STOCKHOLM SCHOOL OF ECONOMICS

Do energy price changes have an impact on the Swedish stock market?

Master's thesis in Accounting and Financial Management

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Abstract

This thesis examines the impact the energy resources oil, coal and electricity have on the Swedish stock market. The stock market has been divided by sectors, resulting in 15 sector indices. Each index has been tested against the energy variables with a multiple regression approach, with monthly data from the period 1996-01-15 to 2009-07-15. Our findings imply a significant relationship for all energy variables against some sectors, though the explanatory level of electricity is very low. The analysis has been discussed with reference to a free cash flow valuation and how changes in energy prices affect the stock value. The final conclusion is that the impact energy prices have on stock returns is rather limited, as the relationship is only statistically significant on a few number of sector indices.

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1. Introduction

1.1 Background

The energy sector's importance on an economy is truly significant and it is hard to find another factor affecting the economy to the same extent. In 1974, when OPEC increased the oil price, most countries experienced a recession and during the summer of 2008 an oil price peak of approximately 140 dollars per barrel occurred, followed by a severe recession in the world. During 2006 when the price of electricity in Sweden peaked, voices the Swedish industry were heard, among them Urban Bäckström CEO of Svenskt Näringsliv, saying the price development is hurting Swedish corporations and an expansion of energy production is necessary (Dagens Industri, 2006-09-04). As a result from the price peak Swedish industry companies invested billions in wind power stations, in order to reduce the price of electricity (Dagens Industri, 2006-11-03). Also the developing countries, which inhabit the majority of the world population, have a growing need for energy. China is currently expanding their coal fueled electricity capacity with 100 GW a year which constitutes to one-third of the U.S coal consumption (Huber, 2009).

Earlier studies have focused primarily on the macro economical effect oil price changes have on the global economy, rather than the all energy resources, i.e. coal, natural gas and electricity. Hamilton (1983) studied the impact of oil price shocks on the US economy and found that all except one recession post World War II can be explained by dramatic increases in oil price. The international monetary fund (IMF) (2000) examined the impact increased oil prices have on the global economy and found that a 5 USD per barrel increase corresponds to a drop of 0,25 percent of global output. However we are more interested in the relationship between energy prices and the stock market.

1.2 Aim of the study

As we have stated, it has in former studies been proved that the development of oil prices has an impact on the economy. A high price of energy implies increased costs and reduced global output. With regard to this we intend to examine how changes in oil, coal and electricity affect the stock market. The result of our study will be of great interest for investors, asset managers and others who trade stocks on the stock market and who would like to learn the impact fluctuations in energy prices have on industries in order to adjust the portfolio according to expectations of energy price changes.

1.3 Delimitations

The study examines the relationship between energy prices and the Swedish stock market. As a starting point the energy prices included were o*il, electricity, coal* and *natural gas*. However it was learned that natural gas is priced after oil (Commodity Sales/Trader, Nordea Markets) and as a result natural gas was excluded from our study. If natural gas had been included, the risk of distortion of the results in the final models would have been high due to potential measurement errors between natural gas and oil[1]. In order to learn which energy indices best can explain the energy costs of the Swedish market additional interviews with Nordea markets researchers were made. The remaining energy variables were as a result determined to be *London Brent Crude oil, Nord Pool electricity* and *Richard bay coal.*

The Swedish stock market has been classified in accordance with the Global Industry Classification Standards (GICS), used by the OMX Stockholm exchange. We decided to include 15 indices[2] and delimited the time period to 1996-01-15 – 2008-07-15.

1.4 Outline

The paper will be presented in four parts. First, the previous work within the area will be described, in order to provide a background to the subject. In addition a description of the theoretical framework is provided, where we will define drivers of value and describe the discounted cash flow, followed by a statement of the hypothesis. Secondly, the empirical data is described, where the delimitations of the study is outlined. Also, the independent variables used in the models as well as the methodology are discussed. Third, the empirical results found from the regressions and several robustness tests in order to verify the reliability of the results, is presented. Thereafter an analysis is performed where the findings is interpreted and discussed with regards from the theoretical framework described in section one. In the fourth section a summary of the study is presented and conclusions from the findings are stated as well as a discussion of the methodology used and its impact on the results. Finally, suggestions to further research are provided.

2. Literature review

In this section a review of previous studies will be presented. However previous research focuses only on the impact oil has on the macro economy and stock market. No previous

[1] Measurement errors are further explained in section 8

[2] Initially it was 17 indices, two indices were excluded as the time series data were insufficient

studies have been found with regards to the impact coal and electricity has on the economy or the stock return.

The previous research will be presented in two parts: First part deal with studies examining the relationship between energy prices and the economic activity. Secondly we review studies focusing on the relationship between energy prices and the stock market.

2.1 Macroeconomic effects

As mentioned in the introduction, IMF (2000) studied the impact of higher oil prices on the Global economy. Their conclusion was that higher oil prices affect the economy through a variety of channels:

- There will be a transfer of income from oil consumers to oil producers. The latter have a propensity to spend less than the oil consumers, and as a result the global demand is decreased.
- There will be a rise in the cost of production of goods and services in the economy, due to higher energy prices and therefore declining profit margins is a result.
- There will be an impact on the inflation and price level. (The magnitude will vary with monetary policy)
- There will be changes in economic activity, inflation, corporate earnings and monetary policy due to higher oil prices. As a result it will be both direct and indirect effects on the financial markets.
- Finally there will be changes in relative prices, which will create an incentive for energy suppliers to increase production and energy consumers to economize.

Though the IMF found evidence of global effects from higher oil prices, other researchers have come to different conclusions.

Burbidge and Harrison (1984) examined the relationship between oil price shocks and industrial production for the US, UK, Japan, Germany and Canada, by using data on a monthly basis between May 1962 – June 1982. They found evidence of that in the US and UK the impact of oil price shocks was substantial, whereas in Japan, Germany and Canada it was relatively small.

Gisser and Goodwin (1986) also studied the relationship of oil price shocks on the US economy, using monthly data from the years 1961-1982. Their conclusion was that the overall relationship between crude oil and the US economy was stable over the period. They also found that significant changes in the price of oil shifts the aggregate supply curve causing large real effects but weak direct price effects.

Hooker's (1996) study gave a somewhat different result depending on which end year he used. With data up to 1973 he found a correlation between oil price shocks and the US macro economy, but when expanding the time period to the mid 1990's the relationship does no longer hold. In order to explain the difference in results, he tries a few possible explanations such as sample period issues, misspecification of a linear vector autoregression (VAR) equations for the oil price and macroeconomic variables, though none is supported by the data. His conclusion is that the relationship between macro economy and changes in oil prices has changed and does not longer hold. Hooker (1999) has also made a study regarding the asymmetric effect of oil price shocks on GDP as well as Ferderer (1996), Balke, Brown and Yucel (2002). They studied the response oil price shocks had on interest rates. They came to the conclusion that oil price shocks affect the GDP asymmetrically through interest rates.

Miguel, Manzano and Martin-Moreno (2003) utilize a general equilibrium model of small open economy for Spain in order to study the impact of oil price shocks. The study showed that oil price shocks have a negative relationship and significant influence on welfare.

Cunado and Gracia (2003, 2005) have used the Granger causality test to analyze whether oil prices can affect macroeconomic variables in several Asian and European countries. Their conclusion for the European countries was that the oil price shocks affect on macroeconomic variables, do not depend on the oil market volatility. In the Asian countries the national oil price had a more significant impact on the economic activity compared to the world oil price.

Jimenez and Sanschez (2005) have empirically tested oil price shocks effect on real economic activity, through a multivariate vector autoregressive model, in selected OECD countries. The authors came to the conclusion that it do not exist a direct relationship between oil price changes and gross domestic product.

2.2 Stock market effects

Kling (1985) examines the relationship between price changes of crude oil and activity in the stock market between the years 1973-1982 in the US. Their results proved that industries where oil was an input factor the oil price changes affected future stock prices.

Jones and Kaul (1996) examines whether stock prices react to news regarding present and future real cash flows and found that oil price increases had a significant negative effect for the US, Canadian, UK and Japan stock market.

Sadorsky (1999) used a VAR model on monthly data from the US during the period Q1 1947 – Q4 1996. The variables included industrial production, a 3-month T-bill, oil price (defined as the PPI for fuels), real stock returns defined as the return on S&P 500 minus the consumer price index) Sadorsky found that both oil price changes and oil price volatility negatively affect real stock returns. However he concludes that the effect is asymmetric. As he divided the time period to ante 1986 and post 1986 he came to different conclusion. Ante 1986 positive and negative oil price changes are able to explain future error variance in real stock returns. Post 1986 he found that increasing oil price shocks are able to explain to a larger extent the variance in real stock returns, industrial production and interest rates, than decreasing oil price shocks are.

Chen et al (1986) does not find any evidence of a correlation between oil price and US stock returns.

Kaneko and Lee (1995) performed a study which examined the effect of oil price changes on both the US and the Japanese stock market. They found that it don't exist a relationship with the US stock market, but for the Japanese they found a significant relationship.

Gjerde and Saettem (1999) analyzed macroeconomic variables in order to investigate whether a relationship between them and stock returns could be found in Norway. The authors found a positive relationship between oil price shocks and the stock market.

Maghyereh (2004) collected and analyzed stock market data from 22 emerging economies in order to find a relationship between stock return and oil price shocks. The author found a weak evidence of a relationship between oil price shocks and the stock market. The countries with the highest test values had a large energy consumption relative the other countries in the study.

Driesprong et al (2005) came to the conclusion that oil price changes significantly affect the stock market, but that investors do not react fully to this. The effect is stronger in countries where the oil consumption per capita is strong.

Hammodeh and Li (2005) focused their study on Mexico and Norway. In their model they used two main indices, one from each country, as well as two industry sector indices from each country, a transport index and an oil industry index. They found that oil price changes have a significant impact on both the main indices and the sector indices.

Cong, Wei, Jiao, and Fan (2008) used Chinese stock market data with the intention to find a relationship between oil price shocks and the stock market. The authors found a statistically significant relationship between some oil company stocks and a manufacturing index.

3. Theoretical framework

In this section the multiple regression method will be described. In addition a valuation framework will be provided, from which further analysis will be referred to, as well as an explanation for drivers of value. There are a vast amount of different valuation models in order to determine the value of a company. Of these the discounted cash flow model has been chosen as it is widely used among academics and is not affected by the accounting based earnings, instead it only takes the cash flow into account.

3.1 Multiple Regression

In order to determine the relationship between energy prices and the stock market, we will use a multiple regression approach, since energy prices consists of three variables in our model, *oil, electricity and coal.* Also, there are more independent variables affecting the stock market than only the energy prices, of which *industrial production, inflation and interest rate* have been included in our study, which implies a multiple regression model. More independent variables might be able to explain to a larger extent the changes in stock market, than only the prices of energy alone.

The general regression model can be written as followed according to Edlund (1997):

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \cdots + \beta_2 X_{ki} + u_t$$

Where Y_i is the dependent variable and $X_{2i}, X_{3i}, \dots, X_{ki}$ is k-1 explaining variables, u_i is an error term and $\beta_1, \beta_2, \dots, \beta_k$ is *k* regression coefficients that will be estimated. σ^2 is the variance for u_i. With n observations, the regression equation can be estimated for the input variables and is written as followed (Edlund, 1997):

$$\hat{Y}_i = \hat{\beta}_1 + \hat{\beta}_2 X_{2i} + \hat{\beta}_3 X_{3i} + \cdots + \hat{\beta}_2 X_{ki}$$

Where $\hat{Y}_i$ is a prediction of Y_i and $\hat{\beta}_1, \hat{\beta}_2, \dots, \hat{\beta}_k$ is k predicted regression coefficients.

3.2 Drivers of value

As this report will investigate how shareholder value is affected by energy price changes it is important to understand the fundamentals for value creation and how value can be measured. Increased energy prices imply increased costs and declining profit margins (IMF 2000), which could be assumed to result in lower share value for energy consuming sectors.

According to Koller et al (2005) there are two key value drivers for cash flow and value creation; 1) Growth, the rate at which the company can grow its revenues and profits and 2) Return on Invested Capital (ROIC). Value is created by investing capital at rates of return exceeding the Weighted Average Cost of Capital (WACC)[3]. Hence the value creation is higher the more capital the company can invest, as long as the return exceeds the cost of capital and faster growth will then create more value (Koller et al, 2005) .

3.2.1 Enterprise discounted cash flow valuation

Before going through the enterprise DCF, we will define some key concepts:

NOPLAT: *Net Operating Profit Less Adjusted Tax*, aggregates the operating income generated by invested capital and is available to both debt- and equity holders (Koller et al, 2005).

ROIC: *Return on Invested Capital,* measures the ratio of NOPLAT to invested capital. Due to the independency of capital structure for NOPLAT and invested capital, also ROIC is independent. ROIC is a tool to measure how the company is performing relatively to its competitors without the effect of financial structure or other non-operating activities. It focuses solely on the core operations (Koller et al, 2005).

$$ROIC = \frac{NOPLAT}{Invested\ Capital}$$

FCF: Free Cash Flow, is the after-tax cash flow available to all investors and is independent of financing and non-operating items. It is the after-tax cash flow that would be generated if the company financed the business entirely with equity (Koller et al, 2005).

$$FCF = NOPLAT + Noncash\ Operating\ Expenses - Investments\ in\ Invested\ Capital$$

[3] **The Weighted average cost of capital** (WACC**)** is the company's opportunity cost of capital and equals a mixed required return of both debt and equity holders.

The cash flow perpetuity equation is commonly used when estimating the value of a company. Required assumptions are that the company must have a constant investment rate and growth into perpetuity (Koller et al, 2005).

$$V_0 = \frac{FCF_1}{r_{WACC} - g}$$

3.2.2. Expected effects from changes in energy prices

Fluctuations in the energy prices affect the company through the income statement where it is classified as an operating expense (Koller et al, 2005).[4] If an industry sector is highly energy intensive they consequently will get a higher operating cost if the energy prices increase, which is in accordance to IMF (2000) who stated that increased oil prices increases costs of goods and services. The increase in costs will directly reduce NOPLAT which in turn decreases FCF and hence the value of the company is decreased, with regards to the growth into perpetuity formula if all else is held constant. As company value is reduced, the sector index of the company will reflect the change and decrease as well.

$$NOPLAT \downarrow - Net\ Investments = FCF \downarrow$$

$$\frac{FCF_1 \downarrow}{r_{WACC}{}^5 - g} = V_0 \downarrow$$

4. Hypothesis

The result of several previous studies indicates that oil price increases has a negative impact on the overall economy. Regarding the impact a change in electricity and coal has on the economy there exist much less documented research. Researchers have also investigated the correlation between oil price changes and stock return, but there is no agreement of the impact, instead they end up with dissimilar results. However , with the theoretical framework as a basis, changes in the price of energy is expected to affect the Swedish stock market through changes of NOPLAT and FCF if all else is equal, which will have an impact on company valuation. The indices represent the valuation of companies in a specific sector so a changed valuation implies a decrease or increase in the index. The first hypothesis tests this assumption:

[4] Energy price costs are assumed to be included in cost of goods sold.
[5] Weighted Average Cost of Capital is used as a discount factor in the growth into perpetuity formula.

A) H_0: Energy price changes have no significant impact on the stock market
H_1: Energy price changes have a significant impact on the stock market

If a regression result in a significant energy variable the null hypothesis will be rejected, this will indicate that energy price changes have an impact on the stock market. It is further assumed that all sector indices, for which the null hypothesis is rejected, have a negative relationship with the significant energy variable. This is due to, as stated in the theoretical framework, an increase in energy prices should result in lower FCF and hence a decreased value of the company. This implies an increase in the energy variable would yield a negative impact on the energy consuming indices. However the energy sector index is expected to be the only sector that has a positive relationship with the energy variables, since the companies are the suppliers of the energy commodities. This result in hypothesis B):

B) H_0: All tested indices except the “OMXS Energy” have a positive relationship with significant energy variables.

$$\beta_{Energy} = postive$$

$$\beta_{Energy}^{OMXS\,Energy} = negative$$

H_1: All tested indices except “OMXS Energy” have a negative relationship with significant energy variables.

$$\beta_{Energy} = negative$$

$$\beta_{Energy}^{OMXS\,Energy} = positive$$

In addition we predict OMXS Transport and OMXS Pharmaceuticals/Biotech to have a correlation coefficient close to zero. This is due to our perception that transport companies are able to transfer increased prices of energy to the clients as it is a sector with few actors and hence they are able to steer the prices accordingly to energy price fluctuations. The demand for pharmaceutical and biotech products are fairly constant over time and not as affected as many other sectors of macro economical factors. Hence we do not expect any of the two sectors to have any significant relationship with energy price changes.

5. Data description

In order to perform a valid analysis of how the energy prices affect the stock market some limitations have been necessary to make. These limitations include determining a limited period of time to examine as well as a certain market.

5.1 Time period

The time period was determined with the intention to cover the longest period of time. 1996-01-15 to 2008-07-15 was the largest time period available for all variables included in our model. With a long period of time we are able to capture many different patterns and changes in the market which can potentially increase the validity of the results.

5.2 Market

The OMX Stockholm market has been chosen since it is the most traded market in Sweden and where the largest corporations are traded. Level two was chosen as the companies included within each sector are then more homogenous, which will result in a more valid result.

5.3 Independent variables

5.3.1 Energy variables

5.3.1.1 Coal

Coal is generally used for the production of electricity, heating or in technical processes to produce steel. The import of coal for energy related usage accounts approximately for 30% of the imports in 2008 and the rest is used to produce steel (Commodity Sales/Trader, Nordea Markets). Coal as an energy commodity today and historically represent a small part of the Swedish total energy when compared to other resources such as oil products, hydro- and nuclear power (Sweden Energy Institute, 2008). As a proxy for the coal price development Swedish companies are exposed to we have determined to use Richard Bay coal index (Commodity Sales/Trader, Nordea Markets).

Since coal can be used to produce electricity, measurement errors might occur due to the inclusion of both coal and electricity as control variables. However, electricity that has been produced by coal and sold in Sweden generally constitute a minor part of total electricity market, e.g. Vattenfall use 9% fossil fuel to produce electricity to the Nordic countries (Annual Report, 2008).

5.3.1.2 Electricity

The use of electricity is an elementary factor that is important for the economy and society as a whole. Without electricity companies would not be able to maintain any activity, hence it is used in the day to day business. Therefore the fluctuations in electricity prices will affect the operating costs for the companies (IMF, 2000) and an increase of price can affect the FCF negatively. Companies can buy electricity from a physical market place where physical contracts with next day supply are traded or make off-market contracts directly with the supplier. We have chosen to use the indexed spot price of electricity from Nord Pool where the majority of electricity contracts are traded and consequently reflect the price companies are exposed to. At Nord Pool Nordic companies can also manage their electricity risk with derivatives from their financial market where the prices are set with the spot price as a base.

5.3.1.3 Oil

Oil price changes have significant impact on the economy since oil and oil products are important in the production processes as well as liquid fuels for transportation (Financial Analyst, Nordea Markets). Oil has historically been the single most important source for the energy production in Sweden but today nuclear and oil products are approximately equal (Sweden Energy Institute, 2008). As stated previously, IMF (2000) state that global production declines with higher oil prices and that cost of goods and services increases for the companies. The latter would imply a lower NOPLAT with regards to the theoretical framework and hence a lower share value. There are many various types of oil traded on exchanges but the most common are Brent, West Texas Intermediate and Dubai oil. We have chosen to use the indexed spot price of London Brent oil since it is generally the price Swedish companies buy the oil to (Financial Analyst, Nordea Markets).

5.3.2 Control variables

5.3.2.1 S&P500

The Swedish market is affected by how the global economy develops since our exports are an important factor in the estimation of GDP. How the market functions in the USA have spill over effects on the Swedish market which is called an inter-market relationship. As a proxy of the US economy we have used Standard and Poor 500 (S&P 500). The S&P 500 index includes 500 companies in different markets and is widely used as a benchmark by investors (Commodity Sales/Trader, Nordea Markets).

5.3.2.2 Interest rate

Higher interest rate implies a pressure on corporations due to more expensive debt, which implies lower corporate earnings and a cut on stock returns. Also demand on equities is decreased as it becomes more attractive to invest in bonds when it is a high interest rate. As a proxy for interest we use the 10 yr Swedish government bond since it is most commonly used when valuing a company (Financial Analyst, Nordea Markets).

5.3.2.3 Industrial Production

The industrial production can be seen as an estimation of the economic activity. When companies increase their production, a positive effect on the economy could be expected, which consequently will give the companies increased revenues and dividends and hence stock prices increases. As a proxy for the industrial production we intend to use Sweden's reported industrial production index, which is reported the 15th on a monthly basis.

5.3.2.4 Inflation

Previous research has found that there is a relationship between inflation and stock returns. However the studies differ and there has been evidence that both show positive and a negative correlation in relation to the stock return. Gultekin (1983) argued for a positive correlation whereas Fama (1981) found a negative correlation. Though with accordance to the Fisher[6] theorem we do not expect the inflation to have any real impact on the stock return, as the real stock returns is not affected by the inflation according to the theorem. Consumer Price Index (CPI) has been chosen as an estimate of the inflation.

5.4 Sample characteristics

The first step regressions have been performed on a monthly- as well as on a weekly basis. Below we present the descriptive of the monthly collected data as they gave the most significant result in the regressions. First the sample characteristics of the explanatory energy variables; London Brent crude oil, Nord Pool electricity and Richard bay coal are presented. Thereafter we provide the characteristics for the Swedish sector indices. The indices have been classified in accordance with the Global Industry Classification Standards (GICS), used by the OMX Stockholm exchange. In the appendix it is provided graphs illustrating the development of each variable over the examined time period.

[6] Irving Fisher emphasized the distinction between real and monetary rates of interest. He claimed that real interest rate is not affected by monetary measures as the real interest rates equal to the nominal rates minus inflation.

Table I

This table illustrates the descriptive statistics for the energy price changes of oil, electricity and coal. The sample cover the period from 19960115 - 20080715. Total number of observations corresponds to 156.

Energy variables	Min.	Max.	Mean	Std. Dev.
London brent crude oil	-27,74%	26,45%	1,49%	10,43%
Nord Pool electricity	-52,26	82,14%	3,10%	25,32%
Richard bay coal	-26,12%	34,89%	0,64%	11,58%

Table I show that the standard deviation of Nord Pool electricity is significantly greater compared to oil and coal. The energy commodities also have a positive mean over the period.

Table II

This table illustrates the descriptive statistics for each of the stock indices, classified in accordance with GICS, used in our models. The sample 19960115 - 20080715. Total number of observations corresponds to 156.

Dependent variables	Min.	Max.	Mean	Std. Dev.
OMXS Auto and Components	-26,68%	26,68%	0,48%	9,20%
OMXS Commercial/Professional Services	-19,11%	20,98%	0,63%	7,23%
OMXS Consolidated Durables and Apparel	-21,34%	25,44%	1,09%	8,94%
OMXS Consumer Services	-20,77%	23,57%	2,26%	8,13%
OMXS Diversified Financials	-20,24%	15,95%	0,81%	6,75%
OMXS Energy	-36,24%	36,78%	1,88%	12,68%
OMXS Food, Beverages and Tobacco	-14,27%	14,89%	1,12%	5,22%
OMXS Media	-29,71%	28,83%	0,39%	9,94%
OMXS Pharmaceuticals/Biotechnology	-16,60%	19,98%	0,59%	7,19%
OMXS Real Estate	-17,44%	17,73%	1,03%	6,01%
OMXS Retailing	-24,84%	26,22%	1,93%	9,04%
OMXS Software and Services	-34,41%	34,41%	0,34%	11,87%
OMXS Technology Hardware and Equipme	-34,32%	40,78%	1,28%	14,06%
OMXS Telecommunication Services	-28,51%	28,82%	1,51%	9,72%
OMXS Transportation	-29,97%	33,24%	0,09%	11,46%

From table II it can be observed that the standard deviation for the dependent variables compared to the energy variables is much less. The largest standard deviation is found in OMXS Technology Hardware and Equipment, whereas the least is found in OMXS Food, Beverages and Tobacco. It is also stated that all indices have had a positive mean over the period.

Table III

This table illustrates the descriptive statistics for each of the stock indices used in our models. The sample cover the period from 19960115 – 20080715. Total number of observations corresponds to 156.

Control variables	Min.	Max.	Mean	Std. Dev.
Swedish Goverment bond, 10yrs (Interest)	-0,67%	0,53%	3,54%	27,38%
Consumer Price Index (CPI)	-1,34%	1,03%	0,10%	0,42%
Industrial Production (IP)	-38,88%	39,14%	0,58%	12,03%
Standard & Poor 500 (S&P500)	-17,46%	15,90%	0,86%	6,02%

6. Method

Below we will describe and discuss the methodology used for the research. First we explain the methodology of the study, which is then followed by describing the transformation of the raw data and finally the method used to get the final models. The software "Predictive Analytics SoftWare" (PASW)[7] *has been used to perform the statistical analysis of the data.*

6.1 Methodology

The focus of our study is the Swedish stock market, which has been divided into different sectors according to GICS made by the OMX Stockholm exchange. Each index has then been tested against the energy variables London Brent crude oil, Nord Pool electricity and Richard Bay coal in order to examine if a relationship prevails. In addition we have added control variables, which can help explaining changes in the indices to a further extent than the energy variables themselves. The variables we included are; Industrial production, Consumer Price Index and Interest rates, as well as the S&P 500 as an indicator of the overall performance of the US market. The description and motivation of each variable is found in the data section (5.3.2). Though deciding upon which variables to include in the regression model is not straight forward, as former studies have not come to a consensus regarding one appropriate combination of variables (Cremers 2002). When testing the explanatory variables against each sector index, we used spot prices and lagged prices of one to six months, in order to capture a potential lag effect.

[7] Former known as "Statistical Package for the Social Sciences" (SPSS)

6.2 Transforming the data

As we are interested in examining the effect a change in energy prices has on the stock market, each variable has been transformed into returns rather than kept as prices. Regarding the interest rates, it is given in percent in the raw we have calculated the percentage change per month. Finally after the transformations we will be able to perform a valid comparison between the variables in the final models.

$$r_t^{Index} = \frac{P_t^{Index}}{P_{t-1}^{Index}} - 1$$

P_t^{Index} = The index price at "t" point of time

P_t^{Index} = The index price at "t − 1" point of time

6.3 Initial test of energy price effects

As the first approach to examine whether a relationship between energy prices and stock returns exist we performed a multiple regression where each index was tested against all energy variables at spot price. This gave us an early indication if an effect existed.

$$r_t^i = \alpha^i + \beta_1^i r_t^{oil} + \beta_2^i r_t^{electricity} + \beta_3^i r_t^{coal} + \varepsilon^i$$

Where α^i is the constant term, that is estimated with the regression, and ε^i is the error term and the superscript *i* indicates each stock index.

We also ran a cross-correlation test in order to examine the correlation between all variables in the models.

6.4 Including all variables

The subsequent step was to include all the variables discussed in the data section as well as all time lags, spot price to a six month lag. In order to determine which lags of the variables to put in to the model, we tested each sector's index against one explanatory variable at a time, where the latter consisted of spot price and lagged values up to six months. Variables that proofed to be significant were then incorporated in the next stage of the modeling. As a final step all significant variables associated to an index were regressed and the variables that then were significant constituted the final model.

7. Empirical results

In this section we will present the empirical results retrieved from our models. First the outcome from the regressions where only the energy prices, spot and lagged variables, were included, thereafter we included the control variables and finally we present the final models for each stock index.

7.1 Initial test of energy price effects

The initial test included the spot price for each energy price, oil, coal and electricity, and a multiple regression was performed on each sector index in order to examine whether a relationship existed. In table IV we summarize the outcome of the initial regression.

Table IV

In this table we illustrate the relation between the spot price of London Brent Crude oil, Nord Pool electricity and Richard Bay coal. The "r-value" corresponds to the unstandardized beta. * equals a significance level of 10% and ** equals a significance level of 5%.

Stock Index	Constant	r^{oil}	$r^{electricity}$	r^{coal}	Adj. R^2	N
OMXS Auto and Components	0,003	*0,112	-0,023	**0,242	0,099	156
t-value	0,391	1,663	-0,829	4,000		
OMXS Commercial/Professional Services	0,006	0,044	*-0,042	**0,174	0,081	156
t-value	1,089	0,824	-1,916	3,633		
OMXS Consolidated Durables and Apparel	0,012	-0,063	-0,029	**0,223	0,072	156
t-value	1,649	-0,950	-1,070	3,743		
OMXS Consumer Services	**0,022	-0,031	0,001	**0,234	0,095	156
t-value	3,479	-0,523	0,038	4,374		
OMXS Diversified Financials	0,008	0,021	**-0,040	**0,262	0,203	156
t-value	1,591	0,457	-2,075	6,283		
OMXS Energy	0,013	**0,426	-0,054	**0,280	0,189	156
t-value	1,429	4,818	-1,486	3,540		
OMXS Food, Beverages and Tobacco	**0,011	0,000	-0,008	**0,103	0,034	156
t-value	2,617	-0,003	-0,463	2,889		
OMXS Media	0,002	0,074	-0,024	**0,342	0,171	156
t-value	0,270	4,050	-0,823	5,406		
OMXS Pharmaceuticals/Biotechnology	0,007	-0,082	-0,013	0,029	-0,001	156
t-value	1,253	-1,470	-0,573	0,581		
OMXS Real Estate	**0,009	0,041	-0,009	**0,200	0,134	156
t-value	2,065	0,326	-0,517	5,152		
OMXS Retailing	**0,020	0,068	**-0,078	0,090	0,043	156
t-value	2,815	0,989	-2,769	1,470		
OMXS Software and Services	0,002	0,081	-0,049	**0,386	0,156	156
t-value	0,211	0,945	-1,402	5,061		
OMXS Technology Hardware and Equipment	0,014	-0,073	-0,063	**0,383	0,091	156
t-value	1,268	-0,701	-1,473	4,124		
OMXS Telecommunication Services	**0,016	0,005	*-0,057	**0,213	0,063	156
t-value	2,050	0,072	-1,908	3,269		
OMXS Transportation	0,000	-0,062	0,004	**0,311	0,083	156
t-value	0,014	-0,725	0,107	4,087		

From the table above a relationship between energy prices and stock indices can be observed for all indices, except OMXS Pharmaceutical/Biotechnology. The largest adjusted R^2 is found in OMXS Diversified Financial, corresponding to 0,203. Also OMXS Energy and OMXS Media have a relatively large adjusted R^2 value. For OMXS Diversified Financials, r_t^{Coal} corresponds to 0,262, which could be interpreted to that if the price of coal would increase by one percent, OMXS Diversified Financials would rise by 0,262%. This result is significant at 5% level. OMXS Energy is affected by changes in energy prices. An oil price increase by one percent would give a rise in OMXS Energy by 0,426% and if coal price increase by one percent, energy will rise by 0,280%. However the impact is weaker when the price of electricity changes, as the index then should fall by 0,054%. The spot coal price is significant at 5% for all indices, whereas oil and electricity not show significant results to the same extent against the indices. However an interpretation from only this table should be seen as indications, hence we will add further control variables to the model in order to be able to explain changes in stock indices to a larger extent.

7.2 Cross-correlation test

Table V

Below we can observe the correlation between sector indices (dependant variables) and the energy variables (independent variables).

Sector index	Oil	Electricity	Coal
OMXS Auto and Components	0,15	-0,02	0,31
OMXS Commercial/Professional Services	0,07	-0,12	0,27
OMXS Consolidated Durables and Apparel	-0,06	-0,06	0,28
OMXS Consumer Services	-0,01	0,03	0,33
OMXS Diversified Financials	0,06	-0,10	0,44
OMXS Energy	0,36	-0,06	0,28
OMXS Food, Beverages and Tobacco	0,02	-0,02	0,23
OMXS Media	0,11	-0,02	0,40
OMXS Pharmaceuticals/Biotechnology	-0,12	-0,05	0,03
OMXS Real Estate	0,05	0,00	0,39
OMXS Retailing	0,07	-0,20	0,10
OMXS Software and Services	0,09	-0,06	0,38
OMXS Technology Hardware and Equipment	-0,04	-0,09	0,30
OMXS Telecommunication Services	0,01	-0,12	0,24
OMXS Transportation	-0,03	0,03	0,31

The strongest correlation between oil and an index is found with OMXS Energy, with a positive correlation of 0,363. OMXS Auto and components has the second strongest correlation of 0,147. Most other indices have a correlation close to zero, with media as an exemption as its correlation corresponds to 0,106. Moving on to electricity we find OMXS

Retailing as having the strongest correlation of -0,202. Regarding coal we can see the opposite, as all indices are positively correlated with the coal price. This implies that each sector's stock return benefit's from an increased coal price.

7.3 Adding control variables to the model

In the second stage the models is extended with the control variables we described in the data section, by expanding the model we can capture more of the effects affecting the fluctuations of stock prices than only from the change in energy price, which could increase the explanatory value. These variables are: *Consumer price index (CPI), change in interest rate (interest) and Industrial Production (IP)*. We also added the *Standard & Poor 500 (S&P500)* index, in order to capture how the market has been performing in the US. Finally we included the time lagged variables, since the effect a change an explanatory variable have on an index might not come instant, but rather after some time which is called a leading indicator (Sales/Trader, Nordea Markets).

Subsequently each stock index were tested against each variable, from spot to lagged values up to six months, to be able to find which variables that at a significant level of 10% could explain changes in the index. Indices where no energy variables were significant were excluded from the model.

7.4 Final models

Finally we received a model, with variables that are all significant at 10% level. A summary of the findings are provided in the appendix. Below we will present the final model for each sector index:

7.4.1 OMXS Auto and Components

Table VI

In this table we present all the variables that were significant for OMXS Auto and Components; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{\text{AutoComp}} = \alpha^{\text{AutoComp}} + \beta_1 r_t^{S\&P500} + \beta_2 r_t^{\text{Interest}} + \beta_3 r_{t-5}^{\text{Electricity}} + \beta_4 r_{t-1}^{\text{CPI}} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	$r_t^{Interest}$	$r_{t-5}^{Electricity}$	r_{t-1}^{CPI}	Adj. R^2	N
0,005	**0,790	**0,159	**0,053	**3,107	0,284	156

The only energy variable remaining in the final model of OMXS Auto and Components industry is $r_{t-5}^{\text{Electricity}}$. It implies that an increase of 1% in the electricity price increases the sector index by 0,053% five months later. From the other variables we can observe that a change in CPI significantly affects OMXS Auto and Components as a 1% increase imply a 3,107%increase of the index. The interest effect is not at all as strong, as a similar change corresponds to a change in the index by 0,159%. The adjusted R^2 corresponds to 0,284, which is an increase from 0,099 in the initial regression.

7.4.2 OMXS Commercial/Professional Services

Table VII

In this table we present all the variables that were significant for OMXS Commercial/Professional Services; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{\text{ComProf}} = \alpha^{\text{ComProf}} + \beta_1 r_t^{S\&P500} + \beta_2 r_{t-3}^{S\&P500} + \beta_3 r_{t-2}^{\text{Electricity}} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	$r_{t-3}^{S\&P500}$	$r_{t-2}^{Electricity}$	Adj. R^2	N
0,003	**0,773	**0,193	**-0,043	0,391	156

$r_{t-2}^{\text{Electricity}}$ is the only energy variable significant in the final model for commercial professional. It is significant at 5% and an increase of one percent in electricity, implies a decreasing index of -0,043% in two month forward. The other two variables are $r_t^{S\&P500}$ and $r_{t-3}^{S\&P500}$ indicate that an increase of 1% in S&P 500, implies an increase of Commercial Professionals by 0,773% the same month and an increase by 0,193% three months later. The adjusted R^2 corresponds to 0,391, which is an improvement from the initial regression where it amounted to 0,081, meaning that the variance of the sector index can be explained to 39,1% by the final model. All variables are significant at 5%.

7.4.3 OMXS Consolidated Durables and Apparel

Table VIII

In this table we present all the variables that were significant for OMXS Consolidated Durables and Apparel; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{\text{ConDurApp}} = \alpha^{\text{ConDurApp}} + \beta_1 r_t^{S\&P500} + \beta_2 r_{t-1}^{S\&P500} + \beta_3 r_{t-6}^{IP} + \beta_4 r_{t-3}^{\text{Electricity}} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	$r_{t-1}^{S\&P500}$	r_{t-6}^{IP}	$r_{t-3}^{Electricity}$	Adj. R^2	N
0,006	**0,766	**0,229	**0,053	**-0,058	0,273	156

Consumer, durables and apparel are negatively affected by the only energy variable left in the final model, $r_{t-3}^{\text{Electricity}}$. If the price of electricity increases by 1%, a decrease of -0,058% is assumed for the sector index. $r_t^{S\&P500}$ has a quite similar impact as in the models above and we can see that the S&P 500 also has a lag effect as a change of 1%, imply a change on

0,229% in a month for the sector index. In the model the variable r_{t-6}^{IP} is significant a 5% level where a change of 1%, results in an increase of 0,053%. The adjusted R^2 corresponds to 0,273, an increase from 0,072 in the initial regression where only the spot energy prices were used as explanatory variables.

7.4.4 OMXS Diversified Financials

Table IX

In this table we present all the variables that were significant for OMXS Diversified Financials; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{Div.Fin} = \alpha^{Div.Fin} + \beta_1 r_t^{S\&P500} + \beta_2 r_t^{Coal} + \beta_3 r_{t-1}^{Coal} + \beta_4 r_{t-2}^{Electricity}$$

$$+\beta_5 r_{t-3}^{Electricity} + \beta_6 r_{t-6}^{Oil} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	r_t^{Coal}	r_{t-1}^{Coal}	$r_{t-2}^{Electricity}$	$r_{t-3}^{Electricity}$	r_{t-6}^{Oil}	Adj. R^2	N
-0,007	**0,595	**0,179	**0,096	**-0,044	**-0,043	**0,224	0,583	156

OMXS Diversified Financials have all energy variables included in its final model. r_t^{Coal} has a positive impact, with a beta coefficient of 0,179. Coal also has a one month lag effect as a 1% increase in r_{t-1}^{Coal} imply an increase of the OMXS Diversified Financials index by 0,096%. Electricity on the other hand has a significant negative impact on the stock return as $r_{t-2}^{Electricity}$ has a beta coefficient of -0,044 and $r_{t-3}^{Electricity}$ a coefficient of -0,043. This implies that the market respons to changes in the electricity price is delayed two to three months. A delayed response is also observed with oil as r_{t-6}^{Oil} equals to 0,224. In addition $r_t^{S\&P500}$ corresponds to 0,595 implying a relatively strong relationship. The adjusted R^2 amounts to 0,585, which is the largest R^2 level of all models in our paper. This can be compared to the level of 0,203 in the initial regression.

7.4.5 OMXS Energy

Table X

In this table we present all the variables that were significant for OMXS Energy; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{Energy} = \alpha^{Energy} + \beta_1 r_t^{S\&P500} + \beta_2 r_t^{Oil} + \beta_3 r_{t-5}^{Electricity} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	r_t^{Oil}	$r_{t-5}^{Electricity}$	Adj. R^2	N
0,008	**0,575	**0,377	**0,093	0,213	156

In the final model for OMXS Energy we can observe the spot price of oil and the three month lag of electricity price are the only energy variables left. An increase of one percent in the price of oil implies an increase of the OMXS Energy index of 0,377%, whereas the same change in electricity corresponds to an increase of 0,093% in the index five months later. S&P 500 is the only other variable that is significant at 5% level and implies that a one percent increase in the S&P 500 index, implies a 0,575% increase in OMXS Energy. The adjusted R^2 amounts to 0,213, meaning that 21,3% of the variance in OMXS Energy can be explained by the model. This is only about 2,5% more than the R^2 value of only the oil spot price itself against OMXS Energy.

7.4.6 OMXS Food, Beverages and Tobacco

Table XI

In this table we present all the variables that were significant OMXS Food, Beverages and Tobacco; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{FoodBevTob} = \alpha^{FoodbevTob} + \beta_1 r_{t-2}^{Coal} + \beta_2 r_t^{S\&P500} + \beta_3 r_{t-3}^{S\&P500} + \beta_4 r_{t-3}^{IP} + \varepsilon_t$$

Constant	r_{t-2}^{Coal}	$r_t^{S\&P500}$	$r_{t-3}^{S\&P500}$	r_{t-3}^{IP}	Adj. R^2	N
**0,009	**-0,081	**0,252	**0,175	**0,058	0,153	156

r_{t-2}^{Coal} is the only explanatory energy price significant in the final model of OMXS Food, Beverages and Tobacco. It implies that a change of 1% in the price of coal, results in an increase of 0,058% in the sector index. $r_t^{S\&P500}$does not have the same strong impact as in above models, as it only affects the index by 0,252% with an increase of 1%. r_{t-3}^{IP} do neither affect to a large extent as it imply a change of 0,058% with an increase of 1%. The adjusted R^2 corresponds to 0,153, which is a low level and gives an indication that we will not be able to draw any reliable conclusions from the model.

7.4.7 OMXS Media

Table XII

In this table we present all the variables that were significant OMXS Media; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{Media} = \alpha^{Media} + \beta_1 r_t^{S\&P500} + \beta_2 r_{t-5}^{CPI} + \beta_3 r_t^{Coal} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	r_{t-5}^{CPI}	r_t^{Coal}	Adj. R^2	N
-0,016	**0,902	**-5,14	**0,305	0,311	156

In the final model of OMXS Media we find the spot price of coal to be the only significant energy variable. An increase of 1% in the price of coal, imply an increase of 0,305% in OMXS Media. $r_t^{S\&P500}$ implies that a 1% increase of the S&P 500 results in a 0,902% increase in OMXS Media. The strongest affecting variable is r_{t-5}^{CPI} as an increase of 1% indicates a decrease of-5,14% in the Media index. The adjusted R^2 corresponds to 0,311, which is a strong improvement from the initial regression where it amounted to 0,171.

7.4.8 OMXS Retailing

Table XIII

In this table we present all the variables that were significant OMXS Retailing; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{Retail} = \alpha^{Retail} + \beta_1 r_t^{S\&P500} + \beta_2 r_{t-5}^{Oil} + \beta_3 r_t^{Electricity} + \beta_4 r_t^{Interest} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	r_{t-5}^{Oil}	$r_t^{Electricity}$	$r_t^{Interest}$	Adj. R^2	N
**0,017	**0,650	**-0,153	**-0,058	**-7,826	0,234	156

In the final model of OMXS Retailing oil r_{t-5}^{Oil} has a negative impact equal to -0,153, implying that an increase of 1% in the price of oil corresponds to a decrease of -0,153% in OMXS Retailing with a five months delay. Electricity also has a negative impact, but this effect is immediate as $r_t^{Electricity}$ equals to -0,058. The largest impact however comes from changes in interest as $r_t^{Interest}$ corresponds to -7,826, implying that a one percentage change in the interest rate is expected to decrease the retail index by -7,826%. The adjusted R^2 amounts to 0,234, which is a strong increase from the initial regression where it was 0,043. This is mainly due to the inclusion of interest. All variables are significant at 5%.

7.4.9 OMXS Software and Services

Table XIV

In this table we present all the variables that were significant OMXS Software and Services; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{SoftServ} = \alpha^{SoftServ} + \beta_1 r_t^{S\&P500} + \beta_2 r_{t-2}^{Electricity} + \beta_3 r_t^{Coal} + \beta_4 r_{t-1}^{Coal}$$

$$+\beta_5 r_{t-1}^{CPI} + \beta_6 r_{t-1}^{IP} + \beta_7 r_{t-2}^{IP} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	$r_{t-2}^{Electricity}$	r_t^{Coal}	r_{t-1}^{Coal}	r_{t-1}^{CPI}	r_{t-1}^{IP}	r_{t-2}^{IP}	Adj. R^2	N
0,001	**0,924	**-0,070	**0,234	**0,153	**-5,585	*0,112	**0,161	0,251	156

The final model of OMXS Software and Services includes electricity lagged two months and coal at both spot price and one month lag. A 1% increase in electricity implies a -0,07% change in OMXS Software and Services, whereas the same change in coal implies an increase of 0,234% the same month and 0,153% by one month lag. Among the other explanatory variables we find that CPI has a strong impact as an increase of 1% in CPI, implies a -5,585% change in the sector index. A 1% change in S&P 500 implies almost the same change in the index and a 1% increase in industrial production imply an increase of 0,112% with one month lag and 0,161% with two months lag. All variables are significant at 5% level, except r_{t-1}^{IP}which is significant at 10%. The adjusted R^2 amounts 0,251, which is an increase from the initial regression where it was 0,063.

7.4.10 OMXS Technology Hardware and Equipment

Table XV

In this table we present all the variables that were significant OMXS Technology Hardware and Equipment; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{\text{TechHardware}} = \alpha^{\text{TechHardware}} + \beta_1 r_t^{S\&P500} + \beta_2 r_{t-1}^{S\&P500} + \beta_3 r_{t-2}^{\text{Electricity}} + \beta_4 r_{t-3}^{\text{CPI}} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	$r_{t-1}^{S\&P500}$	$r_{t-2}^{Electricity}$	r_{t-3}^{CPI}	Adj. R^2	N
0,007	**1,335	**0,606	*-0,073	*-3,944	0,329	156

OMXS Technology Hardware and Equipment has $r_{t-2}^{\text{Electricity}}$ as the only explanatory energy variable in its final model. If the price of electricity increases by 1%, it implies a fall of

-0,067% in OMXS Technology Hardware and Equipment. $r_t^{S\&P500}$and $r_{t-1}^{S\&P500}$has a strong impact in the model where an increase of 1% result in an increase of 1,379% the same month and 0,545% one month later. The adjusted R^2 amounts to 0,329, which in the initial regression corresponded to 0,091. Both S&P 500 variables are significant at 5%, whereas electricity and inflation is significant at 10%.

7.4.11 OMXS Telecommunication Services

Table XVI

In this table we present all the variables that were significant for OMXS Telecommunication Services; * denotes significance at 10% and ** denotes significance at 5%. The regression is given by:

$$r_t^{\text{Telecom}} = \alpha^{\text{Telecom}} + \beta_1 r_t^{S\&P500} + \beta_2 r_{t-3}^{S\&P500} + \beta_3 r_{t-6}^{\text{Oil}} + \beta_4 r_t^{\text{Coal}} + \varepsilon_t$$

Constant	$r_t^{S\&P500}$	$r_{t-3}^{S\&P500}$	r_{t-6}^{Oil}	r_t^{Coal}	Adj. R^2	N
0,008	**0,652	**0,316	**0,155	**0,124	0,251	156

The final model of OMXS Telecommunication Services is given by two energy variables; r_{t-6}^{Oil} and r_t^{Coal}. An increase of 1% in the first one implies an increase of 0,155% in the sector index, whereas the same change in the latter explanatory variable corresponds to an increase of 0,124% in the sector index. $r_t^{S\&P500}$ and $r_{t-3}^{S\&P500}$ corresponds to an increase of 0,652% and 0,316% respectively with an increase of 1%. All variables are significant at 5%. The adjusted R^2 amounts to 0,251, which is an increase from the initial regression where it corresponded to 0,063.

7.5 F-test

In order to further test whether the energy prices can affect the sector indices we conducted a F-tests on the models. The F-test is used to see if new variables increase the explanatory power of the dependent variable. The hypothesis is hence:

$$H_0 = \beta_2 + \beta_3 \dots \beta_i = 0$$

$$H_1 = \beta_2 + \beta_3 \dots \beta_i \neq 0$$

The null hypothesis will be rejected if the observed F-value is greater than the critical $F_{crit=(m(,n-k))}$-value. According to Gujarati (2003) F_{obs} is calculated as below:

$$F = \frac{(R_{UR}^2 - R_R^2)/m}{(1 - R_{UR}^2)/(n-k)}$$

$m = number\ of\ linear\ restrictions$

$k = number\ of\ parameters\ in\ the\ unrestricted\ regression$

$n = number\ of\ observations$

The unrestricted model's R-square (R_{UR}^2) value are subtracted with the restricted model's R square (R_R^2) value. The unrestricted model is represented by the full final model and in the restricted model we have removed explanatory energy variables so only control variables are remaining.

Table XVII

In this table we present the results from the F-test at a 5% significance level.

Dependent variables	Fobs	Fcrit	Action
OMXS Auto and Components	2,4	5,7	Accept H_0
OMXS Commercial/Professional Services	2,8	8,5	Accept H_0
OMXS Consolidated Durables and Apparel	2,9	5,7	Accept H_0
OMXS Diversified Financials	36,6	3,7	Reject H_0
OMXS Energy	13,8	8,5	Reject H_0
OMXS Food, Beverages and Tobacco	2,9	5,7	Accept H_0
OMXS Media	16,2	8,5	Reject H_0
OMXS Retailing	6,1	3,7	Reject H_0
OMXS Software and Services	11,9	3,3	Reject H_0
OMXS Technology Hardware and Equipment	1,9	5,7	Accept H_0
OMXS Telecommunication Services	4,8	5,7	Accept H_0

Six of the models accept the null hypotheses which imply that the added variables do not give enough additional explanatory influence of dependent variable. OMXS Diversified Financials have the highest observed F-value relative to the critical F-value which indicates that the unrestricted model has a larger explanatory power of the dependent variable than the restricted model. OMXS Retailing has the lowest observed F-value of 6,1 relative the critical F-value of 3,7 but still rejects the null hypothesis.

8. Regression model testing

In this section we will test the reliability of the models output with help of different statistical tests that can indicate common statistical issues, i.e heteroscedasticity, multicollinearity and autocorrelation. We will also test the robustness of our models.

8.1 Heteroscedasticity

Conducting a regression analysis of the data, two assumptions among others must be made according to Edlund (1997):

- The error term's variance is constant
- The error term's variance is independent from the other variables

When the assumptions are satisfied the regression is seen as homoscedastic, otherwise it is referred to as heteroscedastic. If the error term is heteroscedastic the results of the regression cannot be seen as reliable (Gujarati, 2003). There are several methods to identify heteroscedasticity e.g. *Parks test, Glejsers test* and *Whites test*. Whites test is chosen which according to Gujarati (2003) is easy to perform and doesn't rely on the normality assumption in order to test whether the data is homoscedastic or not. This gives the following hypothesis:

H_0 = The error term is homoscedastic H_1= The error term is not homoscedastic

We begin with estimating the regression model where the unstandardized residuals are saved. The square of the residuals are then calculated and used as dependent variables in a new regression model. In the new model the regressors are the squared independent variables and the original independent variables as well as the cross products between the independent variables.

Taking the OMXS Commercial/Professional Services (COMPF) model as an example, the procedure is the following:

1) Starting regression model:

$$r_i^{\text{ComProf}} = \beta_1 + \beta_2 r_t^{S\&P500} + \beta_3 r_{t-3}^{S\&P500} + \beta_4 r_{t-2}^{\text{Electricity}} + u_i$$

2) The estimated regression model with the added squared independent variables and cross products:

$$\hat{u}_i^2 = \alpha_1 + \alpha_2\, r_t^{S\&P500} + \alpha_3\, r_{t-3}^{S\&P500} + \alpha_4\, r_{t-2}^{\text{Electricity}} + \alpha_5 \times \left(r_t^{S\&P500}\right)^2 + \alpha_6 \times \left(r_{t-3}^{S\&P500}\right)^2 + \alpha_7 \times \left(r_{t-2}^{\text{Electricity}}\right)^2 + \alpha_8 \times r_t^{S\&P500} \times r_{t-3}^{S\&P500} + \alpha_9 \times r_t^{S\&P500} \times r_{t-2}^{\text{Electricity}} + \alpha_{10} \times r_{t-3}^{S\&P500} \times r_{t-2}^{\text{Electricity}} + v_i$$

This is a chi squared distribution and under the null hypothesis the R^2 value is asymptotic and degrees of freedom (df) are determined by the number of regressors except the constant variable (df=regressors-1). The χ^2_{OBS} value is obtained through the following calculation, $\chi^2_{OBS} = n \times R^2$ where "n" equals sample size.

The observed result is thereafter compared to the critical value from the chi squared table with degrees of freedom equal to the number of regressors in the original regression minus one. The decision rule is to reject the null hypothesis if the observed value is larger than the critical (Edlund, 1997):

$$\chi^2_{OBS} > \chi^2_{CRIT}$$

3) We continue the example with OMXS Commercial/Professional Services as the dependent variable, where we had a sample size of 156 and an R^2 of 0,089 which gives the following observed value:

$$\chi^2_{OBS} = n \times R^2 = 156 \times 0{,}089 = 13{,}88$$

4) Using 10 coefficients in the model, results in 9 degrees of freedom[8] and hence the critical value at a 5% significance level is:

$$\chi^2_{CRIT} = 16{,}92$$

5) Since $\chi^2_{OBS} = 13{,}88 < 16{,}92 = \chi^2_{CRIT}$ the null hypothesis cannot be rejected in this specific case.

When conducting the above procedure for the final models we retrieve the following results at a 5% significant level:

Table XVIII

In this table we present the results from Whites general test performed on all final models. The highlighted fields indicate which models that were rejected at a 5% significance level.

Model	Chi-square$_{obs}$	Chi-square$_{crit}$
OMXS Auto and Components	19,50	23,69
OMXS Commercial/Professional Services	13,88	16,92
OMXS Consolidated Durables and Apparel	10,73	23,69
OMXS Diversified Financials	43,68	40,11
OMXS Energy	7,02	16,92
OMXS Food, Beverages and Tobacco	14,51	23,69
OMXS Media	51,01	16,90
OMXS Retailing	23,24	23,69
OMXS Software and Services	34,94	48,60
OMXS Technology Hardware and Equipment	4,52	31,41
OMXS Telecommunication Services	13,26	23,69

We can see from the table that the null hypothesis for OMXS Media and OMXS Diverse Financials are rejected, due to an observed chi-square value greater than the critical value, which is an indication of heteroscedasticity in the data. It is possible to decrease the effect of heteroscedasticity through the use of weighted least squares (WLS) according to Professor Edlund. WLS can be used in a linear regression model in order to give observations with less variability a greater weight in determining the coefficients of the regression (Gujarati, 2003).

[8] Number of regressors in original regression minus one: 10-1=9

Which observation that should be used to determine the best weight for the data has been determined through a visual comparison. We set the standardized residuals on the y-axel and standardized predicted values at the X-axel which was compared against a graph for each independent variable (X-axel) and standardized residuals (Y-axel) of the model. The independent variable that turned out to be most similar to the overall model's graph was chosen as the weight variable in the weight estimation procedure in SPSS (Edlund, 1997). After WLS the heteroscedastic relationship was decreased which could be observed visually in a graph where the unstandardized predicted values (X) and the unstandardized residuals (Y) were transformed with the new weight variable.[9]

8.2 Multicollinearity

When two or several explanatory variables have a perfect linear relationship, collinearity between the variables prevails. Depending on the strength of the correlation between the variables it can be impossible to distinguish the specific effect a variable have on the dependent variable (Gujarati, 2003). The consequence of multicollinearity is hence that the coefficients in F-test and t-test do not become significantly separated from zero (Edlund, 1997). In order to get an indication of multicollinearity the following tests have been performed:

- From the correlation table in SPSS the simple correlation among the independent variables were examined. An absolute value of the correlation higher than 0,8 or several correlations larger than 0,5 would indicate multicollinearity (Edlund, 1997).

  The results of the Pearson correlation has been studied and it indicates that multicollinearity do not prevail in the data since none is near the 0,8 level and we don't have several correlation values within a specific model above 0,5.
- The partial correlations that was retrieved from SPSS do not either indicate any collinearity.
- It is also possible to see indications of multicollinearity on the variance inflation factor (VIF). The variance inflation factor is calculated from the tolerance value which estimates how much of a specific variable's variance that is unique. The relationship between VIF and tolerance value is shown below (Edlund, 1997):

$$Tolerance = 1 - R_i^2$$

[9] PASW, Tutorial

$$VIF = \frac{1}{Tolerance}$$

Values of VIF around 10 indicate strong collinearity between variables. The result of VIF from the models can be seen below:

Table XIX

In this table we present the results from regressions where the variance inflation factors (VIF) are studied for all final models.

	VIF	
Model	**Min**	**Max**
OMXS Auto and Components	1,01	1,05
OMXS Commercial/Professional Services	1,00	1,01
OMXS Consolidated Durables and Apparel	1,01	1,02
OMXS Diversified Financials	1,04	1,25
OMXS Energy	1,01	1,03
OMXS Food, Beverages and Tobacco	1,03	1,07
OMXS Media	1,01	1,02
OMXS Retailing	1,01	1,04
OMXS Software and Services	1,05	1,62
OMXS Technology Hardware and Equipment	1,01	1,03
OMXS Telecommunication Services	1,03	1,13

From the table it can clearly be stated that no variable in the models have values near 10 which is a sign of that multicollinearity do not prevail.

- We have also studied the conditional index which is the square root of the maximum eigenvalue divided by each variables eigenvalue as stated below (Gujarati, 2003):

$$CI_i = \sqrt{\frac{eigenvalue_{max}}{eigenvalue_i}}$$

Eigenvalues are calculated in SPSS and can be derived from the correlation matrix. Conditional index values between 10 and 30 indicate multicollinearity and values above 30 is a strong indication (Edlund, 1997). Our output of the models have a largest value of 4,7 in the conditional index which suggest no collinearity.

The above tests indicate that we do not have multicollinearity within our models.

8.3 Auto correlation

In order to obtain correct output from- the regression a necessary assumption to make is that the error term is not correlated at a specific point of time with another error term at another point of time (Gujarati, 2003).

$$E(u_i u_j) = 0, \qquad i \neq j$$

If this assumption doesn't hold we would have a problem referred to as autocorrelation according to Gujarati (2003).

$$E(u_i u_j) \neq 0, \qquad i \neq j$$

It is possible to examine the first degree of autocorrelation with the Durbin-Watsons test provided that the model doesn't include any lagged dependent variables, lack observations, have fixed x-variables and intercept. The Durbin-Watson measure (d) is calculated as below (Gujarati, 2003):

$$d = \frac{\sum_{t=1}^{t=n} (\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{t=n} \hat{u}_t^2}$$

The Durbin-Watson test can vary between zero and four where values near two indicates uncorrelated residuals, whereas values below two suggest a positive autocorrelation and values above indicates a negative autocorrelation (Gujarati, 2003).

The result from the models indicates that the error terms aren't auto correlated since all values are close to 2.

8.4 Robust test

There are several tests to perform in order to further secure the reliability of the data. We have chosen to test how robust our results are. Cook's distance test can be used to see how influential an observation is by comparing it with the means of the dependent and independent variables. Data points that have test values over one are identified and are recommended to be further investigated according to (Garson 2009b).

Table XX

In this table we present the results from Cook's distance test.

Model	Max value
OMXS Auto and Components	0,13
OMXS Commercial/Professional Services	0,21
OMXS Consolidated Durables and Apparel	0,06
OMXS Diversified Financials	0,14
OMXS Energy	0,09
OMXS Food, Beverages and Tobacco	0,12
OMXS Media	0,47
OMXS Retailing	0,09
OMXS Software and Services	0,11
OMXS Technology Hardware and Equipment	0,11
OMXS Telecommunication Services	0,08

The result from the table indicates that we do not have problems with outliers in the data. The highest test value in the dataset is in media which is 0,47 (0,47<1) and should therefore don't be a problem.

9. Analysis

In the section below we intend to discuss the findings from our regression models and interpret the result with regards to the theoretical framework as well as former studies. The discussion is divided between the hypothesis A) and B).

9.1 Hypothesis A

H_0: Energy price changes have no significant impact on the stock market

H_1: Energy price changes have a significant impact on the stock market

In our first hypothesis we tested whether energy prices had a significant effect on stock returns for a wide range of sector indices in Sweden. The first step was to perform an initial regression, where each sector index (dependent variable) was tested against the spot prices of oil, coal and electricity (independent variables). The results gave an indication of the final outcome; if H_0 would be rejected or not. All sector indices had significant energy variables, except OMXS Pharmaceutical and Biotechnology, implying no relationship between energy prices and the specific sector index.

The second step was to add control variables described in the data section, as well as significant time lags for each independent variable in order to improve the explanatory strength of the model. Variables that proved to be significant were included in the final model. Sector indices without any significant energy variable after adding the control variables were excluded.

From the final regression we conclude the null hypothesis can be rejected for a major part of the sector indices, which proofs energy price changes have a significant impact on the stock market. However the beta coefficients are in many models close to zero indicating a weak relationship, but this will be discussed further below.

The conducted F-test on the final models resulted in an even less rejection of the null hypothesis among the sector indices which implies that the energy variables gave a too small explanatory power after the control variables being added. The only models where H_0 were rejected were OMXS Diversified Financials, OMXS Energy, OMXS Media, OMXS Retailing and OMXS Software and Services. These five models represent the models with the highest significant energy variable beta coefficient.

The sectors where the null hypothesis were not rejected constituted of (in addition to OMXS Pharmaceutical/Biotechnology, that was removed in the first step); OMXS Real Estate, OMXS Transportation and OMXS Consumer Services. The acceptance of H_0 implies that the sector is negligible energy intensive so the associated costs are insignificant or the increased operational cost can be compensated with an increased price towards customers. This would keep NOPLAT unchanged, which in turn result in an unaffected FCF and hence the valuation is neither affected. Consequently the question is how companies manage to transfer an increased energy price to the customers. The possibility to increase the prices could be related to the specific market characteristics. In order for companies to be able to dynamically change prices to match the energy costs it facilitate if the product isn't standardized, but asymmetric information between the buyer and seller prevails. This situation would enable companies to price discriminate when selling their products. An example is the transportation sector, where contracts are unique for every transaction. This makes it possible to adjust the prices accordingly to current energy prices and hence the companies within the sector will not see a declining ROIC as a result from increased energy prices. Another aspect is that defensive industries tend not to be as affected as many other sectors to macro economical fluctuations, i.e. Pharmaceutical/Biotechnology since the demand for medicine is fairly constant over time, regardless of macro economical factors. This is the opposite of OMXS Real Estate who proved to be mainly affected by the changes in interest rates.

9.2 Hypothesis B

H_0: All tested indices except the "OMXS Energy" have a positive relationship with significant energy variables.

$$\beta_{Energy} = postive$$

$$\beta_{Energy}^{OMXS\,Energy} = negative$$

H_1: All tested indices except "OMXS Energy" have a negative relationship with significant energy variables.

$$\beta_{Energy} = negative$$

$$\beta_{Energy}^{OMXS\,Energy} = positive$$

As the outcome differed substantially between oil, coal and electricity, the analysis will be divided by energy commodity. E.g. there is no overall finding whether H_0 can be rejected or not since the outcome differs among the energy variables.

9.2.1 Oil

As assumed, our regressions show a positive relationship with OMXS Energy and price changes in oil, which was already indicated in the initial regression test and the cross correlation matrix. In the final model the spot price of oil had a positive beta coefficient of 0,377 with the energy index on a 5% significance level which represents the highest beta in the study. In the initial regression the R^2 was 0,189, whereas in the final model it amounted to 0,213. This proofs that energy prices has a significant impact on the stock return in OMXS Energy, since the R^2 did not increase to a large extent with the inclusion of further explanatory variables.

H_0 were also rejected with regards to OMXS Retailing, as oil had a five month lag effect, corresponding to a beta coefficient of -0,153. This was in line with the author's expectations, as changes in oil prices were predicted to have a negative impact on NOPLAT and hence decrease the FCF, if all else equal, which is in line with the findings of IMF(2000). This result also corresponds to Sadorsky (1999) and Jones and Kaul (1996) [10]findings where oil price shocks had a negative effect on the stock market.

[10] It must be noted that the previous research did not divide the market into sectors and study each individually so their results are not fully comparable.

H_0 was accepted for OMXS Telecommunication Service which consequently implies a positive beta for the oil variable of 0,16 and 0,22 respectively in accordance with Gjerde, O. and Saettem, F. (1999)[11] whom also found a positive relationship between oil prices and the stock market in Norway. However, the beta is relatively low, as well as the adjusted R^2, which indicates that the explanation power is not very strong in OMXS Telecommunication Services and hence one should not draw any strong conclusions from the result. OMXS Diversified Financials do however have a relatively high adjusted R^2 and beta coefficient, with regards to oil. An explanation could be that the companies represented in the sector operate within the financial markets, where they provide loan opportunities and support clients with risk management. Within risk management hedging of energy prices is common. Companies want to reduce their exposure towards fluctuations of oil. If the prices of oil increases, companies should be more eager to hedge their exposure which increase the trade volume and hence probably the income for companies within diversified financials. This reasoning implies that the sector would benefit from increased oil prices which is in line with the result.

Oil was not a significant variable in eleven sector indices models, which indicates that the direct effect of oil price changes on the Swedish stock market is relatively small. There could however exist an indirect effect of oil price changes on the stock market by its relationship to macro economical factors which has been shown in previous studies e.g. Burbidge and Harrison (1984), Gisser and Goodwin (1986), Miguel, Manzano and Martin-Moreno (2003) . In the four models where oil was significant it had the strongest beta coefficient relative the other energy variables in the same model.

9.2.2 Electricity

The cross-correlation matrix indicated a negative relationship between electricity and sector indices. From the initial regression we also observed an indication of a negative relationship between the sector indices and the electricity variables, except OMXS Consumer Services and OMXS Transportation whom showed an electricity variable beta close to zero, indicating that they are not affected by electricity price changes. Of all indices, electricity was only significant at a 10% level with four indices.

As all variables were added into the final models, H_0 was rejected for OMXS Energy as well as OMXS Technology Hardware and Equipment, OMXS Consumer services, OMXS Consolidated Durables and Apparel, OMXS Retailing, OMXS Diversified Financials and

[11] It must be noted that the previous research did not divide the market into sectors and study each individually so their results are not fully comparable.

OMXS Commercial Professionals. H_0 was accepted for OMXS Auto and Components. However the beta coefficients are close to zero in all models and hence indicate a low influence of electricity on the sector indices. It is plausible that the signs of the beta coefficients rather are a coincidence than evidence of a positive or negative relationship. The relationship was expected to be stronger as the use of electricity is crucial to all companies in their day to day business. One reason for the lack of evident relationship might be that companies actively hedge their electricity exposure. Hedging give the company time to react to sudden price changes and hence if needed, time to increase the price to the customers in order to match the increased energy costs. The impact on operational costs would then not be affected to the same extent to changes in electricity prices.

The findings imply that stock market return in Sweden is not affected by changes in electricity prices. The operational costs only changes marginally and hence the NOPLAT is not affected. This result in an unchanged FCF and valuation of the company and in addition ROIC will remain at the same level.

9.2.3 Coal

The initial regression demonstrated a positive relationship with each sector index at 5% significance level, except with OMXS Retailing and OMXS Pharmaceutical/Biotechnology where it was not significant. The level of correlation was also well above our expectations. From the correlation matrix we observe the same indication, that we cannot reject $H_{0,}$ though OMXS Energy indicated a positive correlation and hence the null hypothesis would be accepted for the sector, but as all variables were included, coal was no longer significant.

As we added the remaining control variables and the lagged variables, coal was excluded from most models as it no longer was significant. The remaining models where it was significant were OMXS Food, Beverage and Tobacco, OMXS Media, OMXS Software and Services, OMXS Telecommunication Services and OMXS Diversified financials. OMXS Food, Beverage and Tobacco index was the only index where H_0 was rejected as the beta coefficient was negative. However the coefficient was very close to zero indicating that no significant relationship prevails. A much stronger relationship was observed in the final model of OMXS Media, where the beta coefficient corresponded to 0,305. OMXS Software and Services had two coal variables in the model as both the spot price and one month lag was included, where the beta coefficients corresponded to 0,234 and 0,153 respectively. Also OMXS Diversified financials had an immediate response as well as a one month delay to changes in the coal price, though the one month lag beta coefficient was very close to zero which implies that one should be conservative in making a conclusion of the relationship. In OMXS Telecommunication Services the beta coefficient amounted to 0,124. The findings indicate that in the above sectors where the relationship was significantly separated from zero, an increased price of coal would increase the stock return. This implies that the sectors can benefit from the price increases and increase NOPLAT and FCF as a result, as well as ROIC.

However, since the strongest relationship was found with the Media sector, the authors are hesitant in drawing any conclusions from the findings of coal. The results are affected to a large extent of the distributor of the coal price index, hence one factor of uncertainty is whether Richard bay coal is appropriate as a reflection of the coal price for the Swedish market. An odd result was already observed in the initial regression as each sector index had a significant relationship with coal on a 5% significance level.

10. Conclusion

The purpose of the paper has been to examine the relationship between energy prices and the Swedish stock market for investors who would like to profit from changes in energy prices or manage their risk within their portfolio, with regards to fluctuations in energy prices. We tested two hypothesis, where the first examined if energy prices had an effect on the stock market or not, whereas the second tested the assumption whether all indices but energy had a negative relationship with the energy prices. The discussions have been taken from a FCF valuation approach, e.g. how the changes in energy prices affect NOPLAT and hence the FCF. The hypothesis has been tested on aggregated data from the period of 1996-01-15 to 2009-07-15.

From the regression we can draw the conclusion that the impact from changes in energy prices is different between oil, coal and electricity. The latter can to a slight extent explain changes in the stock market, whereas oil has a significant relationship with OMXS Retailing and OMXS Energy. Also coal is found being able to explain changes in stock return for the sectors OMXS Media, OMXS Telecommunication Services and OMXS Software and services, but discussions has been made as to whether the relationship is reliable.

Previous research of oil has found both significant relationship with the stock market and not; Driesprong et al (2005) found a relationship whereas Chen et al (1986) did not. We found a relationship between oil and stock market However research between the stock market and electricity/coal has not been examined to the same extent, hence we cannot compare our result with previous research.

Finally, the conclusion of our thesis is that the impact energy prices have on the stock market is limited, as it is only statistically significant on a few number of sector indices.

10.1 Potential generalization

As previously stated the study has been performed on the OMX Stockholm exchange, divided by the sector after GICS. The delimitation of time period, 1996-01-15 to 2009-07-15, was chosen as this was the longest data series existing for all indices. Because of these delimitations we do not view the result as representative for other exchanges.

Sadorsky (1999) found that the oil effects are asymmetric as the effect from oil price changes is inconsistent pre 1986 and post 1986, since he found that changes pre 1986 was able to explain future error variance in real stock returns, whereas post 1986 decreasing oil price changes could not explain to the same extent. Hence we are conservative in saying that the result could be representative for other time periods.

The result may also differ with regards to the chosen market of study. Kaneko and Lee (1995) found a significant relationship between oil price changes and the Japanese stock market, whereas a relationship was not found for the US market. In addition the result may be affected as to whether the country of study is a net importer or exporter of energy resources.

The generalization of the findings is therefore considered limited, e.g. it is not considered appropriate to apply the findings on other stock exchanges or time periods. However even as the results may not be applicable on other populations we can still draw the following conclusion for the examined market and time period: *Changes in energy prices has a limited direct impact on the stock return at the OMX Stockholm exchange.*

10.2 Reliability

The method that has been used by the authors has been clearly described and all data has been checked several times for errors, hence we consider the quality of the raw data to be good. With regards to this we consider it simple to replicate the study and end with the same result.

11. Suggestions to further research

Since the impact oil prices have on the stock market has been examined by many researchers, we would suggest further research on the impact coal and electricity have. One could study the difference between coal exporting and importing countries with regards to impact on stock market.

An interesting approach to the area would also be to study the impact of price shocks in each energy variable to stock market. One could also examine further the difference between firms with market power and not by performing a case study.

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12.3 Interviews

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Kopfer, C., Financial Analyst, Nordea Markets, 2009-11-11

13. Appendix

Table XXI

In this table we have summarized the findings of the final model regression sorted after the energy variable.

Oil			Electricity			Coal		
Sector index	**Lag**	**β**	**Sector index**	**Lag**	**β**	**Sector index**	**Lag**	**β**
OMXS Energy	t	0,38	OMXS Energy	(t-5)	0,09	OMXS Media	t	0,31
OMXS Diversified Financials	(t-6)	0,22	OMXS Technology Hardware and Equipment	(t-2)	-0,07	OMXS Software and Services	t; (t-1)	0,234; 0,153
OMXS Telecommunication Services	(t-6)	0,16	OMXS Software and Services	(t-2)	-0,07	OMXS Diversified Financials	t; (t-1)	0,179; 0,096
OMXS Retailing	(t-5)	-0,15	OMXS Consolidated Durables and Apparel	(t-3)	-0,06	OMXS Telecommunication Services	t	0,12
OMXS Auto and Components		N.S	OMXS Retailing	t	-0,06	OMXS Food, Beverages and Tobacco	(t-2)	-0,08
OMXS Commercial/Professional Services		N.S	OMXS Auto and Components	(t-5)	0,05	OMXS Auto and Components		N.S
OMXS Consolidated Durables and Apparel		N.S	OMXS Diversified Financials	(t-2); (t-3)	-0,044; -0,043	OMXS Commercial/Professional Services		N.S
OMXS Consumer Services		N.S	OMXS Commercial/Professional Services	(t-2)	-0,04	OMXS Consolidated Durables and Apparel		N.S
OMXS Food, Beverages and Tobacco		N.S	OMXS Consumer Services		N.S	OMXS Consumer Services		N.S
OMXS Media		N.S	OMXS Food, Beverages and Tobacco		N.S	OMXS Energy		N.S
OMXS Pharmaceuticals/Biotechnology		N.S	OMXS Media		N.S	OMXS Pharmaceuticals/Biotechnology		N.S
OMXS Real Estate		N.S	OMXS Pharmaceuticals/Biotechnology		N.S	OMXS Real Estate		N.S
OMXS Software and Services		N.S	OMXS Real Estate		N.S	OMXS Retailing		N.S
OMXS Technology Hardware and Equipment		N.S	OMXS Telecommunication Services		N.S	OMXS Technology Hardware and Equipment		N.S
OMXS Transportation		N.S	OMXS Transportation		N.S	OMXS Transportation		N.S

Table XXII

In this table we show the development of the indices since 1996-01-15 to 2009-07-15 (indexed values)

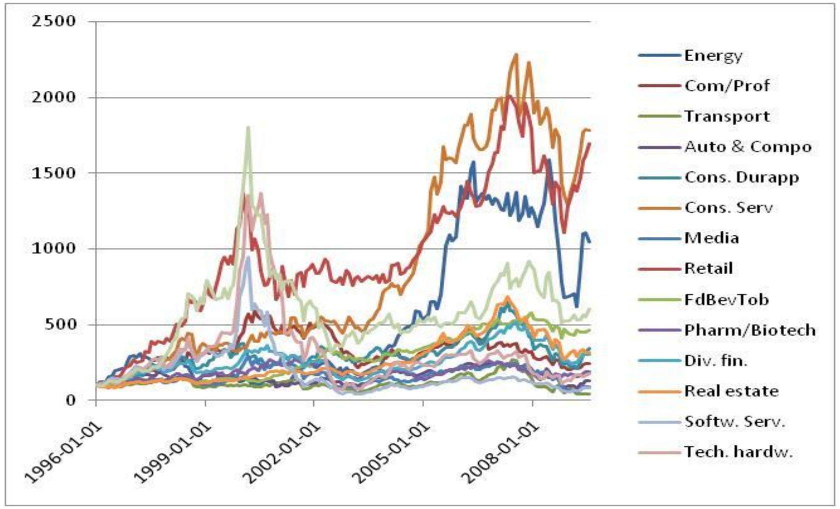

Table XXIII

In this table we show the development of the energy variables since 1996-01-15 to 2009-07-15 (indexed values)