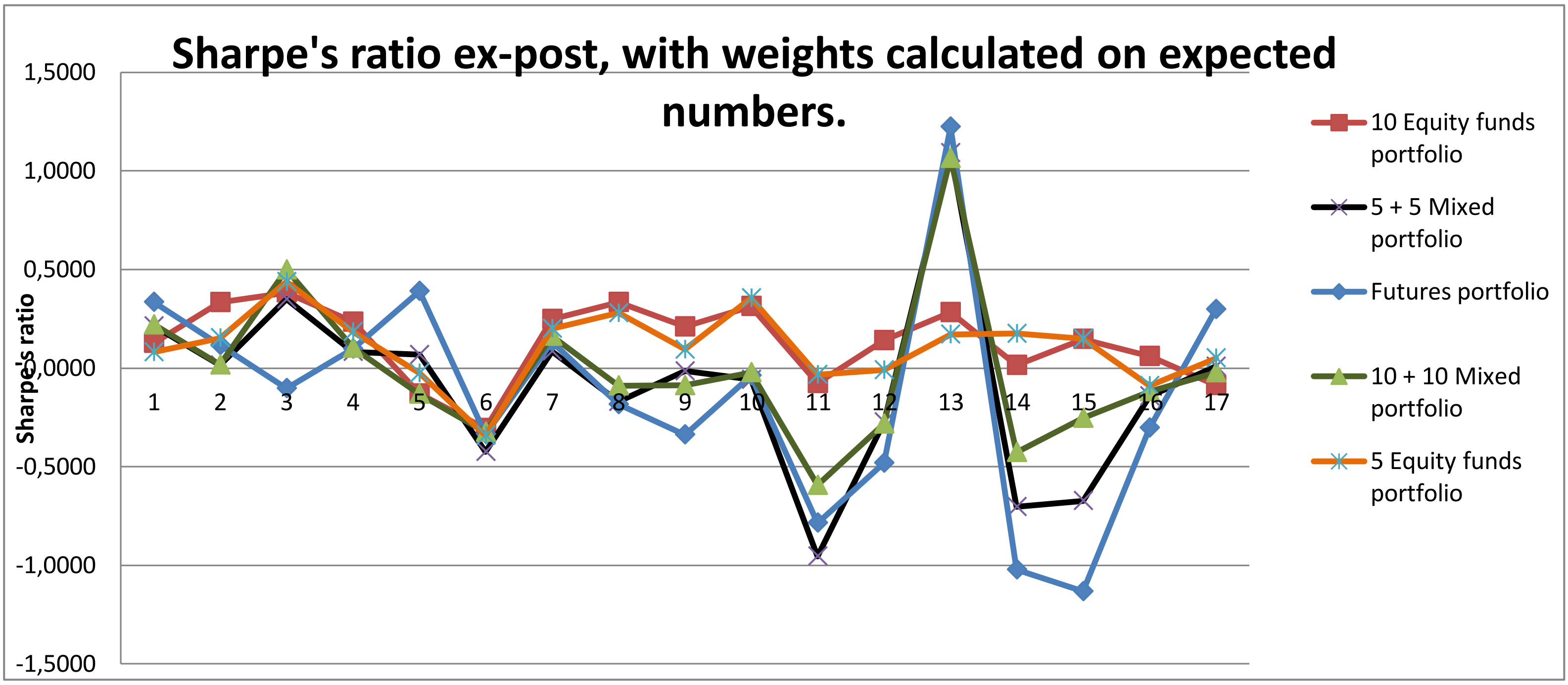
If we instead look at the increase as a percentage of the original value, we can see that the five equity funds portfolio is the clear winner and this with adding five less futures. Average increase for all the periods is 35,8% for the five equity and 26,59% for the 10 equity, a difference of 9.21%. Again this gives us an indication that a smaller not fully diversified portfolio benefits more from adding assets than an already well diversified one.

5.2 Actual results and analysis

In the graph 5.4, below are the results that would have occurred, would you have invested based on the weights given from maximizing Sharpe's ratio with the expected numbers. In other words, the weights are the same as from the five first portfolios, but now the return, variance and covariance are given from data of the actual period instead of being estimated from historical data. The results from each period will be in the form of tables on the first two pages of the appendix.

5.2.1 Research question 4: Will the ex-post Sharpe's ratios, calculated with the same weights as was optimized with expected numbers, follow the same hierarchy as the expected Sharpe's ratios?

Looking at figure 5.4 the answer must be: No I cannot see any sort of resemblance of the ex-post Sharpe ratios with the ex-ante ratios, let alone any hierarchy. What little we can see is that the equity fund portfolios seem to be more stable than the other three portfolios, whichm are all a bit more extreme. If we instead look at the average



of *Figure 5.4 Sharpe's ratio ex-post.*

the Sharpe's ratio over the 17 periods, we can get a clearer view of how a long-term strategy would pan out, using the 60 months equally weighted historical evaluation on expected return from the assets.

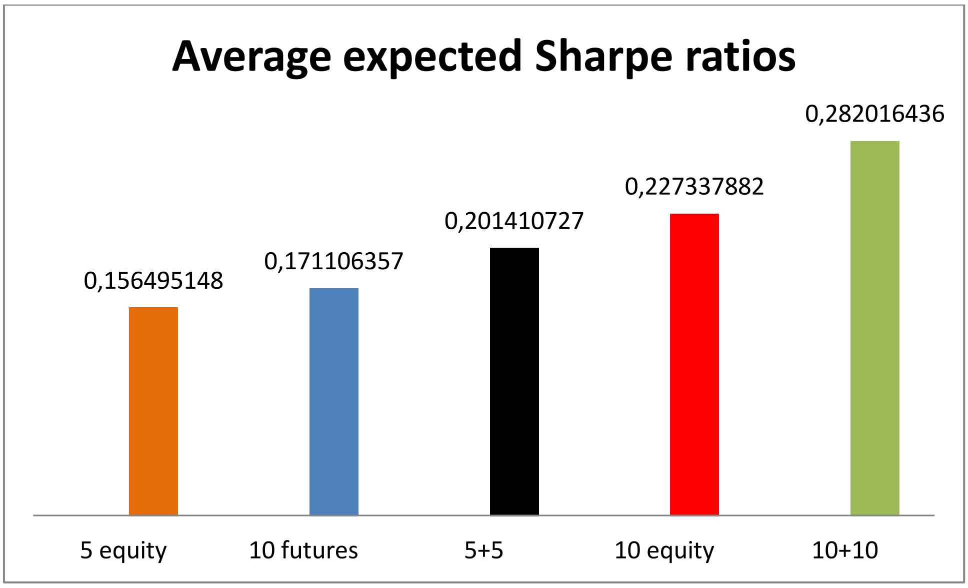


Figure 5.5 Average expected Sharpe ratios.

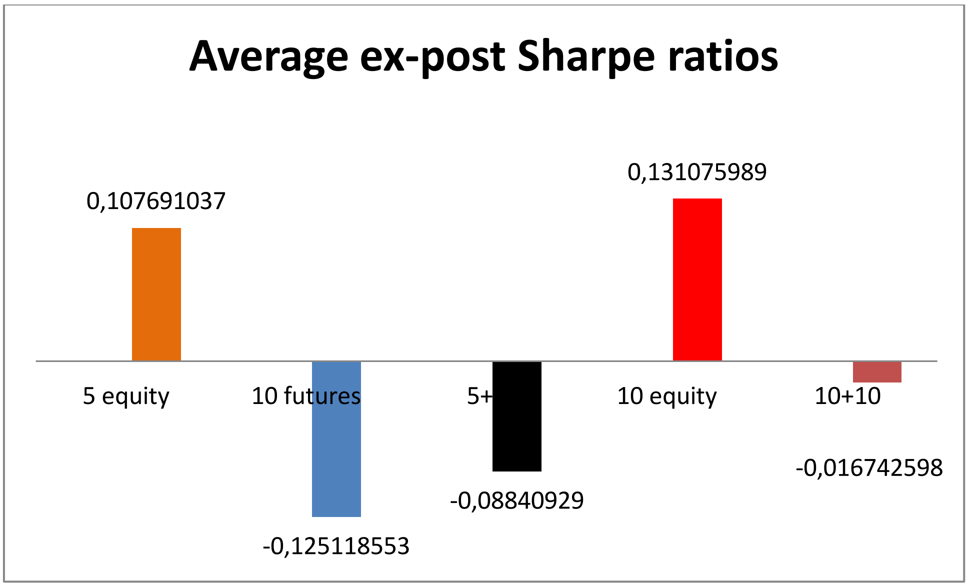


Figure 5.6 Average ex-post Sharpe ratios.

As we can see from Figure 5.5 (created with tables 5.1-5.5) and 5.6 (created with tables 8.1-8.5) above, the hierarchy from expected is not maintained in ex-post. What we can make out though is that the hierarchy between the two equity portfolios are intact, and same goes for the two mixed portfolios. This result is a strong indicator that it would be unwise to add commodity futures to your equity portfolio, both the

5+5 and the 10+10 performs much worse than their respective equity funds portfolio. This result goes against the MPT which says that diversification should lead to a improved Sharpe's ratio and it also goes against studies that have shown that commodity futures add diversification to equity portfolios. Since the market also seems to agree that commodity futures are beneficial assets for portfolios. This result is most probably a case of using a non optimal method (in this case the 60 months equally weighted average returns) for evaluating the expected returns and the variance of the data. Trying to figure out which evaluation method will work best for each new investment horizon is very hard, as is predicting the future.

5.3 Further analysis

For further and deeper analysis I have put tables with expected return and actual return for all periods and assets in the appendix. In the appendix there will also be tables with information about every asset weight for each period. I will also include six variance-covariance matrixes, expected and actual, for periods 1, 7 and 17.
1 and 17 to see the difference between the start and end of the time span, and 7 since I discuss that period it in research question 1.

6. Summary and Conclusions

The commodity markets have seen a great structural change during the last decade. The number of future contracts on commodities has greatly increased as well as the availability. We saw in chapter 1.2 that there is an ongoing debate if these structural changes have been good or bad for investors looking to diversify their portfolios with the help of commodity futures. With this background my objective was to answer three questions for the period 2006-01-01 - 2014-06-30. The two first regarding the effectiveness of using commodity futures for diversifying your equity funds portfolios and how this effectiveness differs between smaller and larger portfolios. The third question was formed to test if the historical method I used to estimate expected return and variance was effective. The theory used in this paper is basic portfolio theory, and in order to fulfil the objective of this paper I simulated real time portfolio optimization with the Sharpe's ratio as the measurement of performance. I formed five different portfolios and rebalanced asset weights once every 6 months. I then compared these portfolios against each other for each period and also, using an average over sub-periods, over the whole period. The data used to create these portfolios are sector/equity indices and continuous future contracts. I create two different mixed portfolios one consisting of 10 equity funds and 10 future contracts and one smaller consisting of five equity funds and five future contracts. The ex-ante results I get are showing substantial benefits for both the smaller and the larger equity portfolios when adding commodity futures, with the smaller gaining more in percent, of respective portfolios original value, and marginally less in absolute terms. The ex-post results show another picture in which the addition of commodity futures hurts the performance of both the portfolios. The results on the Sharpe's ratio of the two mixed portfolios ex-post are negative.

In conclusion, what I have found is that ex-ante it is a good decision to combine commodity futures with your equity funds portfolio, but that with the equally weighted 60 months historical estimation method I have used, it is not a good decision ex-post. This in a decade with many changes on commodity markets and with a financial crisis on top of that. My interpretation of this result is that the estimation method used in this paper has not been optimal in forecasting expected returns. With this in mind further research would then be to find a better estimator by doing the same experiment with the same data but with a number of different historical estimators for the expected returns and variance, and then compare these with ex-post results and each other in order to find a more precise one. Another interesting research objective, as discussed in earlier studies, would be to try and find evidence for inflation being one of the main factors for the low correlation between equity and commodities. In further research I would also incorporate a control group, maybe 10 randomized stocks, that would serve as comparison to adding commodity futures.

7. References

Analystnotes, (2015) *Optimal portfolio* Retrieved January 18, from: http://analystnotes.com/cfa-study-notes-discuss-the-selection-of-an-optimal-portfolio-given-an-investors-utility-or-risk-aversion-and-the-capital-allocation-line.html

Bodie, Zvi. 1983. "Commodity Futures as a Hedge against Inflation." The Journal of Portfolio Management, 9, 12-17.

Bodie, Zvi, Kane, Alex & Marcus, Alan J. (2014). *Investments*. 10 ed. ; Global ed. New York: McGraw-Hill Education

DataStream, (2010) *Futures Continuous Series* Retrieved January 6, from: http://extranet.datastream.com/data/Futures/Documents/Datastream%20Product%20Futures%20Continuous%20Series.pdf

Greer, Robert J. 2007. "The Role of Commodities in Investment Portfolios." CFA Institute, Conference Proceedings Quarterly(December), 35-44.

Hull, John (2012). *Options, futures, and other derivatives*. 8. ed., Global ed. Harlow, Essex: Pearson Education

Irwin H. Scott and Dwight R. Sanders 2012, Financialization and Structural Change in Commodity Futures Markets" Journal of Agricultural and Applied Economics, 44,3(August 2012):371–396

Jensen, Gerald, Mitchell Conover, Robert Johnson and Jeffrey Mercer. (2009). *Is Now the Time to Add Commodities to Your Portfolio?* Retrived January 5, from: http://www.cfainstitute.org/learning/products/publications/contributed/portmanagement/Documents/add_commodities_bob%20johnson_submitted.pdf

Markowitz, H. (1952). Portfolio Selection. The Journal of Finance, Vol.7, No.1, 77--91.

Nobelprize, (n.d) *Press Release* Retrieved January 8, from: (http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1990/press.html).

Silvennoinen Annastiina, Thorp Susan. 2013. " Financialization, crisis and commodity correlation dynamics" Journal of International Financial Markets, Institutions and Money. 42-65.

8. Appendix

8.1 Tables and charts.

The appendix will start with tables for actual returns, standard deviation and Sharpe's ratio for all the ex-post portfolios and periods. Then It will move on to tables showing expected and actual returns for every period and asset (including the risk free, T-Bill). After that comes asset weights for every portfolio and period, and at the end I have put in six covariance matrixes.

Numbers for the 10 equity funds portfolio, ex-post, actual return and standard deviation.

Period	Start date								
1	2006-01-01	A(rp)	0,01362		SD	0,107342		Sharpes	0,126853
2	2006-07-01	A(rp)	0,0197		SD	0,056203		Sharpes	0,333475
3	2007-01-01	A(rp)	0,02808		SD	0,070968		Sharpes	0,382689
4	2007-07-01	A(rp)	0,0157		SD	0,063262		Sharpes	0,233997
5	2008-01-01	A(rp)	-0,0048		SD	0,041493		Sharpes	-0,13011
6	2008-07-01	A(rp)	-0,0529		SD	0,174591		Sharpes	-0,30528
7	2009-01-01	A(rp)	0,02924		SD	0,117821		Sharpes	0,247774
8	2009-07-01	A(rp)	0,02132		SD	0,063657		Sharpes	0,333947
9	2010-01-01	A(rp)	0,01852		SD	0,088117		Sharpes	0,209773
10	2010-07-01	A(rp)	0,02725		SD	0,086742		Sharpes	0,313741
11	2011-01-01	A(rp)	-0,0081		SD	0,104616		Sharpes	-0,07718
12	2011-07-01	A(rp)	0,01609		SD	0,114332		Sharpes	0,140589
13	2012-01-01	A(rp)	0,01979		SD	0,070028		Sharpes	0,282657
14	2012-07-01	A(rp)	0,00091		SD	0,06068		Sharpes	0,014973
15	2013-01-01	A(rp)	0,00793		SD	0,053877		Sharpes	0,147162
16	2013-07-01	A(rp)	0,0018		SD	0,029751		Sharpes	0,060367
17	2014-01-01	A(rp)	-0,0026		SD	0,029469		Sharpes	-0,08714

Table 8.1 Ex-post 10 equity.

Numbers for the 10 futures portfolio, ex-ante, actual return and standard deviation:

Period	Start date								
1	2006-01-01	A(rp)	0,01347		SD	0,037887		Sharpes	0,334708
2	2006-07-01	A(rp)	0,00391		SD	0,025531		Sharpes	0,115815
3	2007-01-01	A(rp)	-0,0017		SD	0,025456		Sharpes	-0,10269
4	2007-07-01	A(rp)	0,00308		SD	0,022429		Sharpes	0,097394
5	2008-01-01	A(rp)	0,01207		SD	0,029283		Sharpes	0,390131
6	2008-07-01	A(rp)	-0,0201		SD	0,061161		Sharpes	-0,33485
7	2009-01-01	A(rp)	0,00367		SD	0,027274		Sharpes	0,132891
8	2009-07-01	A(rp)	-0,003		SD	0,01672		Sharpes	-0,18399
9	2010-01-01	A(rp)	-0,0079		SD	0,023523		Sharpes	-0,33741
10	2010-07-01	A(rp)	-0,0007		SD	0,020002		Sharpes	-0,0378
11	2011-01-01	A(rp)	-0,0169		SD	0,021568		Sharpes	-0,78476
12	2011-07-01	A(rp)	-0,0167		SD	0,034704		Sharpes	-0,48095
13	2012-01-01	A(rp)	0,0221		SD	0,018055		Sharpes	1,223375
14	2012-07-01	A(rp)	-0,0121		SD	0,011878		Sharpes	-1,02204
15	2013-01-01	A(rp)	-0,0247		SD	0,02181		Sharpes	-1,13231
16	2013-07-01	A(rp)	-0,0084		SD	0,027671		Sharpes	-0,30266
17	2014-01-01	A(rp)	0,00343		SD	0,011462		Sharpes	0,298128

Table 8.2 Ex-post 10 futures.

Numbers for the 5 futures + 5 equity funds portfolio, ex-ante, actual return and standard deviation:

Period	Start date								
1	2006-01-01	A(rp)	0,01432		SD	0,063559		Sharpes	0,212861
2	2006-07-01	A(rp)	0,00168		SD	0,051813		Sharpes	0,014091
3	2007-01-01	A(rp)	0,0125		SD	0,033167		Sharpes	0,34912
4	2007-07-01	A(rp)	0,00585		SD	0,059676		Sharpes	0,083048
5	2008-01-01	A(rp)	0,0031		SD	0,036468		Sharpes	0,067461
6	2008-07-01	A(rp)	-0,035		SD	0,083453		Sharpes	-0,42406
7	2009-01-01	A(rp)	0,01244		SD	0,145518		Sharpes	0,085134
8	2009-07-01	A(rp)	-0,0043		SD	0,025798		Sharpes	-0,17047
9	2010-01-01	A(rp)	-0,0004		SD	0,027661		Sharpes	-0,01556
10	2010-07-01	A(rp)	-0,0009		SD	0,016775		Sharpes	-0,05851
11	2011-01-01	A(rp)	-0,0146		SD	0,015365		Sharpes	-0,95391
12	2011-07-01	A(rp)	-0,0096		SD	0,034949		Sharpes	-0,27385
13	2012-01-01	A(rp)	0,01913		SD	0,017519		Sharpes	1,091409
14	2012-07-01	A(rp)	-0,0083		SD	0,011822		Sharpes	-0,70341
15	2013-01-01	A(rp)	-0,0129		SD	0,019135		Sharpes	-0,67286
16	2013-07-01	A(rp)	-0,0019		SD	0,013816		Sharpes	-0,14197
17	2014-01-01	A(rp)	0,00013		SD	0,013743		Sharpes	0,00851

Table 8.3 Ex-post 5+5.

Numbers for the 10 futures + 10 equity funds portfolio, ex-ante, actual return and standard deviation.

Period	Start date							
1	2006-01-01	A(rp)	0,0204		SD	0,089063	Sharpes	0,220197
2	2006-07-01	A(rp)	0,00164		SD	0,039416	Sharpes	0,017357
3	2007-01-01	A(rp)	0,01826		SD	0,034745	Sharpes	0,498917
4	2007-07-01	A(rp)	0,00629		SD	0,052791	Sharpes	0,102201
5	2008-01-01	A(rp)	-0,0037		SD	0,032947	Sharpes	-0,13125
6	2008-07-01	A(rp)	-0,0333		SD	0,104095	Sharpes	-0,32391
7	2009-01-01	A(rp)	0,01982		SD	0,121484	Sharpes	0,162736
8	2009-07-01	A(rp)	-0,0033		SD	0,038138	Sharpes	-0,08886
9	2010-01-01	A(rp)	-0,0031		SD	0,03583	Sharpes	-0,08802
10	2010-07-01	A(rp)	-0,0006		SD	0,02838	Sharpes	-0,02191
11	2011-01-01	A(rp)	-0,0175		SD	0,029474	Sharpes	-0,59347
12	2011-07-01	A(rp)	-0,0115		SD	0,040884	Sharpes	-0,28249
13	2012-01-01	A(rp)	0,02403		SD	0,022562	Sharpes	1,064623
14	2012-07-01	A(rp)	-0,0082		SD	0,019224	Sharpes	-0,4263
15	2013-01-01	A(rp)	-0,0066		SD	0,025985	Sharpes	-0,25334
16	2013-07-01	A(rp)	-0,0018		SD	0,015482	Sharpes	-0,1187
17	2014-01-01	A(rp)	-0,0004		SD	0,01963	Sharpes	-0,02241

Table 8.4 Ex-post 10+10.

Numbers for the 5 equity funds portfolio, ex-ante, actual return and standardeviation.

period	start date							
1	2006-01-01	E(rp)	0,009252876		E(SD)	0,11414139	E(Sharpes	0,08106504
2	2006-07-01	E(rp)	0,011402886		E(SD)	0,068315861	E(Sharpes	0,15295881
3	2007-01-01	E(rp)	0,014414434		E(SD)	0,030841556	E(Sharpes	0,43746909
4	2007-07-01	E(rp)	0,012868824		E(SD)	0,065093044	E(Sharpes	0,18392626
5	2008-01-01	E(rp)	-0,000581183		E(SD)	0,047098346	E(Sharpes	-0,02595642
6	2008-07-01	E(rp)	-0,043106965		E(SD)	0,127361616	E(Sharpes	-0,34168859
7	2009-01-01	E(rp)	0,021052554		E(SD)	0,104751181	E(Sharpes	0,20051836
8	2009-07-01	E(rp)	0,014451586		E(SD)	0,051528685	E(Sharpes	0,27926472
9	2010-01-01	E(rp)	0,00812919		E(SD)	0,08565908	E(Sharpes	0,0944531
10	2010-07-01	E(rp)	0,015346908		E(SD)	0,043115086	E(Sharpes	0,35510547
11	2011-01-01	E(rp)	-0,002135654		E(SD)	0,065170258	E(Sharpes	-0,03335998
12	2011-07-01	E(rp)	-0,000705546		E(SD)	0,075719112	E(Sharpes	-0,00957179
13	2012-01-01	E(rp)	0,017004152		E(SD)	0,099259589	E(Sharpes	0,17119371
14	2012-07-01	E(rp)	0,005482143		E(SD)	0,031182167	E(Sharpes	0,17482422
15	2013-01-01	E(rp)	0,006179002		E(SD)	0,041389377	E(Sharpes	0,14873233
16	2013-07-01	E(rp)	-0,001920579		E(SD)	0,0217503	E(Sharpes	-0,08927332
17	2014-01-01	E(rp)	0,000830671		E(SD)	0,015921416	E(Sharpes	0,05108663

Table 8.5 Ex-post 5 equity.

Table 8.6 Expected returns

Expected weekly returns + actual weekly risk-free rate

period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
date	2006-01-01	2006-07-01	2007-01-01	2007-07-01	2008-01-01	2008-07-01	2009-01-01	2009-07-01	2010-01-01	2010-07-01	2011-01-01	2011-07-01	2012-01-01	2012-07-01	2013-01-01	2013-07-01	2014-01-01
NGCCS00	0,0026757	0,0033387	0,003432	0,0029219	0,0037435	0,0039838	0,0033224	0,0037791	0,0039837	0,00449889	0,0044432	0,0040472	0,004005	0,0038864	0,0031571	0,0016048	0,0017487
NCLCS00	0,0045175	0,0052209	0,0055455	0,0049772	0,0055405	0,0067058	0,0019746	0,004025	0,003974	0,00288079	0,003471	0,0027774	0,0035744	0,0025781	0,0016595	0,0004479	0,0052685
NNGCS00	0,003676	0,0052179	0,0064719	0,0061202	0,0046722	0,0061767	0,0022424	0,0011456	0,0024952	0,00136623	-0,000902	0,0012728	-0,000791	-0,001077	-0,000462	-0,0026539	0,0013753
NSLCS00	0,003064	0,0041931	0,0047944	0,0043677	0,0052798	0,0061744	0,0036163	0,0045833	0,0048544	0,00501436	0,0063046	0,0062118	0,0047683	0,0045641	0,0044754	0,0020218	0,0036668
BMACS00	0,0033497	0,0034202	0,0050964	0,0051876	0,00465	0,0049478	0,0028355	0,0024125	0,001969	0,00219655	0,0037521	0,0049053	0,0034033	0,0025118	0,0011607	0,0001397	0,0012947
NHGCS00	0,0040218	0,0065968	0,0060909	0,0065765	0,0063158	0,0069599	0,0020298	0,0037781	0,0043898	0,00383993	0,0040971	0,0021374	0,0020371	0,0013493	0,0017261	0,0002654	0,0044091
LSWCS20	0,0018706	0,0026829	0,0021567	0,0028883	0,0021834	0,0029565	0,0026396	0,0033691	0,0042752	0,00332537	0,0037858	0,0024042	0,0030621	0,0032421	0,002878	0,0019372	0,0021493
CW.CS20	0,0013305	0,0022175	0,0029019	0,0034516	0,0045242	0,0048939	0,0027268	0,002747	0,0031287	0,0023702	0,0045965	0,0034567	0,0023182	0,0022388	0,0006362	7,062E-05	0,0012554
NCTCS00	0,0004514	0,0019276	0,0025671	0,0020047	0,0019353	0,0018824	-0,0007512	0,0009496	0,0029387	0,00307316	0,0047652	0,0060491	0,0032606	0,0024113	0,0018248	0,0019213	0,0036351
CC.CS00	0,0004379	0,0014801	0,0031676	0,002507	0,0032372	0,0052328	0,0031236	0,0024765	0,0038432	0,00277584	0,005462	0,0055475	0,0033769	0,0037254	0,0030541	0,0010398	0,001516
OILGSAS	0,0050291	0,0045984	0,0058201	0,0058249	0,0069079	0,0052397	0,0016582	0,0030338	0,0026128	0,00245269	0,0025617	0,0024779	0,0012724	0,0005557	-2,95E-05	0,0002247	0,0019935
BMATREU	0,0025155	0,0038263	0,004466	0,0049822	0,0060097	0,0058713	0,0028783	0,0035031	0,0029125	0,00376308	0,0030069	0,0030069	0,0012601	0,0001261	0,0005511	-0,0007392	0,003406
INDUSNA	0,0002106	0,0004308	0,0010393	0,0022327	0,0027532	0,0018316	-0,0002762	0,0003255	0,0003975	0,00104174	0,0010284	0,0010284	0,0006582	0,0004164	0,0005918	0,0014011	0,0037723
CNSMGLA	-0,000555	-0,000589	0,0007893	0,0034348	0,0055034	0,0052819	0,0048923	0,0049109	0,0043905	0,00489997	0,0050063	0,0050063	0,0038897	0,0030999	0,0023664	0,001852	0,0044315
HLTHCAS	0,0008721	0,0017522	0,00237	0,0021754	0,0025063	0,0022072	0,000912	0,0010109	0,0009472	0,00100155	0,000716	0,000716	-2,47E-05	0,0004109	0,0006156	0,001039	0,0013198
CNSMSER	0,0007709	0,001937	0,002813	0,0033637	0,0037647	0,0021575	0,0002652	0,0004832	0,0002441	0,0007696	0,0004468	0,0004468	-0,000871	-0,001143	-0,000252	0,0006915	0,00297
TELCMLA	0,0018054	0,0019615	0,0037788	0,0058468	0,0060387	0,0051726	0,0033221	0,0034107	0,0031556	0,00290309	0,0028943	0,0028943	0,00128	0,000115	0,0001505	-0,0002738	0,0011817
UTILSEF	0,0018337	0,0026727	0,0037357	0,0041932	0,0048691	0,0038827	0,0017125	0,0014532	0,0006665	0,00079625	0,0001939	0,0001939	-0,001499	-0,002148	-0,002468	-0,0021661	-0,000527
FINANEK	0,0033887	0,0037764	0,005011	0,0052882	0,0062538	0,0049914	0,0036365	0,0035007	0,003379	0,00318019	0,0028649	0,0028649	0,0008566	0,0003258	0,0003392	0,0007538	0,0025843
TECNONA	-0,000602	9,477E-05	0,0007403	0,0024568	0,0029099	0,0017245	0,0004256	0,0012746	0,0011675	0,0014969	0,0016781	0,0016781	0,001224	0,0012982	0,0007733	0,0013648	0,0038042
T-Bill	0,0007915	0,0009534	0,0009222	0,0008965	0,0006413	0,000411	4,802E-05	6,144E-05	3,842E-05	3,6504E-05	3,842E-05	1,922E-05	1,154E-05	3,075E-05	2,306E-05	2,114E-05	1,73E-05

Table 8.7 Actual returns

Actual returns and risk-free rate each period

period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
start date	2006-01-01	2006-07-01	2007-01-01	2007-07-01	2008-01-01	2008-07-01	2009-01-01	2009-07-01	2010-01-01	2010-07-01	2011-01-01	2011-07-01	2012-01-01	2012-07-01	2013-01-01	2013-07-01	2014-01-01
NGCCS00	0,0079122	0,0300309	-0,026939	0,0219095	0,0307904	0,0225741	0,007895	-0,008172	-0,004667	-0,0042971	-0,024331	-0,0181765	0,0282261	-0,009027	-0,028096	-0,0004663	0,0111534
NCLCS00	0,009504	-0,006616	0,0065305	0,0123818	0,0154283	-0,044016	0,0275501	0,0060747	0,0013482	0,00618836	0,0027078	0,0038716	-0,005204	0,0028733	0,0027303	0,0017973	0,0022791
NNGCS0	-0,021955	0,0072942	0,0037902	0,0061441	0,0235599	-0,028823	-0,0113766	0,0187373	-0,00412	-0,001444	0,0005694	-0,0118009	0,0008822	0,0093696	0,0019137	0,0088356	0,0032951
NSLCS00	-0,003555	0,0117085	-0,00567	0,0101921	0,0040342	-0,015058	0,0042722	0,0118333	0,0052635	0,01437411	0,0074084	-0,0015041	-0,013306	-0,004501	-0,008087	-0,0004454	0,0162089
BMACS0	0,0191706	-0,006658	0,0086833	-0,0038817	0,0098595	-0,038503	0,0240758	0,0143482	-0,001095	0,01400966	-0,000699	-0,0049115	0,0010881	0,0012007	-0,005854	0,0045791	-0,003
NHGCS0	0,0099308	-0,010751	-0,003158	0,0015483	0,0067205	-0,004402	0,014495	0,0158123	-0,011023	0,0179064	-0,001873	-0,0034202	-0,000948	-0,002733	-0,003017	-0,0022715	0,0029473
LSWCS20	0,0059756	0,010606	0,0070567	0,0165746	0,0026767	-0,013023	-0,0019978	-0,000828	-0,004412	0,02259106	-0,006933	0,0013805	0,0060595	0,0021859	-0,006499	-0,0022639	-0,000827
CW.CS20	-0,00206	0,0052235	0,0018689	0,0066648	0,0038563	-0,016188	0,0061236	0,0139172	0,0061478	0,02170908	-0,002567	-0,0191622	-0,008203	0,0017947	0,0046515	0,001208	-0,001111
NCTCS00	0,004203	0,0208481	-0,005226	0,0131748	0,0209899	-0,019581	-0,0020164	0,0034133	-0,006211	0,02434698	0,0001597	-0,000207	0,0028879	0,0016967	-0,000358	-0,0161775	0,001639
CC.CS00	0,0099819	0,0077203	-0,000678	0,0077041	0,0084219	-0,01628	0,0128052	0,0092447	0,0047441	0,01876151	0,0060954	-0,0052573	0,000156	0,0037447	-0,0157	0,0019133	0,0024238
OILGSAS	0,0020092	0,003966	0,0072764	0,0109559	-0,0079612	-0,018937	0,0147271	0,0045443	0,0014277	0,00744258	9,486E-05	-0,0068171	0,0007731	0,0037909	-0,00362	0,0013444	0,0031521
BMATRE	0,0086545	0,0073213	0,0097634	0,0041862	0,0041841	-0,033563	0,013006	0,0151371	-0,004815	0,0132044	0,0014498	-0,0079244	-0,00113	0,0075246	-0,007249	0,0083635	0,0010962
INDUSNA	0,0021702	0,0020455	0,004898	0,0005096	-0,0046064	-0,015072	0,0018172	0,0102795	0,000631	0,0074547	0,0037513	-0,0009388	0,0026446	0,0022279	0,0054638	0,0074545	0,0014636
CNSMGLA	0,0011835	0,0104246	0,0112405	0,0160328	0,0007421	-0,027602	0,0103576	0,0130273	0,0045267	0,0090498	0,0019396	0,0009633	0,0039978	0,0064586	-0,001359	-0,0016756	0,000313
HLTHCAS	0,0035398	0,0037994	-0,002406	-0,0002398	-0,0005258	-0,001984	-0,0025153	0,0046771	0,0004946	0,00492658	-0,000864	-0,0020551	0,0022349	0,0014463	0,0041737	0,0008395	0,0035518
CNSMSE	0,0042589	0,0065118	0,0039944	-0,0018728	-0,0095106	-0,013087	0,0039915	0,00804	-0,002475	0,00745269	0,0012004	-0,0052239	0,0013439	0,0065885	0,0021409	0,0090394	-0,00058
TELCMLA	0,0019647	0,0119194	0,0116105	4,45E-05	-3,374E-05	-0,013598	0,0053763	0,00784	-0,000386	0,00427591	0,0017455	-0,0037984	0,0014656	-0,000101	-0,003221	0,0015346	-0,001914
UTILSEF	0,0058412	0,0088665	0,0048922	0,0049747	-0,00386	-0,010715	-0,0035153	0,0047998	-0,007535	0,00389988	0,0002556	-0,0065721	-0,001813	0,001545	0,0003504	0,0055045	0,0039413
FINANEK	0,0029718	0,011131	0,0060316	0,0063938	-0,0087347	-0,017899	0,0134069	0,01043	0,0006065	0,00731324	-0,001071	-0,0076681	0,0019629	0,0057436	-0,002504	0,0012842	0,0030677
TECNONA	-0,002416	0,0059652	0,003664	0,0038331	-0,0048709	-0,016757	0,0108475	0,0102916	-0,002136	0,00650473	0,0011038	0,0016222	0,0044703	-0,000983	0,0024191	0,0073015	0,0035363
T-Bill	0,0007915	0,0009534	0,0009222	0,0008965	0,0006413	0,000411	4,802E-05	6,144E-05	3,842E-05	3,6504E-05	3,842E-05	1,922E-05	1,154E-05	3,075E-05	2,306E-05	2,114E-05	1,73E-05

Table 8.8 Weights for the 10 equity funds portfolios

Portfolio weights calculated with expected numbers. 10 equity funds portfolios.

period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
date	2006-01-01	2006-07-01	2007-01-01	2007-07-01	2008-01-01	2008-07-01	2009-01-01	2009-07-01	2010-01-01	2010-07-01	2011-01-01	2011-07-01	2012-01-01	2012-07-01	2013-01-01	2013-07-01	2014-01-01
OILGSAS	147,17%	98,31%	98,31%	60,19%	35,37%	7,22%	-213,52%	-14,79%	-36,59%	-86,96%	8,47%	-9,69%	86,27%	27,49%	-4,29%	-27,31%	-12,34%
BMATREU	229,06%	242,08%	242,08%	19,77%	6,01%	148,17%	91,34%	114,16%	131,22%	247,80%	158,73%	166,24%	124,38%	78,98%	46,91%	-50,02%	-29,17%
INDUSNA	-37,52%	-71,41%	-71,41%	-17,63%	-11,85%	-24,48%	-300,00%	-299,79%	-300,00%	-299,40%	-291,14%	-296,51%	-107,79%	-84,13%	-26,96%	27,33%	13,33%
CNSMGLA	-30,34%	-57,00%	-57,00%	-27,05%	8,00%	32,08%	89,60%	117,48%	135,03%	208,82%	232,05%	217,50%	217,51%	143,64%	144,67%	105,92%	134,62%
HLTHCAS	-148,80%	-118,70%	-118,70%	-96,79%	-55,90%	-40,96%	97,17%	95,55%	196,42%	253,50%	199,82%	210,80%	207,59%	229,94%	215,87%	154,79%	93,15%
CNSMSER	-300,00%	-249,35%	-249,35%	-72,07%	-60,38%	-300,01%	-300,00%	-300,00%	-300,00%	-300,00%	-300,00%	-300,00%	-264,48%	-102,24%	73,38%	191,01%	156,84%
TELCMLA	-8,44%	0,47%	0,47%	26,26%	-1,60%	25,10%	20,59%	54,09%	77,81%	-1,65%	44,66%	61,09%	29,52%	-35,47%	-46,22%	-65,59%	-90,31%
UTILSEF	107,68%	121,57%	121,57%	133,75%	136,65%	168,61%	134,31%	-19,11%	-198,03%	-293,91%	-300,00%	-300,00%	-300,00%	-300,00%	-300,00%	-280,93%	-212,91%
FINANEK	136,24%	143,11%	143,11%	63,95%	37,03%	96,15%	425,38%	204,36%	238,67%	203,05%	114,11%	115,11%	-117,48%	-60,61%	-74,67%	-11,93%	-28,33%
TECNONA	4,95%	-9,09%	-9,09%	9,62%	6,68%	-11,87%	55,14%	148,05%	155,48%	168,75%	233,29%	235,45%	224,50%	202,39%	71,30%	56,72%	75,12%

Table 8.9 Weights for the 10 futures portfolios.

Portfolio weights calculated with expected numbers. 10 futures portfolios.

period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
date	2006-01-01	2006-07-01	2007-01-01	2007-07-01	2008-01-01	2008-07-01	2009-01-01	2009-07-01	2010-01-01	2010-07-01	2011-01-01	2011-07-01	2012-01-01	2012-07-01	2013-01-01	2013-07-01	2014-01-01
NGCCS00	54,93%	34,48%	21,25%	-2,73%	23,16%	21,15%	91,31%	76,09%	66,84%	89,20%	65,67%	68,60%	92,98%	97,05%	96,93%	104,64%	46,62%
NCLCS00	16,35%	11,22%	12,21%	11,68%	15,18%	25,20%	-3,58%	3,66%	-3,94%	-8,21%	-7,59%	-9,97%	1,23%	-4,02%	-12,52%	-10,79%	24,11%
NNGCS00	-1,92%	1,23%	3,55%	4,39%	0,75%	0,78%	2,77%	-3,33%	-0,48%	-1,94%	-7,12%	-2,26%	-9,29%	-9,93%	-9,27%	-29,29%	3,40%
NSLCS00	-11,98%	-10,27%	-3,92%	-2,17%	-2,77%	-10,00%	-28,12%	-20,02%	-17,22%	-25,08%	-11,39%	-14,47%	-30,28%	-28,04%	-14,78%	-18,62%	-20,20%
BMACS00	12,14%	6,56%	14,92%	20,35%	17,39%	13,22%	25,95%	9,93%	-5,37%	3,71%	13,81%	33,03%	24,94%	17,82%	-2,15%	-14,01%	-6,96%
NHGCS00	42,82%	49,05%	37,94%	44,19%	27,63%	27,76%	-7,26%	10,20%	10,04%	9,30%	2,40%	-8,72%	-3,08%	-3,93%	7,64%	-13,15%	35,75%
LSWCS20	5,82%	9,18%	2,09%	17,51%	7,58%	9,31%	29,05%	31,38%	33,59%	18,82%	13,65%	-0,48%	14,46%	20,40%	26,40%	53,92%	9,32%
CW.CS20	9,53%	11,23%	8,52%	19,35%	22,91%	11,26%	17,11%	13,33%	2,24%	-0,30%	4,25%	-6,06%	-4,45%	-5,40%	-29,00%	-20,00%	-9,19%
NCTCS00	-9,35%	0,40%	3,83%	0,78%	-3,40%	-9,94%	-29,64%	-12,47%	9,33%	14,05%	17,16%	24,40%	5,25%	0,31%	1,53%	24,36%	13,41%
CC.CS00	-18,34%	-13,08%	-0,39%	-13,36%	-8,41%	11,25%	2,42%	-8,77%	4,96%	0,45%	9,16%	15,93%	8,25%	15,75%	35,22%	22,93%	3,74%

Table 8.11 Weights for the 10+10 portfolios.

Portfolio weights calculated with expected numbers. 10 futures + 10 equity funds portfolios.

period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
date	2006-01-01	2006-07-01	2007-01-01	2007-07-01	2008-01-01	2008-07-01	2009-01-01	2009-07-01	2010-01-01	2010-07-01	2011-01-01	2011-07-01	2012-01-01	2012-07-01	2013-01-01	2013-07-01	2014-01-01
NGCCS00	23,34%	4,26%	-18,32%	-30,03%	0,46%	12,84%	220,10%	127,53%	73,12%	89,78%	59,55%	66,32%	79,98%	62,89%	50,03%	32,02%	20,81%
NCLCS00	3,81%	6,81%	4,08%	2,21%	6,27%	24,40%	7,78%	4,09%	0,63%	-5,93%	-2,45%	-6,79%	2,14%	0,39%	0,87%	5,45%	15,63%
NNGCS00	-3,39%	1,95%	2,19%	1,80%	-0,97%	1,63%	13,17%	-0,52%	4,31%	1,01%	-3,35%	0,58%	-5,69%	-3,76%	-2,45%	-6,67%	-0,19%
NSLCS00	-10,10%	-13,32%	-4,82%	-5,40%	-7,03%	-18,42%	-78,84%	-31,65%	-10,20%	-23,39%	-1,91%	-9,78%	-22,23%	-12,76%	-2,17%	-0,72%	-5,64%
BMACS00	13,53%	8,30%	8,18%	8,63%	5,19%	5,21%	15,58%	-9,95%	-22,26%	-9,13%	1,82%	23,94%	17,55%	13,79%	2,25%	0,56%	-0,73%
NHGCS00	52,31%	67,22%	31,03%	34,37%	13,86%	19,16%	-43,41%	-8,74%	1,62%	-3,24%	-1,56%	-16,35%	-6,35%	-2,93%	8,42%	5,17%	22,79%
LSWCS20	9,34%	10,27%	3,04%	14,99%	5,37%	5,23%	31,21%	36,66%	33,90%	19,44%	13,64%	-0,49%	13,36%	13,40%	14,89%	13,93%	0,65%
CW.CS20	13,21%	20,70%	12,39%	18,51%	18,42%	13,13%	44,38%	29,30%	4,68%	0,98%	7,44%	-2,18%	0,39%	-0,43%	-15,34%	-3,63%	-4,07%
NCTCS00	-8,78%	-0,88%	0,42%	-1,95%	-6,49%	-14,17%	-72,63%	-12,86%	16,10%	16,87%	22,79%	25,32%	8,26%	2,96%	1,34%	3,86%	4,69%
CC.CS00	-26,06%	-22,14%	-2,19%	-8,48%	-3,74%	13,27%	4,11%	-24,73%	2,59%	-4,30%	5,98%	11,43%	3,20%	10,05%	21,76%	12,52%	5,33%
OILGSAS	98,02%	47,12%	35,61%	43,65%	23,54%	-15,39%	-202,55%	-42,30%	-36,91%	-32,09%	-21,43%	-25,50%	-2,28%	-16,61%	-27,68%	-29,94%	-14,89%
BMATREU	155,98%	97,61%	15,20%	-12,67%	-13,23%	40,69%	75,41%	53,75%	5,85%	29,15%	-2,46%	11,55%	9,62%	-1,24%	-5,65%	-49,83%	-50,21%
INDUSNA	-26,11%	-33,37%	-19,63%	-19,86%	-7,30%	-13,42%	-245,40%	-121,27%	-54,72%	-32,39%	-35,70%	-46,00%	-8,02%	-5,19%	6,27%	27,05%	19,98%
CNSMGLA	-19,05%	-33,01%	-16,96%	-22,72%	6,44%	11,07%	52,48%	51,41%	26,78%	28,31%	30,91%	23,62%	31,07%	24,02%	49,53%	45,21%	74,04%
HLTHCAS	-106,85%	-81,40%	-62,09%	-81,50%	-54,80%	-26,00%	-3,27%	4,58%	34,78%	37,62%	31,66%	36,28%	41,29%	56,35%	87,85%	73,94%	57,87%
CNSMSER	-210,24%	-132,52%	-63,04%	-49,40%	-40,54%	-127,75%	-300,00%	-204,88%	-93,88%	-72,49%	-56,41%	-62,20%	-50,62%	-18,29%	45,49%	98,17%	113,48%
TELCMLA	-5,47%	1,49%	3,36%	27,06%	-0,24%	10,85%	23,40%	21,72%	15,35%	-7,51%	4,18%	3,28%	-5,64%	-20,71%	-32,24%	-40,12%	-54,19%
UTILSEF	68,54%	79,90%	113,65%	122,49%	117,87%	91,41%	123,34%	2,80%	-45,10%	-37,08%	-52,90%	-49,36%	-61,51%	-70,43%	-125,77%	-125,07%	-128,50%
FINANEK	77,18%	79,45%	65,65%	52,13%	28,97%	58,92%	366,78%	138,69%	88,35%	50,44%	39,46%	45,27%	-3,40%	8,28%	-9,25%	10,76%	-13,59%
TECNONA	0,82%	-8,46%	-7,74%	6,17%	7,93%	7,34%	68,33%	86,36%	55,01%	53,93%	60,73%	71,06%	58,88%	60,23%	31,85%	27,34%	36,74%

Table 8.12 Weights for the 5 equity funds portfolios.

Portfolio weights calculated with expected numbers. 5 equity funds portfolios.

period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
start date	2006-01-01	2006-07-01	2007-01-01	2007-07-01	2008-01-01	2008-07-01	2009-01-01	2009-07-01	2010-01-01	2010-07-01	2011-01-01	2011-07-01	2012-01-01	2012-07-01	2013-01-01	2013-07-01	2014-01-01
ASIA-DS Oil &	3,374225	1,8421851	1,1451361	0,959051	0,6082559	0,2443848	-0,7124429	0,9349509	1,0170313	0,12177356	0,9877299	0,7219291	1,7895968	0,2204928	-0,865932	-0,196393	-0,332528
EU-DS Basic M	1,5063207	2,4256708	1,1215497	0,8276814	0,7305747	1,1758193	1,6316304	0,8557738	0,5192363	0,86147805	-0,037772	0,0446282	-2,012811	-1,094085	-0,485799	-0,9368067	-0,342852
N.AMERICA-D	-1,399902	-1,716112	-0,606817	-0,1242884	-0,1957674	-0,726534	-3	-3	-3	-2,3173884	-2,176143	-1,7801974	-2,340612	-0,191853	-0,088376	0,93788	0,5400826
LATIN AMERIC	-0,533027	-0,64244	-0,255272	-0,0736704	0,1793941	0,365286	1,8274657	2,1262252	2,4433157	2,14429931	2,8221094	2,3311914	6,5638263	2,0587164	1,839709	0,722195	0,7929436
ASIA-DS Healt	-1,947617	-0,909304	-0,404597	-0,5887736	-0,3224573	-0,058956	1,2533468	0,0830501	0,0204167	0,1898375	-0,595924	-0,3175513	-3	0,0067282	0,6003987	0,4731247	0,3423536

Table 8.13 Weights for the 5+5 portfolios.

Portfolio weights calculated with expected numbers. 5 futures and 5 equity funds portfolios.

period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
start date	2006-01-01	2006-07-01	2007-01-01	2007-07-01	2008-01-01	2008-07-01	2009-01-01	2009-07-01	2010-01-01	2010-07-01	2011-01-01	2011-07-01	2012-01-01	2012-07-01	2013-01-01	2013-07-01	2014-01-01
NGCCS00	32,92%	15,94%	-6,23%	-22,57%	6,21%	4,68%	163,52%	80,19%	67,25%	73,80%	66,42%	59,93%	71,38%	66,40%	64,74%	46,47%	16,50%
NCLCS00	7,31%	11,74%	5,84%	7,68%	11,76%	22,93%	-25,63%	6,25%	4,67%	-4,02%	-0,32%	-5,68%	8,66%	4,39%	1,20%	2,06%	11,56%
NNGCS00	-4,90%	0,01%	0,64%	-1,14%	-2,36%	0,17%	5,40%	-9,00%	0,37%	-1,59%	-7,88%	-3,30%	-10,51%	-6,93%	-3,84%	-9,53%	0,08%
BMACS00	14,13%	12,72%	19,88%	18,88%	7,83%	7,76%	38,29%	-8,04%	-11,92%	-5,92%	19,56%	35,72%	22,07%	12,46%	0,01%	-3,97%	-8,92%
NHGCS00	46,25%	73,35%	37,41%	37,65%	11,46%	18,09%	-54,05%	8,36%	19,41%	8,88%	14,22%	-3,40%	6,93%	9,74%	15,36%	11,26%	30,63%
OILGSAS	122,91%	74,09%	81,93%	82,06%	42,73%	3,71%	-87,65%	20,60%	11,71%	-6,10%	6,43%	3,60%	-1,14%	-11,38%	-33,75%	-20,15%	-30,07%
BMATREU	41,70%	70,07%	62,24%	53,53%	40,54%	44,48%	155,19%	0,89%	-25,24%	-7,82%	-34,10%	-18,32%	-48,10%	-46,91%	-38,60%	-69,16%	-52,64%
INDUSNA	-53,52%	-65,48%	-45,20%	-10,22%	1,05%	-17,11%	-300,00%	-69,68%	-25,16%	-15,44%	-2,90%	-7,62%	19,49%	29,69%	28,47%	66,90%	47,17%
CNSMGLA	-18,92%	-32,47%	-21,16%	-11,58%	11,03%	17,20%	163,03%	72,73%	50,19%	44,36%	41,96%	35,35%	36,40%	27,13%	37,42%	40,64%	56,06%
HLTHCAS	-87,88%	-59,98%	-35,36%	-54,29%	-30,24%	-1,90%	41,89%	-2,30%	8,70%	13,86%	-3,38%	3,72%	-5,19%	15,42%	28,99%	35,48%	29,62%

Table 8.14 Expected variance-covariance. Period 1.

Variance-Covariance matrix. Period 1. Expected numbers.

	NGCCS00	NCLCS00	NNGCS00	NSLCS00	BMACS00	NHGCS00	LSWCS20	CW.CS20	NCTCS00	CC.CS00	OILGSAS	BMATREU	INDUSNA	CNSMGLA	HLTHCAS	CNSMSER	TELCMLA	UTILSEF	FINANEK	TECNONA
NGCCS00	0,000423	0,000115	0,00025	0,000436	8,06E-05	0,000153	4,11E-05	6,1E-05	7,77E-05	8,53E-05	9,84E-05	7,5E-05	-2,5E-05	-5,4E-05	7,55E-05	5,15E-05	7,5E-05	9,31E-05	7,07E-05	-3,5E-05
NCLCS00	0,000115	0,002649	0,001374	0,000179	7,88E-05	0,00018	0,000126	0,000226	0,000261	0,000194	0,00039	4,35E-05	-3,6E-05	0,000212	0,0001	8,65E-06	0,000156	2,37E-05	0,00015	5,93E-05
NNGCS00	0,00025	0,001374	0,006385	0,000185	-6,1E-05	0,000437	0,000274	2,92E-06	-0,00025	0,000254	0,00054	0,00029	0,000142	0,000425	0,000218	0,000244	0,000133	0,00018	0,000151	9,71E-05
NSLCS00	0,000436	0,000179	0,000185	0,001087	0,000272	0,000385	7,61E-05	7,57E-05	6,5E-05	0,000172	0,000135	0,000164	1,55E-05	8,4E-05	0,000113	0,000153	0,000224	0,00012	0,000189	8,44E-05
BMACS00	8,06E-05	7,88E-05	-6,1E-05	0,000272	0,002184	0,000261	8,8E-05	0,000228	0,000335	0,000284	7,52E-05	0,000162	0,000169	0,000207	5,75E-05	0,000203	0,0004	9,4E-05	0,000284	0,000205
NHGCS00	0,000153	0,00018	0,000437	0,000385	0,000261	0,000844	0,000128	2,15E-05	0,000113	7,83E-05	0,000167	0,000217	0,000179	7,4E-05	0,000107	0,000241	0,000223	9,03E-05	0,000205	0,000327
LSWCS20	4,11E-05	0,000126	0,000274	7,61E-05	8,8E-05	0,000128	0,000785	0,000148	-7,5E-05	8,32E-05	2,62E-05	9,34E-05	0,000104	-1,2E-05	4,31E-05	8,05E-05	6,86E-05	1,86E-05	8,23E-05	0,000258
CW.CS20	6,1E-05	0,000226	2,92E-06	7,57E-05	0,000228	2,15E-05	0,000148	0,00125	0,000202	0,000732	8,47E-05	0,000108	6,28E-05	-0,00016	5,17E-05	0,000102	-2,8E-06	2,79E-05	4,77E-05	7,63E-05
NCTCS00	7,77E-05	0,000261	-0,00025	6,5E-05	0,000335	0,000113	-7,5E-05	0,000202	0,001994	0,00025	6,42E-05	8,47E-05	-1,8E-06	-5,6E-05	2,97E-05	0,000115	0,000104	4,65E-05	9,55E-05	0,000196
CC.CS00	8,53E-05	0,000194	0,000254	0,000172	0,000284	7,83E-05	8,32E-05	0,000732	0,00025	0,001201	0,000119	0,000107	7,62E-05	-0,0001	6,85E-05	0,000105	6,95E-05	7,87E-05	7,18E-05	0,000109
OILGSAS	9,84E-05	0,00039	0,00054	0,000135	7,52E-05	0,000167	2,62E-05	8,47E-05	6,42E-05	0,000119	0,000688	0,000252	0,000158	0,000323	0,000218	0,000235	0,000283	0,000132	0,000304	0,000234
BMATREU	7,5E-05	4,35E-05	0,00029	0,000164	0,000162	0,000217	9,34E-05	0,000108	8,47E-05	0,000107	0,000252	0,000611	0,000442	0,000163	0,000153	0,000552	0,000477	0,000204	0,000378	0,000501
INDUSNA	-2,5E-05	-3,6E-05	0,000142	1,55E-05	0,000169	0,000179	0,000104	6,28E-05	-1,8E-06	7,62E-05	0,000158	0,000442	0,000819	0,000197	0,000106	0,000453	0,000494	0,000121	0,000286	0,000829
CNSMGLA	-5,4E-05	0,000212	0,000425	8,4E-05	0,000207	7,4E-05	-1,2E-05	-0,00016	-5,6E-05	-0,0001	0,000323	0,000163	0,000197	0,002228	0,000242	0,000171	0,000626	0,0001	0,000307	0,00027
HLTHCAS	7,55E-05	0,0001	0,000218	0,000113	5,75E-05	0,000107	4,31E-05	5,17E-05	2,97E-05	6,85E-05	0,000218	0,000153	0,000106	0,000242	0,000335	0,000138	0,00017	0,000151	0,000166	0,00015
CNSMSER	5,15E-05	8,65E-06	0,000244	0,000153	0,000203	0,000241	8,05E-05	0,000102	0,000115	0,000105	0,000235	0,000552	0,000453	0,000171	0,000138	0,000631	0,00053	0,000177	0,000399	0,000639
TELCMLA	7,5E-05	0,000156	0,000133	0,000224	0,0004	0,000223	6,86E-05	-2,8E-06	0,000104	6,95E-05	0,000283	0,000477	0,000494	0,000626	0,00017	0,00053	0,001262	0,000187	0,000598	0,000643
UTILSEF	9,31E-05	2,37E-05	0,00018	0,00012	9,4E-05	9,03E-05	1,86E-05	2,79E-05	4,65E-05	7,87E-05	0,000132	0,000204	0,000121	0,0001	0,000151	0,000177	0,000187	0,000211	0,000144	7,07E-05
FINANEK	7,07E-05	0,00015	0,000151	0,000189	0,000284	0,000205	8,23E-05	4,77E-05	9,55E-05	7,18E-05	0,000304	0,000378	0,000286	0,000307	0,000166	0,000399	0,000598	0,000144	0,000579	0,000458
TECNONA	-3,5E-05	5,93E-05	9,71E-05	8,44E-05	0,000205	0,000327	0,000258	7,63E-05	0,000196	0,000109	0,000234	0,000501	0,000829	0,00027	0,00015	0,000639	0,000643	7,07E-05	0,000458	0,001929

Table 8.15 Expected varianc-covariance period 7.

Variance-Covariance matirx. Period 7. Expected numbers.

	NGCCS00	NCLCS00	NNGCS00	NSLCS00	BMACS00	NHGCS00	LSWCS20	CW.CS20	NCTCS00	CC.CS00	OILGSAS	BMATREU	INDUSNA	CNSMGLA	HLTHCAS	CNSMSER	TELCMLA	UTILSEF	FINANEK	TECNONA
NGCCS00	0,000879	0,000526	0,000499	0,001168	0,000312	0,00058	0,000245	0,000313	0,000233	0,000468	0,000362	0,000485	2,49E-05	0,000244	7,83E-05	0,000197	0,000246	0,000177	0,000248	-1,1E-05
NCLCS00	0,000526	0,002812	0,001522	0,000894	0,000669	0,000967	0,000594	0,000496	0,000714	0,000776	0,000763	0,001027	0,000233	0,000558	0,000117	0,000401	0,000574	0,000455	0,000478	0,00019
NNGCS00	0,000499	0,001522	0,005941	0,000778	0,000351	0,000786	0,00035	-5,7E-05	0,000332	0,00043	0,000552	0,000516	7,38E-05	0,000436	7,58E-05	0,000229	0,000363	0,000348	0,000191	0,000128
NSLCS00	0,001168	0,000894	0,000778	0,002524	0,000722	0,001108	0,000505	0,000559	0,000312	0,000957	0,000758	0,001062	0,000249	0,000605	0,000255	0,000481	0,000649	0,000505	0,000641	0,000177
BMACS00	0,000312	0,000669	0,000351	0,000722	0,001634	0,000629	0,000301	0,000471	0,000478	0,000716	0,000563	0,000733	0,000295	0,000692	0,000268	0,000412	0,000669	0,0004	0,000605	0,000352
NHGCS00	0,00058	0,000967	0,000786	0,001108	0,000629	0,002235	0,000494	0,000656	0,000449	0,000781	0,000797	0,001252	0,000487	0,000908	0,000313	0,000622	0,000929	0,000589	0,000811	0,000439
LSWCS20	0,000245	0,000594	0,00035	0,000505	0,000301	0,000494	0,001222	0,000297	0,000254	0,000512	0,000376	0,000501	0,000108	0,000204	0,000118	0,000148	0,000304	0,000234	0,000318	0,000113
CW.CS20	0,000313	0,000496	-5,7E-05	0,000559	0,000471	0,000656	0,000297	0,002066	0,000635	0,001419	0,000437	0,000656	0,000227	0,000407	0,0002	0,000276	0,000447	0,000305	0,000363	0,000201
NCTCS00	0,000233	0,000714	0,000332	0,000312	0,000478	0,000449	0,000254	0,000635	0,001813	0,000613	0,00042	0,000605	0,000134	0,000395	0,000147	0,000312	0,000387	0,000324	0,000382	0,000146
CC.CS00	0,000468	0,000776	0,00043	0,000957	0,000716	0,000781	0,000512	0,001419	0,000613	0,002405	0,000537	0,00094	0,000299	0,000506	0,000157	0,000383	0,000594	0,000392	0,000479	0,000309
OILGSAS	0,000362	0,000763	0,000552	0,000758	0,000563	0,000797	0,000376	0,000437	0,00042	0,000537	0,001386	0,001187	0,000509	0,000891	0,000458	0,000727	0,000981	0,000673	0,001101	0,000555
BMATREU	0,000485	0,001027	0,000516	0,001062	0,000733	0,001252	0,000501	0,000656	0,000605	0,00094	0,001187	0,001992	0,000884	0,00118	0,000435	0,001079	0,001422	0,000954	0,001296	0,00081
INDUSNA	2,49E-05	0,000233	7,38E-05	0,000249	0,000295	0,000487	0,000108	0,000227	0,000134	0,000299	0,000509	0,000884	0,00074	0,000732	0,000226	0,000611	0,000869	0,00045	0,000724	0,000685
CNSMGLA	0,000244	0,000558	0,000436	0,000605	0,000692	0,000908	0,000204	0,000407	0,000395	0,000506	0,000891	0,00118	0,000732	0,00231	0,000408	0,000798	0,00136	0,000697	0,001117	0,000863
HLTHCAS	7,83E-05	0,000117	7,58E-05	0,000255	0,000268	0,000313	0,000118	0,0002	0,000147	0,000157	0,000458	0,000435	0,000226	0,000408	0,000529	0,000327	0,00044	0,00042	0,000452	0,000243
CNSMSER	0,000197	0,000401	0,000229	0,000481	0,000412	0,000622	0,000148	0,000276	0,000312	0,000383	0,000727	0,001079	0,000611	0,000798	0,000327	0,000839	0,000962	0,000644	0,000873	0,00061
TELCMLA	0,000246	0,000574	0,000363	0,000649	0,000669	0,000929	0,000304	0,000447	0,000387	0,000594	0,000981	0,001422	0,000869	0,00136	0,00044	0,000962	0,001809	0,000835	0,001246	0,000902
UTILSEF	0,000177	0,000455	0,000348	0,000505	0,0004	0,000589	0,000234	0,000305	0,000324	0,000392	0,000673	0,000954	0,00045	0,000697	0,00042	0,000644	0,000835	0,000776	0,000737	0,000453
FINANEK	0,000248	0,000478	0,000191	0,000641	0,000605	0,000811	0,000318	0,000363	0,000382	0,000479	0,001101	0,001296	0,000724	0,001117	0,000452	0,000873	0,001246	0,000737	0,001337	0,000734
TECNONA	-1,1E-05	0,00019	0,000128	0,000177	0,000352	0,000439	0,000113	0,000201	0,000146	0,000309	0,000555	0,00081	0,000685	0,000863	0,000243	0,00061	0,000902	0,000453	0,000734	0,000895

Table 8.16 Expected variance-covariance period 17.

Variance-Covariance matrix. Period 17. Expected numbers.

	NGCCS00	NCLCS00	NNGCS00	NSLCS00	BMACS00	NHGCS00	LSWCS20	CW.CS20	NCTCS00	CC.CS00	OILGSAS	BMATREU	INDUSNA	CNSMGLA	HLTHCAS	CNSMSER	TELCMLA	UTILSEF	FINANEK	TECNONA
NGCCS00	0,000646	0,000364	3,93E-05	0,001047	0,000138	0,000273	5,93E-05	0,000208	0,000217	0,000194	0,000219	0,000369	0,00011	0,000202	5,58E-05	0,000161	0,000211	0,000116	0,000194	9,48E-05
NCLCS00	0,000364	0,002251	0,000406	0,000986	0,00045	0,000815	0,000401	0,00037	0,000545	0,000408	0,000586	0,000959	0,000579	0,000488	0,00011	0,000496	0,000545	0,000454	0,000537	0,000509
NNGCS00	3,93E-05	0,000406	0,004275	0,000215	0,000398	0,000106	0,000388	0,000513	-7,8E-05	0,000545	0,000216	0,000293	0,000192	0,000285	8,8E-05	0,000228	0,000279	0,000181	0,000186	0,000116
NSLCS00	0,001047	0,000986	0,000215	0,002534	0,000563	0,000917	0,000342	0,000493	0,000702	0,000556	0,000714	0,00113	0,000524	0,000634	0,000152	0,00053	0,000654	0,00041	0,000658	0,000416
BMACS00	0,000138	0,00045	0,000398	0,000563	0,001473	0,000422	0,00047	0,00034	0,000538	0,000231	0,000366	0,000474	0,000258	0,000446	6,54E-05	0,000278	0,000432	0,000232	0,000363	0,000129
NHGCS00	0,000273	0,000815	0,000106	0,000917	0,000422	0,00152	0,000377	0,000512	0,000585	0,000333	0,000645	0,001206	0,000618	0,000548	7,18E-05	0,000592	0,000569	0,000427	0,000704	0,000569
LSWCS20	5,93E-05	0,000401	0,000388	0,000342	0,00047	0,000377	0,001555	0,000247	0,000374	0,000376	0,000262	0,000377	0,000213	0,0003	5,99E-05	0,000273	0,000308	0,000214	0,000249	0,000179
CW.CS20	0,000208	0,00037	0,000513	0,000493	0,00034	0,000512	0,000247	0,002014	0,000423	0,001316	0,000297	0,000569	0,000221	0,000212	8,67E-05	0,000326	0,000225	0,000253	0,000267	0,000219
NCTCS00	0,000217	0,000545	-7,8E-05	0,000702	0,000538	0,000585	0,000374	0,000423	0,002484	0,00045	0,000354	0,000587	0,000298	0,000302	6,6E-05	0,000328	0,00035	0,000216	0,000365	0,000197
CC.CS00	0,000194	0,000408	0,000545	0,000556	0,000231	0,000333	0,000376	0,001316	0,00045	0,0021	0,000273	0,000494	0,000228	0,000193	3,33E-05	0,000239	0,000314	0,000148	0,000264	0,000219
OILGSAS	0,000219	0,000586	0,000216	0,000714	0,000366	0,000645	0,000262	0,000297	0,000354	0,000273	0,000911	0,001024	0,000643	0,000592	0,000237	0,00058	0,000669	0,000431	0,000822	0,000515
BMATREU	0,000369	0,000959	0,000293	0,00113	0,000474	0,001206	0,000377	0,000569	0,000587	0,000494	0,001024	0,001992	0,001149	0,000943	0,000214	0,001147	0,001048	0,000835	0,001126	0,000972
INDUSNA	0,00011	0,000579	0,000192	0,000524	0,000258	0,000618	0,000213	0,000221	0,000298	0,000228	0,000643	0,001149	0,00098	0,00062	0,000147	0,000708	0,0007	0,000512	0,000708	0,00076
CNSMGLA	0,000202	0,000488	0,000285	0,000634	0,000446	0,000548	0,0003	0,000212	0,000302	0,000193	0,000592	0,000943	0,00062	0,000854	0,000155	0,000604	0,000732	0,000441	0,000705	0,000463
HLTHCAS	5,58E-05	0,00011	8,8E-05	0,000152	6,54E-05	7,18E-05	5,99E-05	8,67E-05	6,6E-05	3,33E-05	0,000237	0,000214	0,000147	0,000155	0,000324	0,000185	0,000167	0,000207	0,000222	0,000108
CNSMSER	0,000161	0,000496	0,000228	0,00053	0,000278	0,000592	0,000273	0,000326	0,000328	0,000239	0,00058	0,001147	0,000708	0,000604	0,000185	0,000846	0,00068	0,000607	0,000686	0,000601
TELCMLA	0,000211	0,000545	0,000279	0,000654	0,000432	0,000569	0,000308	0,000225	0,00035	0,000314	0,000669	0,001048	0,0007	0,000732	0,000167	0,00068	0,001038	0,00049	0,000756	0,00056
UTILSEF	0,000116	0,000454	0,000181	0,00041	0,000232	0,000427	0,000214	0,000253	0,000216	0,000148	0,000431	0,000835	0,000512	0,000441	0,000207	0,000607	0,00049	0,000615	0,0005	0,000425
FINANEK	0,000194	0,000537	0,000186	0,000658	0,000363	0,000704	0,000249	0,000267	0,000365	0,000264	0,000822	0,001126	0,000708	0,000705	0,000222	0,000686	0,000756	0,0005	0,000947	0,000566
TECNONA	9,48E-05	0,000509	0,000116	0,000416	0,000129	0,000569	0,000179	0,000219	0,000197	0,000219	0,000515	0,000972	0,00076	0,000463	0,000108	0,000601	0,00056	0,000425	0,000566	0,000797

Table 8.17 Actual variance-covariance period 1.

Variance-Covariance matrix. Period 1. Actual period numbers.

	NGCCS00	NCLCS00	NNGCS00	NSLCS00	BMACS00	NHGCS00	LSWCS20	CW.CS20	NCTCS00	CC.CS00	OILGSAS	BMATREU	INDUSNA	CNSMGLA	HLTHCAS	CNSMSER	TELCMLA	UTILSEF	FINANEK	TECNONA
NGCCS00	0,001096	6,07E-05	-0,00015	0,000192	0,000422	0,000353	0,00034	6,67E-05	0,000155	0,000173	0,000383	0,000319	-2,4E-05	9E-05	-6,3E-05	5,85E-05	0,000211	0,000106	0,000146	-8,4E-05
NCLCS00	6,07E-05	0,001284	0,000151	0,00089	0,000513	0,000346	-0,00027	-0,00064	0,000164	0,000634	0,000138	0,000174	7,23E-05	0,000224	0,000188	2,04E-05	0,000104	3,11E-05	0,000102	-6,4E-06
NNGCS00	-0,00015	0,000151	0,001281	0,000457	0,000215	0,000248	0,00014	0,000442	0,000273	0,000348	0,000112	0,000337	7,54E-05	0,000231	9,09E-05	0,00021	-6,7E-05	0,000279	0,00039	-9,1E-06
NSLCS00	0,000192	0,00089	0,000457	0,001314	0,000941	0,000542	6,32E-05	-0,00043	0,000409	0,000868	0,000223	0,000445	0,000132	0,000341	0,000244	0,000174	0,000221	0,000144	0,000335	0,000135
BMACS00	0,000422	0,000513	0,000215	0,000941	0,002526	0,001343	0,00084	-0,00085	0,000702	0,001972	0,000877	0,001402	0,000389	0,000954	0,000721	0,000627	0,000861	0,000656	0,000877	0,000412
NHGCS00	0,000353	0,000346	0,000248	0,000542	0,001343	0,001123	0,000718	-0,00026	0,000633	0,0013	0,000771	0,000985	0,000272	0,000715	0,000559	0,000525	0,000783	0,000537	0,000757	0,000252
LSWCS20	0,00034	-0,00027	0,00014	6,32E-05	0,00084	0,000718	0,001511	0,000908	0,000677	0,000827	0,000723	0,000827	0,00012	0,000413	0,000365	0,000361	0,000411	0,000535	0,000449	0,000123
CW.CS20	6,67E-05	-0,00064	0,000442	-0,00043	-0,00085	-0,00026	0,000908	0,007103	-0,00016	0,00054	0,000644	0,000712	0,000361	-5,6E-05	-0,00022	0,000168	-0,00041	0,000345	-6,1E-05	-7,1E-05
NCTCS00	0,000155	0,000164	0,000273	0,000409	0,000702	0,000633	0,000677	-0,00016	0,001374	0,000367	0,000861	0,000926	0,000372	0,000719	0,000682	0,000532	0,00083	0,000513	0,000845	0,000585
CC.CS00	0,000173	0,000634	0,000348	0,000868	0,001972	0,0013	0,000827	0,00054	0,000367	0,003078	0,000955	0,001551	0,000434	0,000871	0,000706	0,000665	0,000763	0,000666	0,000789	0,000269
OILGSAS	0,000383	0,000138	0,000112	0,000223	0,000877	0,000771	0,000723	0,000644	0,000861	0,000955	0,001326	0,00113	0,000426	0,000776	0,000776	0,000565	0,000884	0,000632	0,000919	0,000466
BMATREU	0,000319	0,000174	0,000337	0,000445	0,001402	0,000985	0,000827	0,000712	0,000926	0,001551	0,00113	0,00168	0,000591	0,001025	0,000793	0,000787	0,001044	0,000828	0,001074	0,000549
INDUSNA	-2,4E-05	7,23E-05	7,54E-05	0,000132	0,000389	0,000272	0,00012	0,000361	0,000372	0,000434	0,000426	0,000591	0,000322	0,000437	0,000392	0,000326	0,000481	0,000334	0,000457	0,000322
CNSMGLA	9E-05	0,000224	0,000231	0,000341	0,000954	0,000715	0,000413	-5,6E-05	0,000719	0,000871	0,000776	0,001025	0,000437	0,000907	0,000637	0,000551	0,000908	0,000609	0,000882	0,000417
HLTHCAS	-6,3E-05	0,000188	9,09E-05	0,000244	0,000721	0,000559	0,000365	-0,00022	0,000682	0,000706	0,000776	0,000793	0,000392	0,000637	0,000907	0,00052	0,000744	0,000525	0,000663	0,000429
CNSMSER	5,85E-05	2,04E-05	0,00021	0,000174	0,000627	0,000525	0,000361	0,000168	0,000532	0,000665	0,000565	0,000787	0,000326	0,000551	0,00052	0,000492	0,000667	0,000458	0,000636	0,00033
TELCMLA	0,000211	0,000104	-6,7E-05	0,000221	0,000861	0,000783	0,000411	-0,00041	0,00083	0,000763	0,000884	0,001044	0,000481	0,000908	0,000744	0,000667	0,001263	0,000656	0,001012	0,000563
UTILSEF	0,000106	3,11E-05	0,000279	0,000144	0,000656	0,000537	0,000535	0,000345	0,000513	0,000666	0,000632	0,000828	0,000334	0,000609	0,000525	0,000458	0,000656	0,000626	0,000633	0,0003
FINANEK	0,000146	0,000102	0,00039	0,000335	0,000877	0,000757	0,000449	-6,1E-05	0,000845	0,000789	0,000919	0,001074	0,000457	0,000882	0,000663	0,000636	0,001012	0,000633	0,001063	0,000508
TECNONA	-8,4E-05	-6,4E-06	-9,1E-06	0,000135	0,000412	0,000252	0,000123	-7,1E-05	0,000585	0,000269	0,000466	0,000549	0,000322	0,000417	0,000429	0,00033	0,000563	0,0003	0,000508	0,00052

Table 8.18 Actual variance-covariance period 7.

Variance-Covariance matrix. Period 7. Actual period numbers.

	NGCCS00	NCLCS00	NNGCS00	NSLCS00	BMACS00	NHGCS00	LSWCS20	CW.CS20	NCTCS00	CC.CS00	OILGSAS	BMATREU	INDUSNA	CNSMGLA	HLTHCAS	CNSMSER	TELCMLA	UTILSEF	FINANEK	TECNONA
NGCCS00	0,000755	0,000546	0,000604	0,000291	0,000507	0,000188	0,000753	0,000627	0,000411	0,000255	0,000464	0,000835	0,00049	0,000283	-3,7E-05	0,000609	0,000411	0,000369	0,000275	0,00034
NCLCS00	0,000546	0,002405	0,00143	0,001399	0,000618	0,000161	0,001333	0,001609	0,000922	0,001096	0,00058	0,001434	0,000417	0,000523	3,04E-05	0,001062	0,000636	0,000616	0,000505	0,000325
NNGCS00	0,000604	0,00143	0,002281	0,001049	0,000232	-0,00019	0,001562	0,001239	0,001077	0,00121	0,000779	0,00169	0,001274	0,000752	5,34E-05	0,001091	0,001042	0,000669	0,000792	0,000833
NSLCS00	0,000291	0,001399	0,001049	0,001392	0,00015	-0,00013	0,001	0,000938	0,000761	0,000661	0,00069	0,001212	0,000783	0,000572	-8,5E-05	0,000703	0,000718	0,000322	0,00067	0,000609
BMACS00	0,000507	0,000618	0,000232	0,00015	0,002726	0,001367	0,001474	0,000327	0,001027	-0,00041	0,000635	0,000974	0,00029	0,000282	0,000218	0,000353	0,000465	0,000474	7,07E-05	-5,1E-05
NHGCS00	0,000188	0,000161	-0,00019	-0,00013	0,001367	0,000994	0,000751	-0,00043	0,000205	-0,00093	-6,8E-05	-0,00029	-0,00037	-0,00015	0,000191	-0,00015	-8,7E-05	0,000131	-0,00041	-0,00041
LSWCS20	0,000753	0,001333	0,001562	0,001	0,001474	0,000751	0,008427	0,001754	0,001535	0,001111	0,000898	0,001025	0,000781	0,000421	0,000524	0,000407	0,000601	0,000993	0,00049	0,000545
CW.CS20	0,000627	0,001609	0,001239	0,000938	0,000327	-0,00043	0,001754	0,006977	0,000915	0,001865	0,000988	0,002732	0,001503	0,001484	0,000417	0,001908	0,001795	0,001172	0,001631	0,000941
NCTCS00	0,000411	0,000922	0,001077	0,000761	0,001027	0,000205	0,001535	0,000915	0,00178	0,000704	0,001108	0,001489	0,000847	0,000805	0,000246	0,000832	0,001054	0,000635	0,000891	0,000377
CC.CS00	0,000255	0,001096	0,00121	0,000661	-0,00041	-0,00093	0,001111	0,001865	0,000704	0,003296	0,001019	0,002422	0,001045	0,000689	-0,00016	0,00109	0,000682	0,00053	0,001208	0,001046
OILGSAS	0,000464	0,00058	0,000779	0,00069	0,000635	-6,8E-05	0,000898	0,000988	0,001108	0,001019	0,002521	0,002856	0,002267	0,001452	0,000668	0,00161	0,001661	0,001113	0,002175	0,001343
BMATREU	0,000835	0,001434	0,00169	0,001212	0,000974	-0,00029	0,001025	0,002732	0,001489	0,002422	0,002856	0,004782	0,003035	0,002143	0,000377	0,002657	0,00251	0,001523	0,002726	0,002173
INDUSNA	0,00049	0,000417	0,001274	0,000783	0,00029	-0,00037	0,000781	0,001503	0,000847	0,001045	0,002267	0,003035	0,003083	0,001605	0,000389	0,001695	0,001924	0,000981	0,002175	0,00197
CNSMGLA	0,000283	0,000523	0,000752	0,000572	0,000282	-0,00015	0,000421	0,001484	0,000805	0,000689	0,001452	0,002143	0,001605	0,001277	0,000326	0,001298	0,00148	0,000723	0,001463	0,001007
HLTHCAS	-3,7E-05	3,04E-05	5,34E-05	-8,5E-05	0,000218	0,000191	0,000524	0,000417	0,000246	-0,00016	0,000668	0,000377	0,000389	0,000326	0,000825	0,000353	0,000308	0,000633	0,000648	9,64E-05
CNSMSER	0,000609	0,001062	0,001091	0,000703	0,000353	-0,00015	0,000407	0,001908	0,000832	0,00109	0,00161	0,002657	0,001695	0,001298	0,000353	0,001881	0,001572	0,001063	0,001603	0,001188
TELCMLA	0,000411	0,000636	0,001042	0,000718	0,000465	-8,7E-05	0,000601	0,001795	0,001054	0,000682	0,001661	0,00251	0,001924	0,00148	0,000308	0,001572	0,001869	0,000804	0,001625	0,001242
UTILSEF	0,000369	0,000616	0,000669	0,000322	0,000474	0,000131	0,000993	0,001172	0,000635	0,00053	0,001113	0,001523	0,000981	0,000723	0,000633	0,001063	0,000804	0,001061	0,001079	0,000572
FINANEK	0,000275	0,000505	0,000792	0,00067	7,07E-05	-0,00041	0,00049	0,001631	0,000891	0,001208	0,002175	0,002726	0,002175	0,001463	0,000648	0,001603	0,001625	0,001079	0,002246	0,001306
TECNONA	0,00034	0,000325	0,000833	0,000609	-5,1E-05	-0,00041	0,000545	0,000941	0,000377	0,001046	0,001343	0,002173	0,00197	0,001007	9,64E-05	0,001188	0,001242	0,000572	0,001306	0,00176

Table 8.18 Actual variance-covariance

Variance-Covariance matrix. Period 17. Actual period numbers.

	NGCCS00	NCLCS00	NNGCS00	NSLCS00	BMACS00	NHGCS00	LSWCS20	CW.CS20	NCTCS00	CC.CS00	OILGSAS	BMATREU	INDUSNA	CNSMGLA	HLTHCAS	CNSMSER	TELCMLA	UTILSEF	FINANEK	TECNONA
NGCCS00	0,000741	7,53E-05	0,000131	0,000162	0,000117	-5,2E-05	0,000182	5,92E-05	0,000854	0,000273	0,000107	0,00019	0,000101	0,000121	0,000135	8,87E-05	-0,00019	0,000111	9,27E-05	2,48E-05
NCLCS00	7,53E-05	0,001213	0,0004	0,000433	2,8E-05	0,000109	-0,00013	0,000343	0,000578	-0,00016	-9,3E-06	-2,2E-06	6,49E-05	-2,1E-05	-0,00013	1,23E-05	1,6E-05	9,61E-05	-4,2E-05	-1,4E-05
NNGCS00	0,000131	0,0004	0,000778	0,000243	3,25E-05	5,5E-05	3,23E-05	0,000242	0,000216	-8,9E-05	-7,4E-05	7,55E-05	6,79E-05	-0,00013	-5E-05	2,96E-05	-4,9E-05	5,06E-05	-6,4E-05	2,2E-05
NSLCS00	0,000162	0,000433	0,000243	0,000541	-2E-05	4,86E-05	-2,4E-05	-2,3E-05	0,000816	-4,1E-05	3,56E-06	-2,6E-05	2,73E-05	4,38E-05	-2,3E-05	3,44E-05	-0,00011	4,78E-05	2,98E-08	-0,00011
BMACS00	0,000117	2,8E-05	3,25E-05	-2E-05	0,00087	0,000479	1,91E-05	0,000255	0,000401	0,000142	0,000116	0,000211	1,55E-05	-8,6E-06	6,73E-06	7,23E-05	-2,3E-05	9,54E-05	-1,1E-05	5,8E-05
NHGCS00	-5,2E-05	0,000109	5,5E-05	4,86E-05	0,000479	0,000364	-5,2E-05	9,52E-05	0,000297	-2,5E-05	1,6E-05	1,24E-05	-6,7E-05	-6,6E-05	-5,4E-05	-3,6E-05	-3,1E-05	8,87E-06	-7,5E-05	-2,6E-05
LSWCS20	0,000182	-0,00013	3,23E-05	-2,4E-05	1,91E-05	-5,2E-05	0,0005	0,000502	0,000274	0,000103	0,000181	7,99E-05	-8E-07	0,000151	-7,2E-06	1,6E-05	-0,00013	8,87E-05	0,000145	4,65E-05
CW.CS20	5,92E-05	0,000343	0,000242	-2,3E-05	0,000255	9,52E-05	0,000502	0,006372	0,000664	8,29E-05	-2,4E-05	0,000145	-0,00033	-0,00036	-2,2E-05	-6E-05	-0,00037	0,000178	8,02E-05	-5,7E-05
NCTCS00	0,000854	0,000578	0,000216	0,000816	0,000401	0,000297	0,000274	0,000664	0,004984	-2,7E-05	0,000269	-0,00015	-9,5E-05	-1,1E-05	6,31E-05	-5,1E-05	-0,00066	0,000148	6,48E-05	-0,00028
CC.CS00	0,000273	-0,00016	-8,9E-05	-4,1E-05	0,000142	-2,5E-05	0,000103	8,29E-05	-2,7E-05	0,000338	0,000108	0,000205	2,24E-05	0,000138	7,46E-05	8,4E-05	-6,3E-05	5,98E-05	0,000108	4,5E-05
OILGSAS	0,000107	-9,3E-06	-7,4E-05	3,56E-06	0,000116	1,6E-05	0,000181	-2,4E-05	0,000269	0,000108	0,000399	0,000162	0,000102	0,000231	5,86E-05	7,8E-05	9,53E-05	0,000103	0,00023	8,32E-05
BMATREU	0,00019	-2,2E-06	7,55E-05	-2,6E-05	0,000211	1,24E-05	7,99E-05	0,000145	-0,00015	0,000205	0,000162	0,000391	0,000177	0,000122	0,000103	0,000204	0,000119	0,00013	0,000157	0,00017
INDUSNA	0,000101	6,49E-05	6,79E-05	2,73E-05	1,55E-05	-6,7E-05	-8E-07	-0,00033	-9,5E-05	2,24E-05	0,000102	0,000177	0,000259	7,2E-05	0,000128	0,000167	0,000135	8,68E-05	6,89E-05	0,000175
CNSMGLA	0,000121	-2,1E-05	-0,00013	4,38E-05	-8,6E-06	-6,6E-05	0,000151	-0,00036	-1,1E-05	0,000138	0,000231	0,000122	7,2E-05	0,000403	-2,3E-05	4,81E-05	0,00014	7,08E-05	0,000236	1,26E-05
HLTHCAS	0,000135	-0,00013	-5E-05	-2,3E-05	6,73E-06	-5,4E-05	-7,2E-06	-2,2E-05	6,31E-05	7,46E-05	5,86E-05	0,000103	0,000128	-2,3E-05	0,000246	0,000116	-2,7E-05	6,84E-05	1,96E-05	0,000112
CNSMSER	8,87E-05	1,23E-05	2,96E-05	3,44E-05	7,23E-05	-3,6E-05	1,6E-05	-6E-05	-5,1E-05	8,4E-05	7,8E-05	0,000204	0,000167	4,81E-05	0,000116	0,000188	5,01E-05	0,000113	8,92E-05	0,000138
TELCMLA	-0,00019	1,6E-05	-4,9E-05	-0,00011	-2,3E-05	-3,1E-05	-0,00013	-0,00037	-0,00066	-6,3E-05	9,53E-05	0,000119	0,000135	0,00014	-2,7E-05	5,01E-05	0,000529	-3,2E-05	9,56E-05	0,000116
UTILSEF	0,000111	9,61E-05	5,06E-05	4,78E-05	9,54E-05	8,87E-06	8,87E-05	0,000178	0,000148	5,98E-05	0,000103	0,00013	8,68E-05	7,08E-05	6,84E-05	0,000113	-3,2E-05	0,000117	8,68E-05	7,95E-05
FINANEK	9,27E-05	-4,2E-05	-6,4E-05	2,98E-08	-1,1E-05	-7,5E-05	0,000145	8,02E-05	6,48E-05	0,000108	0,00023	0,000157	6,89E-05	0,000236	1,96E-05	8,92E-05	9,56E-05	8,68E-05	0,000232	4,2E-05
TECNONA	2,48E-05	-1,4E-05	2,2E-05	-0,00011	5,8E-05	-2,6E-05	4,65E-05	-5,7E-05	-0,00028	4,5E-05	8,32E-05	0,00017	0,000175	1,26E-05	0,000112	0,000138	0,000116	7,95E-05	4,2E-05	0,000209