

ERASMUS UNIVERSITY ROTTERDAM

ERASMUS SCHOOL OF ECONOMICS

MSc Economics & Business

Master specialisation program Financial Economics



# The influence of commodity prices on the Dutch stock market

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*A study into the relationship between changing commodity prices and sector specific stock index returns*

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Finish date: June 2012

## **Abstract**

In this paper a possible relationship between changing commodity prices and the returns of the AEX Index divided into sectors is investigated for the period between March 2001 and December 2010.

This study uses OLS-regressions to investigate the influence of commodities and control variables on the Dutch AEX Index. The full-sample OLS-regressions showed several significant results. The energy- and agriculture-related commodities showed a highly significant relationship with the sectors Oil & Gas and Consumer Goods and Services, where copper showed a positive significant relationship with the sector incorporating mining companies (Basic Materials). The gold price has a significant negative relationship with several sectors. Adding other commodities to the regressions does not change the significance of the commodities which were significant in the initial regressions. Several control variables were added to capture other events with influence on the AEX sector returns. The stock index returns of other countries with large economic power show a highly significant relationship with the returns of the AEX sector indices.

Without the effect of the current financial crisis, the agriculture-related commodities lose their significance, but the energy-related commodities stay significant. The effect of other foreign stock market returns on the Dutch market remains highly significant and positive, indicating the interrelation of the economies around the world.

This paper shows conclusions which are valuable for commodity-related investment opportunities in the Dutch market.

**KEYWORDS:** Commodities, AEX sectors, Domestic influence, Foreign influence

## **Acknowledgements**

The writing process of this thesis turned out to be a period in which I encountered several problems which were not easy to overcome. Nevertheless this final period of my study has proven to be very informative and was the next step in becoming the person I want to be. I could never have achieved this without the help of some very important persons which I would like to thank in this short paragraph. First of all, my thesis supervisor Mr. Vadym Volosovych who supported me through this researching period. He provided essential information and has played a big role in the process which resulted in this paper. I would like to thank him for his vital support and valuable feedback. Furthermore I would like to thank my parents and brother whom created a perfect place to study and always supported me in good times and bad.

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## 1. Introduction

Commodities are becoming overly important in the modern global economy due to a growing world population so that demand for products and food rises. Data from the World Bank shows China hosts over 20% of the world population, where India hosts 18%. More than half of the world's population lives in Asia. The facts that there are so many people in this part of the world and that their economy is experiencing explosive growth creates an all-time high demand for commodity-related products. Because of this higher demand, manufacturers need more basic products such as commodities to fulfill the demand. International trade is one of the factors that make commodity trading easier than it was used to be. The same applies for the speed of trading nowadays. Oil transferred in a tanker from the Middle-East to Europe is traded several times during its journey. Commodities are also used as a diversification investment object by investors, what creates large trading opportunities in the global financial world.

So commodities are not used solely for manufacturing or food processing anymore. The profitability of companies relying more on commodities than before, so a relationship between commodities and companies is not far astray. This paper investigates that possible relationship between commodity prices and the 25 largest companies traded on the Dutch stock exchange and included in the main Dutch stock index, the AEX. The Dutch economy is considered to be a very open one. Dutch import and export equal respectively 62% and 69% of GDP in 2011 according to Statistics Netherlands (CBS). An open economy results in dependence on international trade. The Netherlands is often used as a "hub" for trade. Lots of goods are imported and exported nearly unprocessed; approximately 50% of total exports belong to this category according to Statistics Netherlands. This country has a good infrastructure and facilities for the enormous amounts of goods traded. The port of Rotterdam is the largest in Europe; 430 million tons of goods were processed here in 2010 according to the CBS. The region also includes Europe's largest industrial area according to Port of Rotterdam. Economically this area is significant for the Dutch; over 200.000 people work in this harbor alone. The most frequently traded goods are commodities and industrial goods such as crude oil and chemicals. Furthermore also cargo transshipment is very important. Besides the amounts of goods the companies around the port of Rotterdam demand, also foreign demand is high. There is a direct railroad available between Rotterdam and the German Ruhr-area since 2000, another large West-European industrial area. Next to this railroad, the normal road (trucks) and rivers (Meuse & Rhine) provide the port of Rotterdam excellent access to the backland. Commodities are important in international trade. The value of only crude oil imported by the Dutch equaled 5% of GDP in 2010 according to Statistics Netherlands. The Netherlands appeared to be the world's number two

exporter of agricultural goods and number three when it comes to natural gas. So rising or falling commodity prices might have influence on the stock value of Dutch companies.

For this study the AEX Index is divided into eight sectors identified by the Industry Classification Benchmark (IBC) so that conclusions can be based industry specific. Companies can react differently on changes in commodity prices due to buying or selling activities; commodity-selling companies will benefit from higher commodity prices where commodity-buying companies will suffer. Therefore analyzing the results per sector will be more satisfactory than using the AEX as a whole. Furthermore this paper uses six commodities, which are:

- Copper
- (Natural) Gas
- Gold
- Oil
- Soy
- Wheat

In this study Copper represents the need for metals for industrial purposes including construction. Gas and Oil are both important energy-related commodities. Where oil is imported and used in production processes or trade, natural gas is extracted domestically and used for trade, consumption and production processes. Gold is an interesting investment commodity in times of financial turmoil. Soy and Wheat represent the important agricultural sector for the Netherlands.

Next to these commodities, seven control variables are used to account for other significant events that influence stock prices. The control variables are:

- GDP-Growth
- Market Capitalization as % of GDP
- Domestic credit provided to private sector by banks as % of GDP
- Short term interest rate
- Returns of foreign stock indices

The GDP-growth is an indicator of economic growth. Market capitalization as % of GDP is used in this study to make the size of the market visible, and investigate whether a growing market creates value for companies. Domestic credit provided to private sector by banks as % of GDP is used as a proxy for banking performance, as the financial sector is important for the Netherlands. Short term interest rate is used to see the influence of policy controls on the returns of stock indices. Returns of foreign stock indices are used to indicate the interdependence between markets globally.

The regressions used in this research try to explain the change in return of an AEX sector with changes in commodity prices and in the control variables. The results of this research can be relevant for investors in the Dutch stock market. They can benefit from the knowledge of a possible relationship between Dutch stock prices and commodity prices.

The central research question that is answered during this study is the following:

**Is there an identifiable relationship between changing commodity prices and the sector specific returns of the AEX Index?**

The results of the OLS-regressions show some familiar results. Oil-producing companies benefit from higher oil prices where other sectors are suffering due to rising costs. Higher prices for agricultural commodities result in higher production prices for consumer-related companies. The performance of foreign stock indices is highly significant for the Dutch stock index performance; all sectors show positive and significant coefficients in every regression.

The structure of this paper is as follows. The next section reviews the relevant existing literature. In section 3 the used data is described and motivated. Section 4 includes the methodology for this research, while section 5 covers the results. In section 6 a robustness test is performed and Section 7 concludes the total.

## 2. Literature Review

In this section the existing literature available with respect to the research topic will be reviewed. Other authors have already done research to the relationship between commodity prices and financial markets in several countries. Chong & Miffre (2009) collected data on 25 commodities in several categories and 13 stock- and fixed income markets. Their study showed positive and significant correlations between several commodity prices and performance of stock- and fixed income markets. However, during heavily volatile times, correlations fell.

Driesprong, Jacobsen & Maat (2007) created an oil-price-based investment strategy. They showed that, even with 0.5% switching costs between stocks and a risk free asset, their strategy would still be profitable. With this study they provided the academic world with evidence of oil prices having influence on the forecast of stock returns.

Commodities are also a good diversification object for portfolio managers. Jensen, Johnson & Mercer (2002) have found that adding commodity related investment objects to a portfolio enhances performance. This creates a possible link between commodities and the stock market.

According to the World Bank's Global Commodity Outlook (2012) the prices of commodities are dependent on consumption and political influences. Both influence the demand for commodities which influence the price. Hamilton (1983) concludes recessions in the United States were preceded by large increases in crude oil prices. Oil prices contribute to the forecast of real GNP according to this study, due to the use of this commodity in production processes. According to the World Bank (Development Prospects Group, Mitchell 2008) the rise of food prices is mainly caused by the production of biofuels out of grain and oilseeds. This method of production rapidly declined stocks of grain resulting in higher grain prices and thus food prices. This literature concludes commodities are also important for the cost of production of commodity-related companies.

Based on the above described papers, there could be a relationship between commodity prices and the Dutch stock market. However, commodity prices are not the only variable that moves the stock markets. Chen, Roll & Ross (1986) conclude that stock returns are exposed to systematic economic news. There is a large number of respected papers available in which the authors tried to find variables that have predicting power when it comes to stock prices. Fama & Schwert (1977), Campbell (1987), Breen, Glosten & Jagannathan (1989), Ang & Bekaert (2007) and the 1989 World Development Report by the World Bank all conclude the short-term interest rate has got a significant influence on the stock markets. Lower interest rate means people and institutional investors look for



other opportunities to make money instead of saving the money. On the other hand it becomes cheaper for companies to borrow money, creating more investments and added value for the company resulting in higher future returns.

Levine & Zervos (1998) came with evidence in favor of financial control variables to predict the stock market. According to them, a lot of researchers take the market capitalization ratio (market capitalization divided by GDP) as an indication of market development. An indicator for the performance of the, for the Netherlands, important banking sector is the “Domestic credit to private sector provided by banks as % of GDP” as suggested by the World Bank (Beck, Demirgüç-Kunt and Levine, 2000). This variable shows the amount of money (as % of GDP) that has been provided to the private sector by banks other than central banks.

Campbell & Diebold (2007) suggest also GDP-growth has an influence on the stock market. A country with a healthy and growing economy should have a good investor’s climate too.

Available literature states financial markets are interdependent on each other. Berben & Jansen (2005) find correlations between the world’s most important financial markets have been rising during last decennia. Forbes & Rigobon (2002) conclude financial markets are globally interdependent resulting in same-sign changes in stock index performances because of high and positive correlations. Shocks in foreign financial markets have influence on domestic financial markets.

## 3. Data

This section describes the data involved in this research, divided into three main parts (AEX Index, Commodities and Control Variables).

### 3.1 AEX Index

The AEX Index is the most important Dutch stock index and contains the shares of the 25 Dutch companies with the largest market capitalization. This index was founded in 1983 as the EOE-index (European Options Exchange) and incorporated 13 companies. Since 1990 the index contains the 25 companies as stated above and is called AEX since 1994. A table containing the current composition of the AEX Index and its ICB-classification can be found in Appendix A.

For this research I used the sector decomposition of the AEX instead of using the AEX Index as a whole. In this way I am able to draw conclusions industry specific resulting in a more detailed explanation of influences by both commodity prices and changing values of the control variables. According to Appendix A, the AEX Index can currently be divided into 8 different sectors. These sectors are:

- Basic Materials
- Consumer Goods
- Consumer Services
- Financials
- Industrials
- Oil & Gas
- Technology
- Telecom

The levels of the sector indices are calculated as a total return index. This way of calculating assumes that for example dividends are directly reinvested into the company. This gives a more complete picture of the real performances of the companies included in the index. The difference between the price index and the total return index can be large, depending on cash payouts such as dividends. According to NASDAQ, total return index values include reinvestment of all cash distributions of index members on the ex-date. In this way, cash payments such as dividends are still incorporated within the company which can use this money for further investment to create value. The total return index is generally seen as a more accurate measure of index performance compared with the

“normal” price index measure. The data for AEX sectors is downloaded with a monthly frequency directly from Thomson DataStream.

The next step is to calculate monthly return per index. This has been done according to the following basic formula:

$$\frac{(X_t - X_{t-1})}{X_{t-1}}$$

Where X stands for the value of the total return index and t stands for a moment in time. Results from this formula are normally between -1 and 1, where these two values indicate a 100% gain or loss over the last month.

The data for the sectors are Winsorized at the 1%-level. Winsorizing is a technique that reduces the extreme influence of outliers without omitting them. The values outside the 1-99% interval are replaced with the last values included in the interval. Due to this technique, the outliers are still used in the analysis, but not in their original extreme form. The data is only Winsorized for the full sample tests because this sample period incorporates the global financial crisis.

The illustration below shows the descriptive statistics of the Winsorized AEX data for all sectors.

**Table 1: Descriptive statistics sectors AEX-Index**

	Basic Materials	Consumer Goods	Consumer Services	Financials	Industrials	Oil & Gas	Technology	Telecom	AEX Total Return
<b>Mean</b>	0,008	0,006	0,002	-0,002	0,005	0,004	-0,002	0,001	0,000
<b>Median</b>	0,014	0,012	0,008	0,006	0,004	0,012	0,002	0,002	0,009
<b>Maximum</b>	0,293	0,131	0,096	0,252	0,242	0,157	0,438	0,124	0,132
<b>Minimum</b>	-0,322	-0,135	-0,186	-0,393	-0,278	-0,219	-0,367	-0,213	-0,221
<b>Std. Dev.</b>	0,096	0,051	0,054	0,099	0,097	0,064	0,124	0,066	0,068
<b>Skewness</b>	-0,600	-0,457	-0,718	-0,721	-0,231	-0,524	0,159	-0,452	-0,806
<b>Kurtosis</b>	4,578	3,787	3,493	5,345	3,559	3,713	4,108	2,931	3,801
<b>Jarque-Bera Probability</b>	19,319	7,156	11,346	37,255	2,587	7,896	6,537	4,048	15,916
<b>Observations</b>	118	118	118	118	118	118	118	118	118

Data is collected from the 1<sup>st</sup> of February 2001 until the 1<sup>st</sup> of December 2010. Because the return is calculated according to the formula above, the first observation is only used for the calculation of return in the next month. Therefore the number of observations sums up to 118. The standard null-hypothesis for normal distribution can be rejected for the total AEX-index and every sector except

Industrials at the 5%-level. The negative skewness results in a longer left-hand side tail compared with the right-handed tail and shows that the majority of observations have values larger than the mean value. The mean-value for the sectors Financials and Technology is actually negative. This sample includes the global financial crisis; the influence is clear. At the end of 2010 the AEX total return index is at the same level as at the start of this sample in 2001 which is due to the recent global financial crisis. The sectors Financials and Technology are also the most volatile sectors taking the standard deviation into account. The stocks of the companies in these sectors are volatile and thus more vulnerable for economic influences affecting the prospects, resulting in more risky investment opportunities. Compared with the total AEX Index, it can be concluded that the volatility of sectors is generally higher.

## 3.2 Commodities

This research investigates the possible relationship between changing commodity prices and the different sectors of the AEX Index. According to the earlier mentioned Environmental Accounts of the Netherlands, this country has got a physical trade deficit and on the other hand a monetary trade surplus. The Netherlands are importing more goods than they export in terms of weight; in terms of money this is the other way around.

Crude oil is imported frequently and turned into more refined (and thus more expensive) products, creating a monetary trade surplus. Domestically extracted natural gas also plays a large role in this surplus, because the country is the world's number three exporter of this commodity. According to the Dutch Input-Output table (IOT) which is annually published by the CBS, 31% of total national import consists of oil, oil related products, natural gas and chemicals.

Natural gas is also imported from foreign countries instead of using only domestically extracted gas. This is because of the properties of natural gas. Before gas can be used as a fuel, some industrial processes have to change the properties of gas and remove impurities. Natural gas extracted from the ground is not the same everywhere. The main difference is the amount of nitrogen in the gas. More nitrogen in the gas means less heat when it is combusted. This makes low-caloric gas (Dutch gas with higher levels of nitrogen when compared with gas from other countries) not suitable for all purposes. This opens the international market for natural gas with different properties. The Netherlands occupies the 3<sup>rd</sup> place when it comes to export of natural gas; an economic relation between energy commodities and the financial markets of this country is plausible.

In the world of agricultural products the Netherlands is also a large player. Using high-tech working methods which create advantages to other producers, the country is the largest exporter of agricultural products after the United States. In this business other countries are trying hard to close the gap with the leading exporters. The sector therefore needs help from the government to stay ahead. The national government realizes the domestic value of this sector (Export equals €72 billion or 17.5% of GDP) and provides the demanded support. Subsidizing research for even better and more efficient ways of production and creating more demand for sustainable products are examples here. In this research soy and wheat are the commodities that represent the agricultural sector. Soy is used in all kinds of consumer products; around 70% of the products in the supermarket contain soy. Although this particular commodity is not produced domestically, it is used in a lot of products and by many companies. According to the Dutch government, wheat is the most important Dutch agricultural crop. Wheat is also used frequently for consumer goods which one can find in the supermarket. Wheat can be processed to wheat flour, which is used widely in the bakers' guild. Also wheat is processed for animal feed. There are many livestock farmers in the Netherlands who need food made out of wheat to feed their cattle.

Because of the large industrial sector of the Netherlands, a metal commodity has to be incorporated. Copper is a metal used frequently in industrial companies. This metal has some properties which make it very handfull. Copper has a high electrical conductivity which makes it more suitable for products like electrical wires, integrated circuits and printed circuit boards than for example aluminum. With ASML the Netherlands host one of the largest companies in the world involved in the chip-producing industry.

Another worldwide important commodity is gold. Gold is not specifically used more frequent in the Netherlands than in other countries, but it is seen as an interesting investment-related commodity around the globe. Gold is used frequently for diversification purposes by investors because its returns are generally independent of those on other assets (Jaffe (1989)). Also this commodity is seen as a safe haven in times of financial turmoil, keeping its value most of the time. Expectation is that gold has a negative relationship with the stock exchange; in a financial crisis the stock prices get lower, while gold prices go sky high.

Looking at the IOT again, it appears that manufacturing is the most important sector in Holland, creating a value of 12.6% of the total GDP. Second and third are the financial sector and trading sector with a percentage of respectively 5.6 and 3.9. Combined these three sectors are responsible for over 22% of the Dutch GDP. According to these figures it is clear that commodities play a role in the Dutch national economy.

Summarizing the text above, these commodities are incorporated in this research:

- Crude Oil
- Natural Gas
- Soy
- Wheat
- Copper
- Gold

Data (Spot prices) for these commodities was also downloaded from Thomson DataStream in monetary values. Once again the monthly returns are calculated with the formula:

$$\frac{(X_t - X_{t-1})}{X_{t-1}}$$

Where this time  $X$  stands for the price of a commodity and  $t$  for a certain moment in time. The results are summarized in the table below which contains the descriptive statistics for all six commodities.

**Table 2: Descriptive statistics Commodities & Components**

	Copper	Gas	Gold	Oil	Soy	Wheat	Energy	Agriculture
<b>Mean</b>	0,018	0,018	0,015	0,015	0,013	0,013	0,000	0,000
<b>Median</b>	0,012	-0,006	0,021	0,029	0,019	0,003	0,055	-0,044
<b>Maximum</b>	0,355	0,740	0,129	0,249	0,201	0,375	2,528	3,669
<b>Minimum</b>	-0,332	-0,424	-0,171	-0,399	-0,395	-0,368	-3,329	-4,310
<b>Std. Dev.</b>	0,097	0,213	0,049	0,104	0,094	0,099	1,119	1,192
<b>Skewness</b>	-0,023	0,765	-0,460	-0,660	-0,844	0,631	-0,263	-0,234
<b>Kurtosis</b>	5,201	4,132	4,216	4,638	5,321	7,341	3,143	5,347
<b>Jarque-Bera</b>	23,836	17,817	11,423	21,760	40,497	100,484	1,465	28,171
<b>Probability</b>	0,000	0,000	0,003	0,000	0,000	0,000	0,481	0,000
<b>Observations</b>	118	118	118	118	118	118	118	118

The number of observations is the same for all variables as for the sectors described in the last paragraph for the same reasons. Again the null-hypothesis for normal distribution has to be rejected at the 1% level for every commodity (except Energy). Kurtosis-values are higher than 3 (leptokurtic variables), indicating heavy tails in the distribution. Heavy tails means more “extreme” events in the data. Variables Energy and Agriculture are “virtual commodities” created out of the Oil and Gas

(Energy) or Soy and Wheat (Agriculture) series using Principal Component Analysis. In this study, this data-reducing technique combines two correlated series and creates one new series preserving most of the observed variance. More on this can be found in the Methodology part and Appendix C. The mean-values are all positive, indicating commodities became more expensive during this sample period. The standard deviations of the energy-related commodities (Oil & Gas) indicate volatile energy prices. Both the Energy and Agriculture component have a mean value of zero and a standard deviation around one. The method of Principal Component Analysis always constructs new variables with a mean of zero and standard deviation of one.

### 3.3 Control Variables

The main purpose of this research is to identify the relationship between commodities and the AEX. However there will be more factors that have an influence on the dependent variable which in this case are the sectors of the AEX. Authors and scientists have been doing research to find factors that forecast the stock market. A summary of the most important findings can be found in the literature review (section 2). The control variables used in this research are divided into three groups: Financial Control variables, Policy Control variables and Macro-Economic Control variables. This section explains why these control variables are important for the Dutch economy.

#### 3.3.1 Real Economy control variable

The development of the Dutch national Gross Domestic Product (GDP) is used in this research as a simple proxy for economic wellbeing. GDP is often used as such due to its easily quantifiable value. This measure is calculated by the following formula:

$$GDP = C + I + G + (X - M)^1$$

In this formula, “C” stands for private consumption, “I” for gross investment, “G” for government spending and  $(X - M)$  equals the trade balance or (exports – imports). The Dutch GDP measures the total value of the finished goods and services which are produced in the Netherlands and therefore has a relationship with the stock exchange. Expectations are that this relationship is positive resulting in a positive stock price change when GDP rises. Negative GDP growth indicates a difficult economic period. Companies will make less money which will result in lower stock prices. GDP tells economists whether an economy is in a recession or not. Because negative GDP growth results in negative economic prospects, the relationship between this measure and the stock exchange is expected to

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<sup>1</sup> [www.oecd.org](http://www.oecd.org)

be positive (as in same-sign changes). GDP is calculated quarterly and thus at a different interval compared with other variables. Therefore this variable is denoted as monthly quarter-on-quarter growth resulting in the same number of observations compared with other variables (118).

### 3.3.2 Financial control variables

A financial control variable incorporated in this research is the market capitalization of the Dutch stock index as percentage of GDP. This variable is calculated according to the following formula:

$$\text{Market Capitalization (\%GDP)} = \frac{(\text{Stock price} * \text{Number of Shares Outstanding})}{\text{GDP}} * 100\%^2$$

This ratio shows the size of the stock market compared with the size of the real economy. The expectation of the relationship with the sector indices is positive. A larger market means more trade which is good for the companies included.

The other financial control variable incorporated in this research is the “Domestic credit provided to the private sector by banks as percentage of GDP”-variable. This measure is seen as a proxy for the performance of the banking sector (excluding the central bank). As stated above the value of financial services is one of the most important sectors in the Dutch economy. The two variables described above are only provided annually. Because the other variables are all (except GDP) collected with a monthly interval, these measures are converted to monthly year-to-year growth resulting in the same number of observations (118).

### 3.3.3 Policy control variable

The government plays a role in the economic development of a country. The interest rate is one of the most important instruments with which a government can boost or cool down the economy. Low interest rates result in the cheap borrowing of money. Companies can easily borrow money to invest in new projects because the interest they have to pay back is low. People who want to buy a house using a mortgage do want to make this step during low interest times for the same reason. Investing money in for example the stock or fixed income market is likely to outperform the benefits of a savings account. Low interest rates therefore can help prevent economic contraction. On the other hand, when an economy grows too fast it can cause serious damage to a country. The government can therefore raise interest rates to lower the spending of companies and individuals. Borrowing becomes more expensive so companies have more reason to delay large investments and individuals

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<sup>2</sup> [www.worldbank.org](http://www.worldbank.org)



have stronger incentives to let their money rest at the bank receiving high interest instead of investing it and take more risk. In this research the independent variable “Dutch short term interest rate” is expected to have a negative relationship with the dependent variables because of the above described influences. The short term interest rates are coming from OECD.org (Organization for Economic Co-operation and Development) and covers the same sample period as the AEX sectors (118 monthly observations).

#### **3.3.4 Foreign control variable**

The United States of America forms the world’s leading economy. This country still outperforms all other countries when it comes to the value of total import and export according to the World Bank. Lots of goods coming from and going to the USA have a connection to Europe, where Rotterdam is one of the most frequently used transportation hubs. Because the USA is the world’s leading economy, its performance is overly important for the rest of the world. The most important stock index in the United States is the diversified S&P 500, including the 500 American companies with the largest market capitalization and is considered as the best indicator for the American economy.

While America is the most important economy in the world, there are other countries following and closing the gap. Of course China and India are two of these countries. But also Brazil and Russia are of growing importance for the global economy (the so-called BRIC countries). Therefore also the Morgan Stanley Capital International World Index (MSCI) is included in this research. Compared with the S&P500 this index is even more diversified including stocks from emerging and developing countries.

The most important trade partner for the Netherlands is Germany according to the CBS. In 2010 the Netherlands exported 24% of their total to Germany. On the other hand, 18% of the total value of the Dutch import is coming from their eastern neighbors. The economic relation between these two countries is very tight according to those figures. The Netherlands needs Germany and the other way around. Therefore a change in the German economic climate is valuable for the Dutch. For Germany, the most important indicator of economic performance is the DAX (Deutschen Aktienindex). The DAX includes the stocks of the 30 largest German companies and is based in Frankfurt.

All indices mentioned above are good predictors for the AEX Index. However, because they are used together in the regressions, the correlation between these international indices cannot be too high. If so, the problem of multicollinearity arises. The correlations between these indices is too high (in the 0.84 – 0.97 range) and therefore the indices may not be used in the regressions together. To

overcome this problem the Principal Component Analysis is used once again. The variable created out of these three is called Foreign Influences and replaces the S&P 500, MSCI World Index and DAX in this research. The descriptive statistics of the control variables are as follows:

**Table 3: Descriptive statistics Control Variables**

	GDP-Growth	Market cap (%GDP)	Credit by banks (%GDP)	Short term interest rate	Foreign Influences
<b>Mean</b>	0,003	0,907	0,616	0,028	0,000
<b>Median</b>	0,005	0,910	0,000	0,026	0,219
<b>Maximum</b>	0,015	1,220	1,697	0,051	4,264
<b>Minimum</b>	-0,022	0,440	0,000	0,006	-5,098
<b>Std. Dev.</b>	0,007	0,221	0,776	0,013	1,675
<b>Skewness</b>	-1,319	-0,555	0,465	0,049	-0,500
<b>Kurtosis</b>	5,772	2,835	1,235	2,027	3,669
<b>Jarque-Bera</b>	71,997	6,195	19,569	4,702	7,124
<b>Probability</b>	0,000	0,045	0,000	0,095	0,028
<b>Observations</b>	118	118	118	118	118

The number of observations once again sums up to 118 in all cases and also the null-hypothesis for normal distribution can be rejected. The ratio Market capitalization/GDP has been growing fast looking at the mean-value and the same applies for the performance of the banks. GDP experienced a small growth where the same applies for the short term interest rate. The variable Foreign Influences once again has a mean of zero due to the method of Principal Components. The standard deviation for both “Market capitalization/GDP” and “Credit provided by banks/GDP” are substantial compared with GDP-Growth and the short term interest rate. This is partly due to the frequency of the data which is annually (converted to monthly).

All correlations of the variables used in this research can be found in Appendix B.

## 4. Methodology

This section describes the methodology used to provide empirical evidence which supports the conclusions.

### 4.1 Multiple linear regression

To be able to answer the research question stated in the introduction, a relationship between commodity prices and the sectors of the AEX has to be established. This paper uses linear regression analysis to measure this relationship. The standard form of a multiple linear regression used in the paper is:

$$\text{Sector Return} = \beta_1 + \Delta\text{Commodity} + \Delta\text{Economic control variable} + \Delta\text{Financial control variables} \\ + \Delta\text{Policy control variable} + \Delta\text{Foreign control variable} + e_i$$

The formula above shows the dependent variable is the return of a sector of the AEX-Index. The first independent variable is a constant, followed by the change in commodity prices. Next the control variables are incorporated per category as described in the Data-section. The last term represents the error term. According to the standard regression form above, this is one of the regressions used in this study:

$$\Delta\text{Returns Oil \& Gas} = C + \beta_1 \text{Oil} + \beta_2 \text{GDP} + \beta_3 \text{Market cap} + \beta_4 \text{Credit by banks} + \beta_5 \text{Short Rate} + \beta_6 \text{Foreign Influences} + e_i$$

The left-hand side of the equal sign represents the index returns Oil & Gas sector, C is the Constant, and the Beta's are the coefficients that indicate the effect of the change in a commodity and/or control variable on the returns of the AEX Sector Oil & Gas. In the regression above the influence of the control variables and the commodity oil is examined.

### 4.2 HAC-Standard Errors

Two phenomena often arising in studies containing financial time-series data are autocorrelation and heteroskedasticity. In finance, autocorrelation means the correlation of error terms amongst each other on a different moment in time within the same series. Heteroskedasticity means the variances of the error terms are not constant. Both Carter Hill (2008) and Brooks (2008) state not correcting for these phenomena most of the time leads to incorrect regression results. Ignoring autocorrelation and heteroskedasticity makes estimated coefficients inefficient and thus they are not BLUE (Best Linear Unbiased Estimator). The variance of the error terms is not constant (heteroskedasticity) and the error terms are correlated over time (autocorrelation) which has consequences for the

calculation of the coefficient variances and thus standard errors. Using the wrong standard errors (used to calculate t-statistics) might result in wrong conclusions about the null-hypothesis (Type 1 (reject good model) / Type 2 (accept wrong model) errors). To overcome these potential problems, heteroskedasticity and autocorrelation consistent standard errors (HAC-Standard Errors) can be estimated, by implementing the Newey-West algorithm. This is exactly what has been done for every regression, so that autocorrelation and heteroskedasticity do not influence the results by calculating coefficients with the wrong standard errors.

### **4.3 Principal Component Analysis**

The method of Principal Components is a method of data reduction. According to Jolliffe (2002), “the central idea of principal components is to reduce the dimensionality of a data set in which there are a large number of interrelated variables, while retaining as much as possible of the variation present in the data set.” So this method combines observed series of data to create new series (components) while it maximizes the variance. The components are ranked from high to low variance. As a result the first component captures most of the variance. The second component captures most of the variance that is not captured by the first component and so forth.<sup>3</sup> In this study this method is used to create an Energy component out of Oil & Gas, to create an Agricultural component out of Soy & Wheat and to create the Foreign Influences variable out of the German DAX Index, American S&P500 and the MSCI World Index. In this way most of the variance of the original variables is still used, but problems caused by correlations between the original variables are solved. The results of the Principal Component Analysis are shown and explained in Appendix C.

### **4.4 Eviews Programming**

Because this study incorporates several sectors, commodities and control variables there are a lot of regressions to be made. For this study the method of programming is used to be able to run several regressions at the same time. This program uses loops to switch between dependent variables and groups to add commodities and control variables. Also the regression results were automatically (i.e. due to a programmed process) stored in a matrix or vector to process them easily. The program used for this study and a description of how it works can be found in Appendix D. As the title of this paragraph tells, Eviews is used in this research. Eviews is an American program for statistical analysis.

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<sup>3</sup> For a more detailed explanation of Principal Component Analysis, see Jolliffe (2002), Volosovych (2011) and Alexander (2008)

## 5. Results

The first regressions investigate the role of several control variables, to be able to see their influence on the AEX total return index. The variable Foreign Influence is expected to have a highly significant influence on the AEX. A potential problem in the regressions is the higher correlation between the size variable (Market Capitalization as percentage of GDP) and the Dutch GDP-growth which is around 0.5 (See Appendix B). This might introduce the problem of multicollinearity which should be visible in the regression results if present. The regression using all control variables indeed shows a highly significant influence created by the foreign indices. The other variables are not significant for the AEX total return index, although they have some explanatory power. The results of the full control variables regression can be found below.

**Table 4: Regression AEX total return index vs all control variables, Coefficients and {t-statistics}**

R-Squared	0.78
GDP-Growth	-0.121 {-0.292}
Market capitalization (%GDP)	0.008 {0.648}
Credit to private sector provided by banks (%GDP)	-0.004 {1.217}
Short term interest rate	-0.106 {-0.491}
Foreign Influence	0.036 {9.648}

Because multicollinearity has negative influence on results, it is undesirable. The table below contains three regressions; two to be able to see both individual effects on the AEX total return index and one for the combined effect.

**Table 5: Regression AEX total return index vs GDP/Market capitalization, Coefficients and {t-statistics}**

R-Squared	0.02	0.014	0.017
GDP-Growth	0.665 {0.384}	1.131 {0.317}	
Market capitalization (%GDP)	0.029 {0.377}		0.040 {0.161}

Looking at the results above there are no clear signs of multicollinearity. The combined regression gives the same signs to the coefficients as the individual regressions and there are no changes in significance.

Now it is clear the model consisting only of control variables has a high explanatory power for the AEX total return index and there are no clear signs of multicollinearity, commodities are to be added to the model. Next to adding commodities, the AEX total return index makes way for the AEX total return index per sector.

The following eight pages present the used method and results of the regressions ran for every sector included in the AEX Index. Per sector 14 regressions have been made and all of them are numbered (see top row per table). In every regression the sector itself is the dependent variable, the other variables described are independent variables. The control variables are always included in every single regression, where the commodities switch between present and absent.

The first six regressions in every table [numbered (1) to (6)] include the control variables and one commodity. These regressions show the individual effect of a commodity in combination with control variables on the sector index. Regressions number seven to ten represent the effect of including a principal component instead of the two separate commodities. For example regression number seven includes the commodities “gas” and “oil”, where number eight includes the component “energy”. The properties of gas and oil are closely related, so creating an energy component is better than using both commodities together. They will explain partly the same change in the sector index; an energy component created out of both commodities will not.<sup>4</sup> The same is done in regressions number nine & ten, for commodities soy and wheat and the component Agriculture. The last four regressions contain several combinations of components and the two remaining commodities “copper” and “gold”. The last regression contains everything; commodities “copper” and “gold”, and components “energy” and “agriculture”. For every regression also the R-squared measure is included, as this measure indicates the goodness of fit of the model.

The numbers represent the coefficients the independent variables have. The numbers in parentheses represent the t-statistics which tell whether the coefficient is significant or not. A distinction has been made between three levels of significance, namely the 10%- , 5%- and 1%-levels which are indicated by the number of asterisks (one for 10% level, two for 5% level and three for 1% level). For the regressions below 118 observations are used for every variable, dependent and independent.

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<sup>4</sup> See “Methodology”-part and Appendix C for further explanation about the Principal Component Analysis.

**Table 6A: Coefficients and {T-statistics} for Sector Basic Materials (4 companies), 118 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
	R-Squared	0.64	0.62	0.62	0.65	0.62	0.62	0.65	0.64	0.62	0.62	0.66	0.64	0.65	0.66	
Commodities & Components	Copper	0.17 {2.45}**										0.12 {1.66}*	0.15 {1.99}**		0.12 {1.57}	
	Gas		0.03 {1.29}					0.01 {0.48}								
	Gold			0.19 {1.68}*								0.06 {0.49}	0.09 {0.68}		0.04 {0.35}	
	Oil				0.19 {3.47}***			0.18 {3.22}***								
	Soy					0.08 {1.01}				0.06 {0.68}						
	Wheat						0.07 {1.65}			0.05 {0.95}						
	Energy								0.02 {2.57}**			0.01 {2.13}**		0.01 {2.56}**	0.01 {2.12}**	
	Agriculture										0.01 {1.64}		0.00 {0.86}	0.01 {1.56}	0.00 {0.87}	
	Control Variables	GDP	-0.57 {-0.62}	-0.47 {-0.43}	-0.34 {-0.33}	-0.76 {-0.91}	-0.41 {-0.40}	-0.51 {-0.51}	-0.79 {-0.94}	-0.75 {-0.79}	-0.50 {-0.50}	-0.50 {-0.52}	-0.82 {-0.97}	-0.60 {-0.70}	-0.85 {-0.99}	-0.88 {-1.10}
		Market Cap (%GDP)	0.03 {0.92}	0.03 {0.79}	0.03 {0.73}	0.03 {0.91}	0.03 {0.75}	0.03 {0.78}	0.03 {0.94}	0.04 {0.95}	0.03 {0.78}	0.03 {0.79}	0.03 {1.11}	0.03 {0.95}	0.04 {1.03}	0.03 {1.15}
Credit by Banks (%GDP)		-0.00 {-0.30}	-0.00 {-0.32}	-0.00 {-0.18}	-0.00 {-0.41}	-0.00 {-0.21}	-0.00 {-0.21}	-0.00 {-0.44}	-0.00 {-0.45}	-0.00 {-0.19}	-0.00 {-0.19}	-0.00 {-0.43}	-0.00 {-0.23}	-0.00 {-0.39}	-0.00 {-0.40}	
Short-term Rate		0.45 {0.88}	0.25 {0.43}	0.29 {0.49}	0.36 {0.80}	0.18 {0.31}	0.21 {0.35}	0.37 {0.81}	0.33 {0.68}	0.18 {0.30}	0.18 {0.31}	0.48 {1.04}	0.41 {0.77}	0.28 {0.58}	0.43 {0.91}	
Foreign Influence		0.04 {9.69}***	0.04 {10.35}***	0.04 {10.26}***	0.04 {10.80}***	0.04 {9.82}***	0.04 {10.14}***	0.04 {10.73}***	0.04 {10.68}***	0.04 {9.67}***	0.04 {10.04}***	0.04 {9.77}***	0.04 {9.42}***	0.04 {10.26}***	0.04 {9.61}***	

**Table 6b: Coefficients and {T-statistics} for Sector Consumer Goods (3 companies), 118 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
R-Squared	0.47	0.48	0.48	0.47	0.49	0.49	0.48	0.47	0.50	0.50	0.49	0.50	0.51	0.51	
Commodities & Components	Copper	-0.02 {-0.65}									-0.02 {-0.44}	0.01 {0.41}		0.00 {0.11}	
	Gas		0.02 {1.28}				0.02 {1.20}								
	Gold			-0.09 {-1.43}							-0.11 {-1.46}	-0.06 {-0.85}		-0.07 {-1.03}	
	Oil				0.01 {0.14}			-0.00 {-0.07}							
	Soy					-0.09 {-2.28}**				-0.07 {-1.60}					
	Wheat						-0.07 {-3.22}***			-0.05 {-1.67}*					
	Energy							0.00 {0.89}			0.00 {1.32}		0.00 {1.13}	0.00 {1.28}	
	Agriculture									-0.01 {-3.87}***		-0.01 {-3.19}***	-0.01 {-3.77}***	-0.01 {-3.08}***	
	Control Variables	GDP	-0.42 {-0.66}	-0.50 {-0.77}	-0.45 {-0.72}	-0.45 {-0.70}	-0.39 {-0.66}	-0.29 {-0.49}	-0.49 {-0.78}	-0.50 {-0.77}	-0.30 {-0.52}	-0.29 {-0.51}	-0.53 {-0.86}	-0.32 {-0.55}	-0.37 {-0.65}
Market Cap (%GDP)		0.03 {2.08}*	0.03 {2.08}**	0.03 {2.13}**	0.03 {2.03}**	0.03 {2.30}**	0.03 {2.00}**	0.03 {2.07}**	0.03 {2.02}**	0.03 {2.16}**	0.03 {2.14}**	0.03 {2.12}**	0.03 {2.12}**	0.03 {2.15}**	0.03 {2.14}**
Credit by Banks (%GDP)		-0.00 {-0.64}	-0.00 {-0.73}	-0.00 {-0.71}	-0.00 {-0.65}	-0.00 {-0.72}	-0.00 {-0.73}	-0.00 {-0.72}	-0.00 {-0.71}	-0.00 {-0.76}	-0.00 {-0.76}	-0.00 {-0.79}	-0.00 {-0.78}	-0.00 {-0.85}	-0.00 {-0.88}
Short-term Rate		-0.21 {-0.79}	-0.18 {-0.67}	-0.21 {-0.82}	-0.18 {-0.67}	-0.13 {-0.53}	-0.16 {-0.60}	-0.18 {-0.66}	-0.17 {-0.63}	-0.12 {-0.50}	-0.13 {-0.51}	-0.21 {-0.78}	-0.13 {-0.49}	-0.10 {-0.41}	-0.12 {-0.46}
Foreign Influence		0.02 {8.52}***	0.02 {9.12}***	0.02 {8.85}***	0.02 {8.80}***	0.02 {9.68}***	0.02 {9.50}***	0.02 {8.81}***	0.02 {9.03}***	0.02 {9.90}***	0.02 {9.96}***	0.02 {8.70}***	0.02 {9.32}***	0.02 {10.16}***	0.02 {9.58}***



**Table 6C: Coefficients and {T-statistics} for Sector Consumer Services (4 companies), 118 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
	R-Squared	0.56	0.55	0.58	0.55	0.57	0.56	0.55	0.55	0.57	0.57	0.58	0.59	0.57	0.59	
Commodities & Components	Copper	-0.06 {-1.47}										-0.03 {-0.74}	-0.02 {-0.38}		-0.02 {-0.36}	
	Gas		-0.01 {-0.59}					-0.01 {-0.44}								
	Gold			-0.19 {-2.34}**								-0.17 {-2.02}**	-0.15 {-1.67}*		-0.15 {-1.66}	
	Oil				-0.03 {-0.70}			-0.02 {-0.63}								
	Soy					-0.09 {-2.22}**					-0.07 {-1.75}*					
	Wheat						-0.07 {-2.91}***				-0.04 {-1.54}					
	Energy								-0.00 {-0.78}			-0.00 {-0.14}		-0.00 {-0.56}	-0.00 {-0.10}	
	Agriculture										-0.01 {-3.25}***		-0.01 {-2.05}**	-0.01 {-3.13}***	-0.01 {-2.04}**	
	Control Variables	GDP	-0.37 {-0.78}	-0.41 {-0.88}	-0.46 {-1.03}	-0.38 {-0.79}	-0.39 {-0.87}	-0.30 {-0.68}	-0.37 {-0.76}	-0.37 {-0.77}	-0.31 {-0.70}	-0.29 {-0.65}	-0.41 {-0.86}	-0.32 {-0.69}	-0.24 {-0.52}	-0.31 {-0.65}
		Market Cap (%GDP)	0.02 {0.98}	0.02 {0.94}	0.02 {1.15}	0.02 {1.00}	0.02 {1.04}	0.02 {0.93}	0.02 {0.95}	0.02 {0.94}	0.02 {0.97}	0.02 {0.95}	0.02 {1.08}	0.02 {1.00}	0.02 {0.90}	0.02 {0.98}
Credit by Banks (%GDP)		-0.01 {-1.23}	-0.01 {-1.25}	-0.01 {-1.41}	-0.01 {-1.25}	-0.01 {-1.33}	-0.01 {-1.33}	-0.01 {-1.24}	-0.01 {-1.24}	-0.01 {-1.36}	-0.01 {-1.37}	-0.01 {-1.39}	-0.01 {-1.45}	-0.01 {-1.36}	-0.01 {-1.46}	
Short-term Rate		-0.17 {-0.72}	-0.10 {-0.40}	-0.15 {-0.65}	-0.11 {-0.48}	-0.04 {-0.16}	-0.07 {-0.28}	-0.11 {-0.48}	-0.11 {-0.46}	-0.03 {-0.14}	-0.04 {-0.16}	-0.18 {-0.81}	-0.11 {-0.49}	-0.05 {-0.22}	-0.11 {-0.50}	
Foreign Influence		0.02 {4.97}***	0.02 {4.93}***	0.02 {5.05}***	0.02 {4.93}***	0.02 {5.50}***	0.02 {5.18}***	0.02 {4.90}***	0.02 {4.91}***	0.02 {5.52}***	0.02 {5.49}***	0.02 {5.01}***	0.02 {5.38}***	0.02 {5.39}***	0.02 {5.34}***	

**Table 6D: Coefficients and {T-statistics} for Sector Financials (4 companies), 118 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
	R-Squared	0.76	0.77	0.76	0.76	0.77	0.76	0.77	0.76	0.77	0.76	0.77	0.77	0.77	0.77	
Commodities & Components	Copper	0.02 {0.44}										0.07 {1.35}	0.07 {1.30}		0.08 {1.61}	
	Gas		-0.05 {-2.74}***					-0.06 {-3.00}***								
	Gold			-0.13 {-1.05}								-0.13 {-1.22}	-0.13 {-1.11}		-0.10 {-0.99}	
	Oil				0.01 {0.13}			0.03 {0.59}								
	Soy					-0.10 {-1.83}*					-0.10 {-1.66}*					
	Wheat						-0.04 {-1.01}				-0.00 {-0.11}					
	Energy								-0.01 {-1.18}			-0.01 {-1.33}		-0.01 {-1.09}	-0.01 {-1.34}	
	Agriculture										-0.01 {-1.76}*		-0.01 {-1.90}*	-0.01 {-1.77}*	-0.01 {-1.99}**	
	Control Variables	GDP	-0.38 {-0.64}	-0.17 {-0.31}	-0.36 {-0.57}	-0.37 {-0.59}	-0.29 {-0.45}	-0.27 {-0.42}	-0.23 {-0.43}	-0.19 {-0.31}	-0.28 {-0.43}	-0.22 {-0.33}	-0.28 {-0.48}	-0.31 {-0.49}	-0.09 {-0.14}	-0.18 {-0.28}
		Market Cap (%GDP)	0.01 {0.39}	0.00 {0.18}	0.01 {0.38}	0.01 {0.37}	0.01 {0.36}	0.01 {0.34}	0.00 {0.19}	0.01 {0.27}	0.01 {0.35}	0.01 {0.33}	0.01 {0.33}	0.01 {0.38}	0.01 {0.24}	0.01 {0.29}
Credit by Banks (%GDP)		0.00 {0.32}	0.00 {0.51}	0.00 {0.25}	0.00 {0.32}	0.00 {0.27}	0.00 {0.30}	0.00 {0.50}	0.00 {0.41}	0.00 {0.26}	0.00 {0.26}	0.00 {0.32}	0.00 {0.17}	0.00 {0.34}	0.00 {0.27}	
Short-term Rate		-0.14 {-0.43}	-0.19 {-0.56}	-0.20 {-0.63}	-0.16 {-0.51}	-0.10 {-0.29}	-0.15 {-0.47}	-0.16 {-0.51}	-0.20 {-0.60}	-0.10 {-0.29}	-0.12 {-0.34}	-0.16 {-0.49}	-0.07 {-0.22}	-0.15 {-0.44}	-0.08 {-0.24}	
Foreign Influence		0.05 {11.99}***	0.05 {12.90}***	0.05 {12.19}***	0.05 {12.24}***	0.05 {12.49}***	0.05 {12.46}***	0.05 {13.00}***	0.05 {12.84}***	0.05 {12.43}***	0.05 {12.79}***	0.05 {12.62}***	0.05 {12.24}***	0.05 {13.38}***	0.05 {12.98}***	

**Table 6E: Coefficients and {T-statistics} for Sector Industrials (4 companies), 118 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
R-Squared	0.64	0.64	0.66	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.67	0.66	0.64	0.67	
Commodities & Components	Copper	-0.04 {-0.73}									-0.01 {-0.09}	0.01 {0.20}		-0.00 {-0.06}	
	Gas		0.02 {0.58}				0.02 {0.56}								
	Gold			-0.29 {-2.36}**							-0.32 {-2.43}**	-0.30 {-2.41}**		-0.32 {-2.43}**	
	Oil				0.01 {0.11}		0.00 {0.00}								
	Soy					-0.02 {-0.37}				-0.00 {-0.01}					
	Wheat							-0.05 {-0.77}		-0.05 {-0.73}					
	Energy							0.00 {0.40}			0.01 {0.90}		0.00 {0.46}	0.01 {0.90}	
	Agriculture									-0.00 {-0.70}		-0.00 {-0.11}	-0.00 {-0.72}	-0.00 {-0.12}	
Control Variables	GDP	0.14 {0.17}	0.03 {0.04}	0.06 {0.08}	0.07 {0.09}	0.10 {0.12}	0.19 {0.23}	0.03 {0.04}	0.02 {0.03}	0.19 {0.23}	0.15 {0.19}	-0.09 {-0.11}	0.06 {0.07}	0.08 {0.10}	-0.07 {-0.09}
	Market Cap (%GDP)	-0.02 {-0.95}	-0.02 {-0.86}	-0.02 {-0.82}	-0.02 {-0.96}	-0.02 {-0.97}	-0.02 {-0.95}	-0.02 {-0.86}	-0.02 {-0.90}	-0.02 {-0.94}	-0.02 {-0.96}	-0.02 {-0.70}	-0.02 {-0.82}	-0.02 {-0.88}	-0.02 {-0.69}
	Credit by Banks (%GDP)	-0.00 {-0.47}	-0.00 {-0.55}	-0.00 {-0.60}	-0.00 {-0.50}	-0.00 {-0.51}	-0.00 {-0.52}	-0.00 {-0.55}	-0.00 {-0.54}	-0.00 {-0.53}	-0.00 {-0.52}	-0.00 {-0.69}	-0.00 {-0.61}	-0.00 {-0.58}	-0.00 {-0.70}
	Short-term Rate	-0.07 {-0.18}	-0.01 {-0.03}	-0.10 {-0.29}	-0.01 {-0.03}	-0.00 {-0.01}	0.00 {0.00}	-0.01 {-0.03}	-0.00 {-0.00}	0.00 {0.00}	0.01 {0.02}	-0.08 {-0.23}	-0.08 {-0.25}	0.03 {0.08}	-0.07 {-0.21}
	Foreign Influence	0.05 {7.07}***	0.05 {7.43}***	0.05 {7.81}***	0.05 {6.94}***	0.05 {7.45}***	0.05 {7.56}***	0.05 {6.94}***	0.05 {7.16}***	0.05 {7.39}***	0.05 {7.64}***	0.05 {7.40}***	0.05 {7.43}***	0.05 {7.42}***	0.05 {7.43}***

**Table 6F: Coefficients and {T-statistics} for Sector Oil & Gas (3 companies), 118 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
R-Squared	0.32	0.33	0.32	0.36	0.32	0.32	0.37	0.37	0.32	0.32	0.39	0.32	0.37	0.39	
Commodities & Components	Copper	-0.04 {-0.91}									-0.07 {-1.59}	-0.03 {-0.65}		-0.07 {-1.38}	
	Gas		0.04 {2.23}**				0.03 {1.39}								
	Gold			-0.08 {-0.58}							-0.12 {-0.88}	-0.07 {-0.44}		-0.12 {-0.82}	
	Oil				0.14 {2.62}***		0.13 {2.37}**								
	Soy					0.02 {0.56}			0.05 {1.07}						
	Wheat						-0.04 {-0.70}			-0.05 {-1.01}					
	Energy							0.01 {3.04}***			0.02 {3.91}***		0.01 {3.07}***	0.02 {3.91}***	
	Agriculture									-0.00 {-0.19}		0.00 {0.07}	-0.00 {-0.54}	0.00 {0.02}	
Control Variables	GDP	0.16 {0.24}	-0.03 {-0.04}	0.10 {0.16}	-0.18 {-0.25}	0.10 {0.14}	0.19 {0.28}	-0.25 {-0.36}	-0.23 {-0.35}	0.20 {0.29}	0.13 {0.18}	-0.22 {-0.43}	0.13 {0.20}	-0.19 {-0.31}	-0.23 {-0.41}
	Market Cap (%GDP)	-0.00 {-0.23}	-0.00 {-0.05}	-0.00 {-0.20}	-0.00 {-0.16}	-0.00 {-0.22}	-0.00 {-0.23}	-0.00 {-0.05}	0.00 {0.01}	-0.00 {-0.24}	-0.00 {-0.22}	0.00 {0.09}	-0.00 {-0.21}	0.00 {0.01}	0.00 {0.09}
	Credit by Banks (%GDP)	-0.00 {-0.71}	-0.00 {-0.83}	-0.00 {-0.79}	-0.00 {-0.87}	-0.00 {-0.70}	-0.00 {-0.76}	-0.00 {-0.93}	-0.00 {-0.95}	-0.00 {-0.72}	-0.00 {-0.74}	-0.00 {-1.06}	-0.00 {-0.76}	-0.00 {-0.99}	-0.00 {-1.06}
	Short-term Rate	-0.10 {-0.34}	-0.04 {-0.12}	-0.08 {-0.25}	0.04 {0.14}	-0.07 {-0.23}	-0.04 {-0.13}	0.04 {0.15}	0.03 {0.09}	-0.06 {-0.21}	-0.05 {-0.16}	-0.08 {-0.28}	-0.11 {-0.35}	0.04 {0.15}	-0.08 {-0.27}
	Foreign Influence	0.02 {5.64}***	0.02 {5.31}***	0.02 {5.63}***	0.02 {5.21}***	0.02 {5.05}***	0.02 {5.34}***	0.02 {5.21}***	0.02 {5.22}***	0.02 {5.10}***	0.02 {5.15}***	0.02 {6.13}***	0.02 {5.28}***	0.02 {5.17}***	0.02 {5.80}***

**Table 6G: Coefficients and {T-statistics} for Sector Technology (2 companies), 118 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
R-Squared	0.60	0.60	0.63	0.61	0.60	0.60	0.61	0.60	0.60	0.60	0.63	0.63	0.60	0.63	
Commodities & Components	Copper	-0.02 {-0.29}									0.06 {0.88}	0.05 {0.77}		0.06 {0.81}	
	Gas		-0.01 {-0.33}				-0.00 {-0.11}								
	Gold			-0.41 {-2.61}**							-0.43 {-2.77}***	-0.45 {-2.64}***		-0.44 {-2.74}***	
	Oil				-0.07 {-0.72}		-0.07 {-0.71}								
	Soy					-0.06 {-0.74}				-0.07 {-0.83}					
	Wheat						0.01 {0.17}			0.04 {0.50}					
	Energy							-0.01 {-0.64}			-0.00 {-0.33}		-0.01 {-0.62}	-0.00 {-0.33}	
	Agriculture									-0.00 {-0.39}		0.00 {0.24}	-0.00 {-0.28}	0.00 {0.25}	
Control Variables	GDP	-1.11 {-0.89}	-1.10 {-0.89}	-1.18 {-0.95}	-0.98 {-0.77}	-1.11 {-0.91}	-1.16 {-0.90}	-0.97 {-0.76}	-0.99 {-0.79}	-1.18 {-0.91}	-1.10 {-0.87}	-1.18 {-0.94}	-1.27 {-0.98}	-0.97 {-0.75}	-1.21 {-0.92}
	Market Cap (%GDP)	0.01 {0.18}	0.01 {0.15}	0.01 {0.29}	0.01 {0.16}	0.01 {0.19}	0.01 {0.18}	0.01 {0.16}	0.00 {0.13}	0.01 {0.19}	0.01 {0.18}	0.01 {0.26}	0.01 {0.29}	0.00 {0.13}	0.01 {0.25}
	Credit by Banks (%GDP)	-0.01 {-0.87}	-0.01 {-0.84}	-0.01 {-0.95}	-0.01 {-0.84}	-0.01 {-0.88}	-0.01 {-0.86}	-0.01 {-0.82}	-0.01 {-0.81}	-0.01 {-0.87}	-0.01 {-0.88}	-0.01 {-0.93}	-0.01 {-0.96}	-0.01 {-0.81}	-0.01 {-0.92}
	Short-term Rate	-0.52 {-1.05}	-0.50 {-0.99}	-0.61 {-1.27}	-0.54 {-1.14}	-0.45 {-0.92}	-0.50 {-0.98}	-0.54 {-1.13}	-0.53 {-1.09}	-0.46 {-0.92}	-0.48 {-0.96}	-0.55 {-1.16}	-0.56 {-1.18}	-0.51 {-1.09}	-0.57 {-1.20}
	Foreign Influence	0.06 {5.59}***	0.06 {5.63}***	0.06 {5.85}***	0.06 {5.59}***	0.06 {5.79}***	0.06 {5.75}***	0.06 {5.56}***	0.06 {5.62}***	0.06 {5.78}***	0.06 {5.86}***	0.06 {5.68}***	0.06 {5.72}***	0.06 {5.80}***	0.06 {5.69}***

**Table 6 H: Coefficients and {T-statistics} for Sector Telecom (1 company), 118 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
R-Squared	0.28	0.28	0.28	0.29	0.28	0.28	0.29	0.28	0.28	0.28	0.29	0.29	0.28	0.29	
Commodities & Components	Copper	-0.04 {-0.77}									-0.03 {-0.55}	-0.03 {-0.56}		-0.03 {-0.51}	
	Gas		0.01 {0.48}				0.02 {0.92}								
	Gold			-0.10 {-0.59}							-0.08 {-0.46}	-0.09 {-0.52}		-0.08 {-0.49}	
	Oil				-0.06 {-1.21}			-0.07 {-1.35}							
	Soy					-0.04 {-0.67}				-0.06 {-1.20}					
	Wheat						0.03 {0.41}			0.05 {0.76}					
	Energy							-0.00 {-0.53}			-0.00 {-0.24}		-0.00 {-0.51}	-0.00 {-0.25}	
	Agriculture									-0.00 {-0.09}		0.00 {0.14}	-0.00 {-0.05}	0.00 {0.14}	
	Control Variables	GDP	0.88 {1.07}	0.79 {0.99}	0.82 {1.00}	0.96 {1.21}	0.85 {1.07}	0.77 {0.89}	0.91 {1.15}	0.89 {1.12}	0.76 {0.90}	0.84 {1.01}	0.88 {1.06}	0.84 {0.98}	0.89 {1.11}
Market Cap (%GDP)		-0.02 {-0.90}	-0.02 {-0.84}	-0.02 {-0.91}	-0.02 {-0.92}	-0.02 {-0.90}	-0.02 {-0.84}	-0.02 {-0.86}	-0.02 {-0.91}	-0.02 {-0.85}	-0.02 {-0.88}	-0.02 {-0.92}	-0.02 {-0.89}	-0.02 {-0.91}	-0.02 {-0.91}
Credit by Banks (%GDP)		-0.01 {-2.24}**	-0.01 {-2.27}**	-0.01 {-2.24}**	-0.01 {-2.25}**	-0.01 {-2.29}**	-0.01 {-2.22}**	-0.01 {-2.28}**	-0.01 {-2.23}**	-0.01 {-2.28}**	-0.01 {-2.24}**	-0.01 {-2.17}**	-0.01 {-2.17}**	-0.01 {-2.19}**	-0.01 {-2.13}**
Short-term Rate		-0.05 {-0.14}	0.01 {0.03}	-0.02 {-0.06}	-0.04 {-0.11}	0.03 {0.09}	-0.00 {-0.01}	-0.03 {-0.10}	-0.01 {-0.02}	0.03 {0.08}	0.01 {0.03}	-0.06 {-0.16}	-0.06 {-0.17}	-0.01 {-0.02}	-0.07 {-0.17}
Foreign Influence		0.02 {3.14}***	0.02 {3.01}***	0.02 {3.11}***	0.02 {3.12}***	0.02 {3.11}***	0.02 {3.01}***	0.02 {3.10}***	0.02 {3.06}***	0.02 {3.13}***	0.02 {3.03}***	0.02 {3.07}***	0.02 {3.04}***	0.02 {3.04}***	0.02 {3.02}***

## 5.1 Commodities

Copper has a positive and significant influence on the returns of the Basic Materials sector. Looking at the companies incorporated in this sector, it makes sense that a higher price of copper is good for these companies. Companies active in the steel- and other metal industries profit from higher copper prices because they sell this product to their customers. All other sectors (except Financials) show a negative relationship between their results and copper. Many companies use copper in one way or another, linking higher prices to higher costs.

Natural gas is a commodity used frequently for trade (as in futures contracts) and in production processes. A positive sign is expected for the coefficient regarding the Oil & Gas sector. The companies in this sector extract gas from the ground and sell it; a higher price means higher revenues. Taking the results into account, indeed the sign for the Oil & Gas sector is positive and significant. Natural gas seems to be significant for the Financials sector too, although the sign is negative. This effect will rely heavily on the trades financial institutions make using contracts for gas as diversification objects to reduce risk. On other sectors natural gas has no significant influence.

Gold is an interesting object functioning as alternative investment. This commodity is seen as a safe haven in times of financial turmoil because it keeps its value. The sector Basic Materials therefore is expected to have a positive relationship with gold, while all others are expected to have a negative relationship. According to the results in the tables above the expectations are true indeed. The sector Basic Materials shows a positive and significant coefficient, while for all other sectors this coefficient is negative and significant for the sectors Consumer Services, Industrials and Technology.

Crude oil has a positive and highly significant influence on the Basic Materials sector, but the companies included in this sector are not oil-related companies. This result is not predicted because companies in this sector use oil in their production process therefore higher oil prices “should” lower profits. The robustness test will reveal whether this result is also valid when the last financial crisis is taken out of the sample. The oil-coefficient for the Oil and Gas sector is also positive and highly significant, but this was expected for the same reason a positive and significant gas-coefficient was expected.

Soy and wheat are two commodities used a lot for consumer-related end products such as food. Therefore expectations are negative signs for both the Consumer Goods and the Consumer Services sectors. Expectations for the other sectors are neutral; they do not have a strong relationship with both agricultural commodities. This is exactly what the results show; a negative and significant

relationship between the commodities and the Consumer-sectors and not too much significance with the other sectors. The financial sector shows some affiliation with soy, but this will be due to trading activities.

The principal components Energy and Agriculture are expected to have significant influence on the sectors including companies with core-businesses related to the commodities oil and gas (Energy) and soy and wheat (Agriculture). Energy indeed is positive and significant for the Oil & Gas sector while Agriculture is negative and significant for the Consumer-sectors. Energy also appears to be significant for the sector Basic Materials as gas was also significant for this sector. The results for the components are probably better than using both commodities in one regression. It makes sense to state oil and gas prices will explain partly the same changes in sector returns. The same applies for soy and wheat. Combining these commodities into one while most of the variance is still present is the best solution for the correlation problem here. The r-squared measure does not increase when comparing the regressions (commodities against components) but the results now indicate Energy commodities in general are important for the Oil & Gas sector (and the same applies for the Agriculture component).

Adding more commodities to the regressions (numbers 11 to 14) does not change results much. The coefficients that were significant in the single commodity regressions remain significant. The r-squared measure increases most of the time with a few percent. It is satisfactory to observe that adding more commodities does not change the results; the results showed in the single commodity regressions are strong.

## 5.2 Control Variables

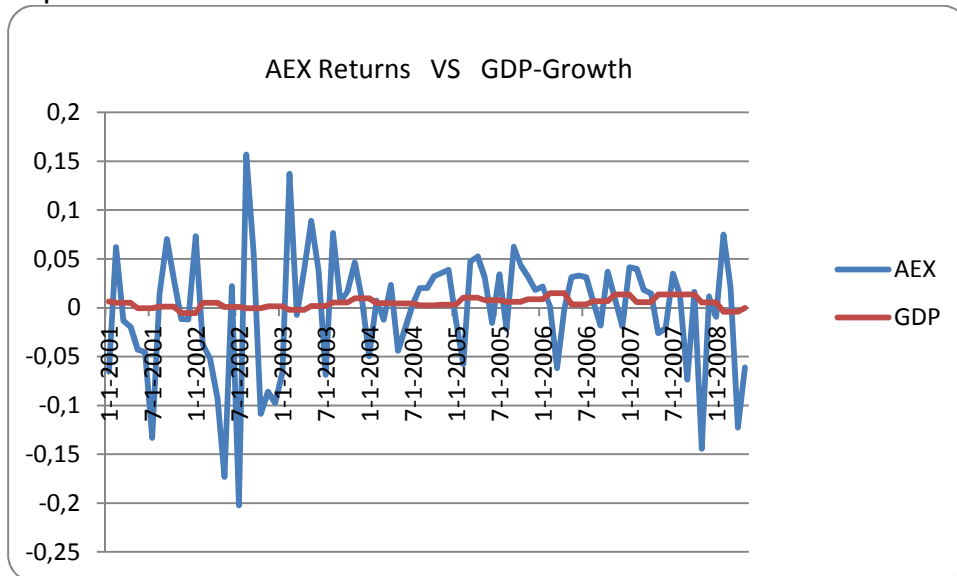
### 5.2.1 Real economy variable

The GDP measure (calculated as GDP-growth) was initially expected to have positive influence on the Dutch stock market. However the results show otherwise. Almost every sector shows negative signs for this variable, resulting in the fact that the stock index loses value when the GDP-growth gets higher. A possible explanation for this phenomenon can be found in the Efficient Market Hypothesis and the data frequency. Financial trading nowadays happens every second the markets are open. All information is used quickly and efficient to get new pricing quotes. The prospects are changing almost by the second, making this market efficient. The GDP measure however is published once a quarter. When prospects for the economy get somewhat negative, the supply side of the economy has to deal with lower demand. This means fewer products are produced resulting finally in a lower GDP. Although this can happen fast, it happens certainly not as fast as the markets can adjust to new



information available. Taking these thoughts into account, the returns of the whole AEX were plotted against the GDP-growth. The graphic illustration below represents the outcome of this plot.

**Graph 1: AEX Returns vs GDP-Growth**



According to this graph the GDP-growth might still be positive while the stock exchange is already in bad weather and the other way around. The red line, representing GDP-growth, is not as volatile as the blue line representing the AEX-returns. However the movements often are opposite to each other. This is due to the statement above, but also because of expectations. Investors know the economy will grow less after times of fast growth. They are anticipating on times of economic turmoil when the economy is growing fast. Taking this graph into account negative coefficients are possible.

### 5.2.2 Financial control variables

The size-variable (market capitalization as percentage of GDP) shows positive coefficients for most sectors. This makes sense because a larger market contains several advantages for the companies denoted on this market. The sector Consumer Goods even shows significant coefficients for this particular variable. Observed negative coefficients (Oil & Gas / Telecom) are insignificant at the 10%-level.

The variable containing information about the performance of the banking sector (Credit to private sector provided by banks as percentage of GDP) shows very small negative coefficients which are insignificant except for the Telecom sector. The telecom sector of course benefits from times of economic prosperity. Looking at the micro-economic level, people will buy more expensive smartphones/tablet PCs when they can save money. Borrowing money from banks is a sign the population does not have enough cash to “make ends meet”. A cut on luxury products such as

telecom-products is a logical result. Looking at the GDP-growth variable also a positive coefficient is depicted; this sector is sensitive for real-economic activity.

### **5.2.3 Policy control variable**

The policy control variable incorporated in this study is the Dutch short term interest rate. According to the (extensive) theory on this variable the relationship between stock index returns and the interest rate should show negative coefficients. Lowering interest rates is done by politics to stimulate the market, while raising them is done to cool the economic growth. The results indeed show negative coefficients for every sector (except Basic Materials and Oil & Gas when the Energy component is included). The results seem to be insignificant for the sector returns, but they have the right sign.

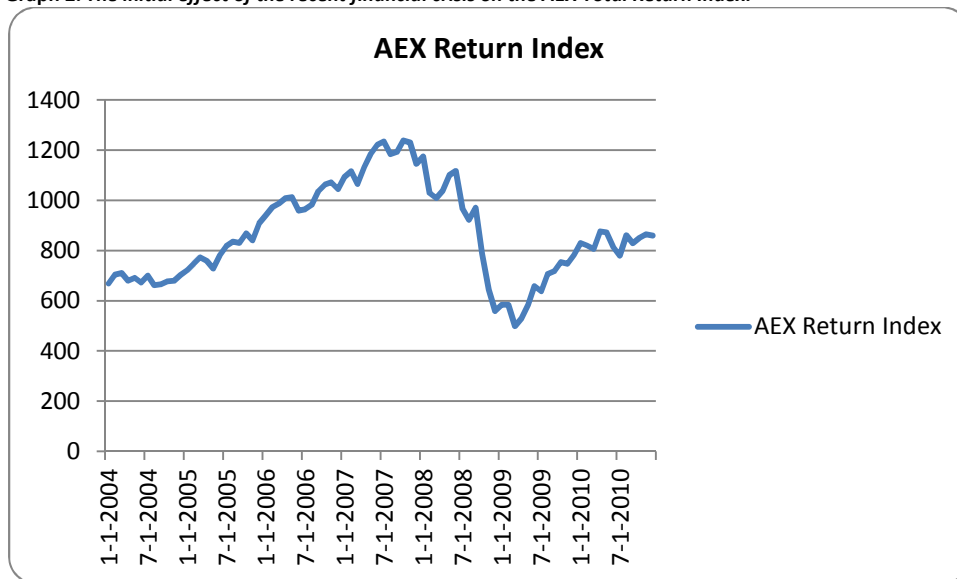
### **5.2.4 Foreign control variable**

The relationship between the component Foreign Influence with the AEX sectors is a very strong one looking at the t-statistics and significance levels (always significant at 1%-level). As stated before, this variable is created to undermine the problem of multicollinearity caused by high correlations between the three foreign stock indices S&P500, DAX and MSCI World Index. The coefficients are positive for every sector, showing the sectors are dependent from results of other economies. This result is partly explained by the economic activities of the Netherlands. As stated in the beginning of this paper the Dutch economy relies heavily on international trade. Companies nowadays are operating global, meaning a good economic performance of foreign companies result in more international demand for their products. The Dutch economy benefits from this growing demand and thus international trade.

## 6. Robustness check

To be able to determine which results are robust, another set of regressions has been made. This time the dataset is shortened till December 2007. Around the start of 2008 the global financial crisis started to take shape. The world's largest economy (USA) was indebted dramatically in this period, a sign for the start of a massive (Western) crisis. USA-housing prices declined sharply, setting of rising interest rates for adjustable-rate mortgages. Securities traded between financial institutions (including subprime mortgages) to lower risks lost value quickly triggering a world changing financial debacle. Of course the AEX Index lost value too as can be seen in the graph below.

Graph 2: *The initial effect of the recent financial crisis on the AEX Total Return Index.*



This graph clearly shows a quick loss of around 45% within a timespan of one year. This immense crisis and its consequences did influence almost everything in the financial world. By excluding the extreme results of the recent global financial crisis only “normal” periods of time are included. The total number of observations lowered from 118 to 83. In contradiction to the full-sample dataset, the data used for these regressions is not winsorized. The tables below have the same composition as the tables containing the full-sample results. The first six columns contain the results of the regressions including all control variables and only one commodity. The next four show the effect of using a principal component instead of two commodities from the same category (Energy vs Oil & Gas; Agriculture vs Soy & Wheat). The final four regressions and thus columns use combinations of the remaining two commodities and both principal components. At the top of every table the R-Squared measure is presented. Once again the tables show coefficients and t-statistics which are in parentheses. The number of asterisks indicate significance at 10% (\*), 5% (\*\*) or 1% (\*\*\*) level.

**Table 7A: Coefficients and {T-statistics} for Sector Basic Materials (4 companies), 83 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)		
R-Squared	0.53	0.52	0.53	0.54	0.52	0.53	0.54	0.53	0.53	0.52	0.54	0.54	0.53	0.54		
Commodities & Components	Copper	0.08 {1.02}									0.05 {0.59}	0.06 {0.72}		0.05 {0.60}		
	Gas		0.01 {0.32}				-0.00 {-0.08}									
	Gold			0.18 {1.40}							0.12 {0.84}	0.14 {1.04}		0.12 {0.83}		
	Oil				0.10 {1.55}			0.10 {1.34}								
	Soy					-0.02 {-0.27}				-0.01 {-0.19}						
	Wheat						-0.05 {-0.54}			-0.04 {-0.48}						
	Energy							0.01 {1.32}			0.00 {0.89}		0.01 {1.26}	0.00 {0.83}		
	Agriculture									-0.00 {-0.71}		-0.00 {-0.85}	-0.00 {-0.59}	-0.00 {-0.73}		
	Control Variables	GDP	-0.08 {-0.06}	0.13 {0.11}	-0.03 {-0.03}	-0.29 {-0.21}	0.18 {0.15}	0.35 {0.25}	-0.30 {-0.21}	-0.05 {-0.04}	0.39 {0.28}	0.36 {0.27}	-0.23 {-0.17}	0.09 {0.07}	0.15 {0.11}	-0.02 {-0.02}
		Market Cap (%GDP)	0.09 {1.12}	0.10 {1.24}	0.09 {1.29}	0.11 {1.37}	0.09 {1.16}	0.08 {1.07}	0.11 {1.35}	0.11 {1.40}	0.08 {1.07}	0.08 {1.08}	0.11 {1.34}	0.08 {1.10}	0.10 {1.28}	0.10 {1.23}
Credit by Banks (%GDP)		0.00 {0.36}	0.00 {0.51}	0.00 {0.44}	0.00 {0.55}	0.00 {0.47}	0.00 {0.47}	0.00 {0.52}	0.00 {0.64}	0.00 {0.47}	0.00 {0.47}	0.00 {0.51}	0.00 {0.37}	0.00 {0.63}	0.00 {0.50}	
Short-term Rate		-0.27 {-0.25}	-0.54 {-0.48}	-0.54 {-0.51}	-0.63 {-0.57}	-0.43 {-0.39}	-0.33 {-0.29}	-0.61 {-0.55}	-0.66 {-0.59}	-0.29 {-0.26}	-0.30 {-0.27}	-0.51 {-0.46}	-0.16 {-0.16}	-0.49 {-0.43}	-0.32 {-0.29}	
Foreign Influence		0.03 {7.79}***	0.03 {8.13}***	0.03 {8.33}***	0.03 {7.82}***	0.03 {7.57}***	0.03 {8.56}***	0.03 {7.55}***	0.03 {8.08}***	0.03 {7.91}***	0.03 {8.05}***	0.03 {7.58}***	0.03 {7.58}***	0.03 {7.76}***	0.03 {7.39}***	

**Table 7B: Coefficients and {T-statistics} for Sector Consumer Goods (3 companies), 83 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)		
R-Squared	0.37	0.37	0.37	0.37	0.38	0.37	0.37	0.37	0.38	0.38	0.38	0.40	0.38	0.40		
Commodities & Components	Copper	0.03 {0.82}									0.05 {1.23}	0.05 {1.39}		0.05 {1.43}		
	Gas		0.01 {0.38}				0.01 {0.50}									
	Gold			-0.09 {-0.95}							-0.12 {-1.07}	-0.13 {-1.29}		-0.13 {-1.21}		
	Oil				-0.02 {-0.43}			-0.03 {-0.49}								
	Soy					-0.06 {-1.21}				-0.05 {-1.08}						
	Wheat						-0.05 {-1.12}			-0.05 {-0.97}						
	Energy							-0.00 {-0.13}			0.00 {0.01}		-0.00 {-0.28}	-0.00 {-0.15}		
	Agriculture									-0.01 {-1.57}		-0.01 {-1.65}	-0.01 {-1.60}	-0.01 {-1.66}		
	Control Variables	GDP	-1.77 {-1.36}	-1.69 {-1.29}	-1.62 {-1.23}	-1.61 {-1.19}	-1.50 {-1.18}	-1.42 {-1.08}	-1.57 {-1.16}	-1.69 {-1.27}	-1.28 {-0.99}	-1.27 {-0.99}	-1.72 {-1.32}	-1.26 {-0.99}	-1.24 {-0.95}	-1.25 {-0.97}
		Market Cap (%GDP)	-0.05 {-0.96}	-0.05 {-0.87}	-0.05 {-0.92}	-0.06 {-1.06}	-0.06 {-1.11}	-0.06 {-1.16}	-0.05 {-0.98}	-0.05 {-0.99}	-0.07 {-1.27}	-0.07 {-1.29}	-0.06 {-1.01}	-0.08 {-1.30}	-0.08 {-1.39}	-0.08 {-1.41}
Credit by Banks (%GDP)		-0.01 {-2.26}**	-0.01 {-2.18}**	-0.01 {-2.22}**	-0.01 {-2.36}**	-0.01 {-2.29}**	-0.01 {-2.30}**	-0.01 {-2.22}**	-0.01 {-2.32}**	-0.01 {-2.31}**	-0.01 {-2.33}	-0.01 {-2.25}**	-0.01 {-2.34}**	-0.01 {-2.41}**	-0.01 {-2.38}**	
Short-term Rate		1.11 {1.47}	1.00 {1.37}	1.06 {1.39}	1.06 {1.48}	1.23 {1.60}	1.23 {1.72}*	1.03 {1.39}	1.05 {1.47}	1.38 {1.81}*	1.39 {1.83}	1.20 {1.51}	1.59 {1.85}*	1.42 {1.89}*	1.61 {1.93}*	
Foreign Influence		0.02 {5.21}***	0.02 {5.38}***	0.02 {5.47}***	0.02 {5.33}***	0.02 {5.74}***	0.02 {5.38}***	0.02 {5.28}***	0.02 {5.37}***	0.02 {5.67}***	0.02 {5.66}***	0.02 {5.11}***	0.02 {5.36}***	0.02 {5.58}***	0.02 {5.30}***	

**Table 7C: Coefficients and {T-statistics} for Sector Consumer Services (4 companies), 83 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)		
R-Squared	0.73	0.73	0.74	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.75	0.76	0.74	0.76		
Commodities & Components	Copper	0.02 {0.56}									0.06 {1.81}*	0.06 {1.89>**}		0.06 {2.00}**		
	Gas		-0.02 {-1.46}				-0.02 {-1.64}									
	Gold			-0.18 {-2.30}**							-0.21 {-2.61}**	-0.22 {-2.96}***		-0.21 {-2.81}***		
	Oil				0.01 {0.20}		0.02 {0.53}									
	Soy					-0.04 {-1.09}			-0.03 {-0.95}							
	Wheat						-0.06 {-1.19}			-0.05 {-1.10}						
	Energy							-0.00 {-0.56}				-0.00 {-0.24}		-0.00 {-0.70}	-0.00 {-0.40}	
	Agriculture									-0.00 {-1.38}		-0.01 {-1.45}	-0.01 {-1.45}	-0.01 {-1.48}		
	Control Variables	GDP	-0.90 {-1.18}	-0.87 {-1.14}	-0.69 {-0.98}	-0.89 {-1.08}	-0.71 {-0.93}	-0.56 {-0.70}	-0.97 {-1.19}	-0.80 {-1.00}	-0.47 {-0.57}	-0.48 {-0.60}	-0.79 {-1.09}	-0.41 {-0.52}	-0.40 {-0.48}	-0.37 {-0.46}
		Market Cap (%GDP)	0.01 {0.21}	-0.00 {-0.06}	0.01 {0.16}	0.01 {0.31}	0.00 {0.06}	-0.00 {-0.03}	0.00 {0.03}	0.00 {0.07}	-0.01 {-0.17}	-0.01 {-0.17}	-0.00 {-0.03}	-0.02 {-0.39}	-0.02 {-0.39}	-0.02 {-0.47}
Credit by Banks (%GDP)		-0.01 {-1.80}*	-0.01 {-2.03}**	-0.01 {-1.78}*	-0.01 {-1.78}*	-0.01 {-1.77}*	-0.01 {-1.78}*	-0.01 {-2.03}**	-0.01 {-1.87}*	-0.01 {-1.76}*	-0.01 {-1.77}	-0.01 {-1.83}*	-0.01 {-1.89}*	-0.01 {-1.87}*	-0.01 {-1.87}*	
Short-term Rate		-0.27 {-0.43}	-0.23 {-0.37}	-0.28 {-0.48}	-0.34 {-0.58}	-0.19 {-0.32}	-0.13 {-0.21}	-0.25 {-0.40}	-0.28 {-0.45}	-0.02 {-0.04}	-0.03 {-0.05}	-0.10 {-0.15}	0.23 {0.35}	0.05 {0.08}	0.27 {0.40}	
Foreign Influence		0.03 {9.72}***	0.03 {9.98}***	0.03 {10.64}***	0.03 {9.73}***	0.03 {9.96}***	0.03 {10.37}***	0.03 {9.49}***	0.03 {10.16}***	0.03 {10.20}***	0.03 {10.34}***	0.03 {10.24}***	0.03 {10.33}***	0.03 {10.57}***	0.03 {10.49}***	

**Table 7D: Coefficients and {T-statistics} for Sector Financials (4 companies), 83 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)		
R-Squared	0.67	0.68	0.67	0.67	0.67	0.67	0.68	0.67	0.67	0.67	0.69	0.69	0.68	0.69		
Commodities & Components	Copper	0.04 {0.80}									0.09 {1.77}*	0.09 {1.64}		0.10 {1.82}*		
	Gas		-0.05 {-2.13}**				-0.05 {-2.37}**									
	Gold			-0.19 {-1.52}							-0.21 {-1.79}*	-0.25 {-1.94}*		-0.21 {-1.88}*		
	Oil				-0.00 {-0.06}		0.03 {0.53}									
	Soy					-0.09 {-1.48}				-0.09 {-1.40}						
	Wheat						-0.03 {-0.43}			-0.01 {-0.22}						
	Energy							-0.01 {-1.22}				-0.01 {-1.16}		-0.01 {-1.28}	-0.01 {-1.24}	
	Agriculture										-0.01 {-1.62}		-0.01 {-1.71}*	-0.01 {-1.86}*	-0.01 {-1.90}*	
	Control Variables	GDP	-0.84 {-0.64}	-0.80 {-0.62}	-0.57 {-0.47}	-0.72 {-0.57}	-0.42 {-0.33}	-0.60 {-0.46}	-0.95 {-0.74}	-0.55 {-0.45}	-0.35 {-0.27}	-0.25 {-0.20}	-0.63 {-0.49}	-0.22 {-0.17}	-0.01 {-0.00}	-0.04 {-0.03}
		Market Cap (%GDP)	-0.03 {-0.41}	-0.06 {-0.86}	-0.03 {-0.40}	-0.03 {-0.38}	-0.05 {-0.58}	-0.03 {-0.47}	-0.06 {-0.80}	-0.05 {-0.71}	-0.05 {-0.64}	-0.05 {-0.66}	-0.06 {-0.80}	-0.06 {-0.77}	-0.08 {-1.02}	-0.09 {-1.11}
Credit by Banks (%GDP)		-0.01 {-0.89}	-0.01 {-1.46}	-0.01 {-0.85}	-0.01 {-0.87}	-0.01 {-0.93}	-0.01 {-0.85}	-0.01 {-1.46}	-0.01 {-1.16}	-0.01 {-0.92}	-0.01 {-0.90}	-0.01 {-1.22}	-0.01 {-1.00}	-0.01 {-1.25}	-0.01 {-1.35}	
Short-term Rate		0.07 {0.07}	0.23 {0.22}	0.00 {0.00}	-0.04 {-0.04}	0.27 {0.25}	0.05 {0.05}	0.20 {0.20}	0.13 {0.13}	0.32 {0.31}	0.35 {0.34}	0.42 {0.42}	0.69 {0.63}	0.59 {0.56}	0.93 {0.87}	
Foreign Influence		0.04 {5.85}***	0.04 {6.29}***	0.04 {5.98}***	0.04 {5.88}***	0.04 {5.90}***	0.04 {6.07}***	0.04 {6.07}***	0.04 {6.26}***	0.04 {6.01}***	0.04 {6.07}***	0.04 {6.21}***	0.04 {6.05}***	0.04 {6.43}***	0.04 {6.42}***	

**Table 7E: Coefficients and {T-statistics} for Sector Industrials (4 companies), 83 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)		
R-Squared	0.65	0.65	0.68	0.65	0.65	0.65	0.65	0.65	0.66	0.65	0.68	0.68	0.65	0.68		
Commodities & Components	Copper	0.00 {0.07}									0.06 {0.91}	0.07 {1.11}		0.06 {0.86}		
	Gas		0.02 {0.80}				0.02 {0.79}									
	Gold			-0.39 {-2.07}**							-0.47 {-2.37}**	-0.43 {-2.20}**		-0.47 {-2.32}**		
	Oil				0.02 {0.17}		-0.00 {-0.00}									
	Soy					0.07 {1.27}				0.07 {1.37}						
	Wheat						-0.04 {-0.33}			-0.05 {-0.41}						
	Energy							0.00 {0.53}			0.01 {1.08}		0.00 {0.54}	0.01 {1.08}		
	Agriculture									0.00 {0.25}		0.00 {0.15}	0.00 {0.29}	0.00 {0.22}		
	Control Variables	GDP	-1.66 {-0.93}	-1.62 {-0.89}	-1.32 {-0.74}	-1.72 {-0.92}	-1.89 {-1.01}	-1.45 {-0.74}	-1.62 {-0.86}	-1.76 {-0.95}	-1.65 {-0.82}	-1.80 {-0.93}	-1.60 {-0.87}	-1.55 {-0.77}	-1.94 {-0.97}	-1.74 {-0.83}
		Market Cap (%GDP)	0.13 {1.14}	0.15 {1.27}	0.13 {1.06}	0.14 {1.18}	0.15 {1.28}	0.13 {1.09}	0.15 {1.26}	0.15 {1.25}	0.14 {1.21}	0.14 {1.20}	0.15 {1.18}	0.12 {0.99}	0.16 {1.28}	0.15 {1.18}
Credit by Banks (%GDP)		0.00 {0.37}	0.00 {0.49}	0.00 {0.41}	0.00 {0.38}	0.00 {0.39}	0.00 {0.37}	0.00 {0.49}	0.00 {0.44}	0.00 {0.39}	0.00 {0.38}	0.00 {0.48}	0.00 {0.34}	0.00 {0.45}	0.00 {0.49}	
Short-term Rate		-1.40 {-0.84}	-1.54 {-0.96}	-1.30 {-0.80}	-1.43 {-0.89}	-1.64 {-1.03}	-1.26 {-0.81}	-1.54 {-0.95}	-1.51 {-0.94}	-1.48 {-0.96}	-1.53 {-0.97}	-1.30 {-0.78}	-1.16 {-0.68}	-1.66 {-1.05}	-1.43 {-0.83}	
Foreign Influence		0.05 {7.05}***	0.05 {7.11}***	0.05 {8.48}***	0.05 {7.01}***	0.04 {6.90}***	0.05 {7.30}***	0.05 {7.02}***	0.05 {7.04}***	0.05 {7.02}***	0.05 {7.21}***	0.05 {8.58}***	0.05 {8.45}***	0.05 {7.15}***	0.05 {8.48}***	



**Table 7F: Coefficients and {T-statistics} for Sector Oil & Gas (3 companies), 83 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
R-Squared	0.30	0.32	0.30	0.37	0.30	0.32	0.38	0.37	0.32	0.31	0.37	0.32	0.38	0.38	
Commodities & Components	Copper	0.03 {0.53}									-0.00 {-0.03}	0.03 {0.46}		0.00 {0.06}	
	Gas		0.04 {1.91}*				0.02 {0.83}								
	Gold			0.08 {0.53}							-0.01 {-0.04}	0.06 {0.39}		-0.01 {-0.08}	
	Oil				0.19 {3.85}***		0.17 {3.79}***								
	Soy					-0.04 {-0.89}				-0.03 {-0.69}					
	Wheat						-0.11 {-1.47}			-0.11 {-1.43}					
	Energy							0.01 {3.12}***				0.01 {3.12}***		0.01 {3.03}***	0.01 {2.96}***
Agriculture										-0.01 {-1.47}	-0.01 {-1.48}	-0.01 {-1.22}	-0.01 {-1.18}		
Control Variables	GDP	0.14 {0.13}	0.27 {0.26}	0.15 {0.14}	-0.56 {-0.56}	0.36 {0.34}	0.79 {0.71}	-0.48 {-0.48}	-0.18 {-0.17}	0.87 {0.76}	0.79 {0.69}	-0.17 {-0.16}	0.67 {0.58}	0.31 {0.27}	0.31 {0.27}
	Market Cap (%GDP)	-0.10 {-1.45}	-0.07 {-1.03}	-0.10 {-1.36}	-0.06 {-1.01}	-0.11 {-1.51}	-0.12 {-1.74}*	-0.05 {-0.83}	-0.04 {-0.74}	-0.13 {-1.77}*	-0.12 {-1.77}	-0.04 {-0.74}	-0.13 {-1.73}*	-0.07 {-1.12}	-0.07 {-1.11}
	Credit by Banks (%GDP)	-0.01 {-1.05}	-0.01 {-0.78}	-0.01 {-1.00}	-0.01 {-1.06}	-0.01 {-1.03}	-0.01 {-1.04}	-0.01 {-0.90}	-0.01 {-0.74}	-0.01 {-1.04}	-0.01 {-1.05}	-0.01 {-0.73}	-0.01 {-1.04}	-0.01 {-0.77}	-0.01 {-0.77}
	Short-term Rate	1.15 {1.28}	0.86 {0.93}	1.04 {1.13}	0.80 {1.00}	1.21 {1.35}	1.47 {1.69}*	0.72 {0.89}	0.67 {0.81}	1.56 {1.75}*	1.53 {1.75}*	0.66 {0.78}	1.59 {1.72}*	1.07 {1.30}	1.08 {1.23}
	Foreign Influence	0.02 {4.81}***	0.02 {5.00}***	0.02 {4.78}***	0.02 {5.12}***	0.02 {4.95}***	0.02 {5.00}***	0.02 {5.13}***	0.02 {5.13}***	0.02 {5.07}***	0.02 {5.10}***	0.02 {5.19}***	0.02 {4.99}***	0.02 {5.30}***	0.02 {5.43}***

**Table 7G: Coefficients and {T-statistics} for Sector Technology (2 companies), 83 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
R-Squared	0.68	0.67	0.68	0.67	0.67	0.68	0.67	0.67	0.68	0.68	0.69	0.70	0.68	0.70	
Commodities & Components	Copper	0.13 {1.50}									0.20 {1.73}*	0.20 {1.82}*		0.20 {1.68}*	
	Gas		-0.01 {-0.28}				-0.02 {-0.47}								
	Gold			-0.33 {-1.62}							-0.47 {-2.14}**	-0.44 {-2.00}**		-0.46 {-2.17}**	
	Oil				0.04 {0.33}		0.05 {0.41}								
	Soy					0.01 {0.07}			-0.02 {-0.16}						
	Wheat						0.22 {1.51}		0.23 {1.51}						
	Energy							0.00 {0.09}			0.00 {0.25}		0.00 {0.19}	0.00 {0.35}	
Agriculture									0.01 {1.27}		0.01 {1.14}	0.01 {1.27}	0.01 {1.16}		
Control Variables	GDP	-2.02 {-0.98}	-1.69 {-0.83}	-1.39 {-0.67}	-1.85 {-0.89}	-1.70 {-0.80}	-2.80 {-1.28}	-1.92 {-0.91}	-1.70 {-0.84}	-2.75 {-1.23}	-2.49 {-1.11}	-1.86 {-0.84}	-2.52 {-1.03}	-2.55 {-1.13}	-2.60 {-1.04}
	Market Cap (%GDP)	-0.07 {-0.59}	-0.07 {-0.54}	-0.07 {-0.57}	-0.05 {-0.40}	-0.06 {-0.52}	-0.02 {-0.16}	-0.06 {-0.44}	-0.06 {-0.43}	-0.02 {-0.18}	-0.03 {-0.22}	-0.08 {-0.53}	-0.06 {-0.41}	-0.02 {-0.14}	-0.04 {-0.27}
	Credit by Banks (%GDP)	-0.01 {-1.27}	-0.01 {-1.22}	-0.01 {-1.14}	-0.01 {-1.12}	-0.01 {-1.17}	-0.01 {-1.24}	-0.01 {-1.19}	-0.01 {-1.12}	-0.01 {-1.24}	-0.01 {-1.22}	-0.01 {-1.19}	-0.01 {-1.30}	-0.01 {-1.17}	-0.01 {-1.21}
	Short-term Rate	0.94 {0.50}	0.63 {0.33}	0.66 {0.36}	0.52 {0.27}	0.55 {0.31}	-0.22 {-0.12}	0.59 {0.30}	0.55 {0.28}	-0.17 {-0.09}	-0.09 {-0.05}	1.20 {0.56}	0.65 {0.32}	-0.15 {-0.08}	0.54 {0.24}
	Foreign Influence	0.06 {7.69}***	0.06 {7.35}***	0.06 {7.86}***	0.06 {7.47}***	0.06 {7.37}***	0.06 {7.94}***	0.06 {7.31}***	0.06 {7.36}***	0.06 {7.79}***	0.06 {7.71}***	0.06 {8.33}***	0.06 {8.42}***	0.06 {7.39}***	0.06 {8.18}***

**Table 7H: Coefficients and {T-statistics} for Sector Telecom (1 company), 83 observations. \* indicates significance at 10% level (\*\* = 5% level, \*\*\* = 1% level).**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)		
R-Squared	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57		
Commodities & Components	Copper	-0.01 {-0.16}									-0.00 {-0.06}	-0.00 {-0.00}		-0.00 {-0.02}		
	Gas		0.01 {0.54}				0.01 {0.64}									
	Gold			-0.05 {-0.24}							-0.05 {-0.23}	-0.05 {-0.24}		-0.05 {-0.24}		
	Oil				-0.02 {-0.27}			-0.03 {-0.39}								
	Soy					-0.05 {-1.01}				-0.05 {-1.00}						
	Wheat						0.00 {0.07}			0.01 {0.17}						
	Energy							0.00 {0.08}			0.00 {0.17}		0.00 {0.04}	0.00 {0.12}		
	Agriculture										-0.00 {-0.66}	-0.00 {-0.68}	-0.00 {-0.65}	-0.00 {-0.64}		
	Control Variables	GDP	0.27 {0.22}	0.25 {0.22}	0.28 {0.24}	0.32 {0.26}	0.40 {0.35}	0.22 {0.17}	0.37 {0.30}	0.23 {0.20}	0.35 {0.28}	0.42 {0.34}	0.27 {0.23}	0.47 {0.38}	0.42 {0.33}	0.46 {0.36}
		Market Cap (%GDP)	0.04 {0.41}	0.04 {0.47}	0.04 {0.39}	0.03 {0.36}	0.03 {0.31}	0.04 {0.42}	0.04 {0.43}	0.04 {0.40}	0.03 {0.33}	0.03 {0.32}	0.04 {0.41}	0.03 {0.30}	0.03 {0.31}	0.03 {0.31}
Credit by Banks (%GDP)		-0.01 {-1.23}	-0.01 {-1.15}	-0.01 {-1.26}	-0.01 {-1.27}	-0.01 {-1.26}	-0.01 {-1.24}	-0.01 {-1.15}	-0.01 {-1.22}	-0.01 {-1.26}	-0.01 {-1.25}	-0.01 {-1.20}	-0.01 {-1.24}	-0.01 {-1.22}	-0.01 {-1.20}	
Short-term Rate		-0.79 {-0.68}	-0.82 {-0.69}	-0.75 {-0.64}	-0.74 {-0.64}	-0.60 {-0.51}	-0.78 {-0.67}	-0.80 {-0.69}	-0.77 {-0.65}	-0.63 {-0.54}	-0.61 {-0.52}	-0.78 {-0.64}	-0.59 {-0.48}	-0.62 {-0.51}	-0.62 {-0.49}	
Foreign Influence		0.03 {12.82}***	0.03 {11.88}***	0.03 {13.24}***	0.03 {12.45}***	0.03 {12.21}***	0.03 {12.23}***	0.03 {11.63}***	0.03 {12.47}***	0.03 {11.97}***	0.03 {11.93}***	0.03 {12.47}***	0.03 {12.67}***	0.03 {11.91}***	0.03 {12.45}***	

## 6.1 Commodities

Copper appears to become less significant for the Basic Materials sector in comparison with the full-sample test. The sign of the coefficient remains positive which is a good thing. For several other sectors the sign went from positive to negative.

Natural gas remains its positive and significant influence on the Oil & Gas sector and its negative influence on the Financials sector. The full-sample test results repeat themselves in the robustness check, meaning this variable has a robust influence on the above mentioned sectors.

Just like natural gas, gold also keeps its explanatory power for the sectors it was already significant for in the full-sample test. Both Consumer Services and Industrials sectors are significantly and negatively influenced by gold prices.

Crude oil loses significance for the Basic Materials sector. The significant result for the Oil & Gas sector remains. According to these results the price of crude oil was more important for the Basic Materials sector when the recent financial crisis was incorporated. The oil price is still highly significant for the Oil & Gas sector which makes sense looking at the core-business activities of the companies included in this sector.

Soy loses significance for all sectors it was significant for in the first full-sample test. The signs however are still the same (negative). The significant results from the first test are apparently not significant when the global financial crisis is taken out of consideration. According to a Dutch research bureau the worldwide production of soy increased more than 54% over the first decade of the 21<sup>st</sup> century. Soy is becoming a more important commodity in this world. China's soy-consumption 7-folded over the same period and is now the largest customer of soy products and is still growing at high speed. The last years included in the full-sample tests (and thus excluded in the last test) were the years soy was becoming more and more important in comparison with the years before. Wheat also loses its significant results when the last few years are excluded from the research. Next to the explanation for the loss of significant results for soy, both agricultural commodities lose their significance in the robustness check. The sample period becomes shorter in terms of time and thus observations what has some influence. Combining both these commodities into one using the principal component analysis the results are still not significant for the sectors Consumer Goods and Consumer Services (the sectors for which these commodities are most important looking at core-business activities of the companies included). For these two commodities the financial crisis was a period of time in which the companies got more dependent of commodity prices.

The other component created out of two related commodities (Energy, created out of the Oil & Gas series) loses significance for the sector Basic Materials, which is in line with expectations looking at the results for the single commodities where oil appeared to lose its significance. However for the most important sector for these commodities (once again based on core-business activities of the companies included) the coefficients are still positive and highly significant. The Energy-component has a robust and positive relationship with the returns of the Oil & Gas sector.

## **6.2 Control Variables**

### **6.2.1 Real economy variable**

The GDP-variable shows negative coefficients once again. The explanation behind these results has already been discussed in the results-section of the full-sample test. Also the coefficients still have an insignificant effect on the dependent variables.

### **6.2.2 Financial control variables**

The variable representing the size of the market (market capitalization as percentage of GDP) shows different results in the robustness check. In the full-sample test this variable showed to have significant influence for the Consumer Goods sector; in the robustness check this significance is lost. At the same time the sign of the coefficient was opposed too. During the pre-crisis period the influence of this variable on the dependent variables (AEX-sectors) was a negative one. When the market capitalization in terms of GDP was rising, the returns of the Consumer Goods sector were declining. The same explanation compared with the full-sample test applies here. The frequency of the data is somewhat different. Although all variables have monthly observations, both the market size variable and the banking-performance variable are only supplied as annual observations. Using the technique of interpolation to manually change the frequency from annual to monthly does not take away the fact that the real number of observations for both these variables is different compared with other variables. Looking at the banking-performance variable (Domestic credit provided by banks to private sector as percentage of GDP), the pre-crisis period gave significant negative coefficients for the Consumer Goods and Consumer Services sectors. The significant coefficients for the Telecom sector in the full-sample test are not robust because they lose their significance in the robustness check.

### **6.2.3 Policy control variable**

The short-term interest rate was not significant in the full-sample test, but had negative coefficients which were in line with the theory about this variable. Now looking at the results the robustness-check gave, the coefficients are now and then positive and even significant at the 10%-level now and

then. This variable is considered as a policy variable, meaning governments use the interest rate to partly control the economy to reduce extreme growth or to stimulate it in difficult times. When the government tries to reduce the growth of an economy by increasing the interest rate, it becomes more expensive for individuals and companies to borrow money therefore investments will take place less often resulting in less growth of the economy. But when an economy keeps growing despite a higher interest rate, the coefficients of regression results will become positive (higher rates, higher index values).

#### **6.2.4 Foreign control variable**

The component Foreign Influence, created out of the series S&P500, DAX and MSCI World due to high correlations and thus the multicollinearity problem, still gives highly significant positive coefficients. This shows that the international economies around the Dutch economy are very important for Dutch domestic growth; a result based on the Dutch open economy relying heavily on international trade.

## 7. Conclusions and potential future research areas

The purpose of this paper was to investigate a possible relationship between commodities and the sector specific returns of the Dutch AEX index. To be able to answer this question, the AEX Index has been divided into eight different sectors which were dependent variables (left-hand side) in the regressions that have been made. Six commodities (Copper, Gas, Gold, Oil, Soy and Wheat) have been used to identify a possible relationship between them and the different sectors. Also several control variables (GDP-growth, Market capitalization (%GDP), Credit to private sector provided by banks (%GDP), Short term interest rate and foreign stock index returns) were added to capture other effects on the AEX Index. All data was obtained with monthly observations from March 2001 until December 2010 resulting in 118 observations. All variables are calculated as growth/return compared with the previous month (except short term interest rate, market capitalization and credit to private sector provided by banks as percentages of GDP which are denoted in levels). Finally a robustness check has been made which took out the recent financial crisis to be able to judge which results are robust.

The results show strong evidence of a positive relationship between the price of energy-related commodities and the Oil & Gas sector. Oil-producing companies like Royal Dutch Shell benefit from higher oil and gas prices. Initially agriculture-related commodities (soy and wheat) had a significant negative influence on consumer-sectors, but the robustness test showed these results were not robust enough. Gold showed several robust negative coefficients for the sectors Consumer Services, Financials, Industrials and Technology. As a commodity which keeps its value a negative coefficient was expected because gold prices rise in times of financial turmoil. Copper had positive and significant influence on the metal-producing companies in the Basic Materials sector, but the significance was lost during the robustness check.

The control variables were added to every regression to capture other influences that move the AEX Index. There is very strong evidence of a positive relationship between foreign economic performances and the Dutch index. In every regression this variable is positive and highly significant (at 1%-levels), even after the robustness check. This shows to what extent the Dutch economy is relying on international economic performances and trade.

Concluding all the results from this study, sectors react differently to commodity prices based on their core-business activities. The companies producing/mining commodities (Basic Materials / Oil & Gas) have positive relationships with commodity prices, while commodity-consuming sectors see

costs rising with commodity prices. Explanatory power was added to the models by the control variables, from which the foreign influence was the most important one by far.

This study contains a robustness check which uses data from March 2001 until December 2007. The results were different compared with the full-sample test. In future research work one could use higher frequency data in a shorter period of time what could provide even more accurate results. Because the second test uses a shorter period of time showed different results, one might also research the underlying reason why this is the case. Finally a profitable investment strategy can be created and tested based on the results this study provides with regards to the established relationships. On the other hand, one could investigate long-run Dutch stock returns. According to Fama & French (1988) these long-run stock returns have large predictable components which might not be commodity-related at all.



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## Appendix A: Composition AEX-Index to sectors and industries based on ICB-Classifications

Company	ICB Industry (Level 1)	ICB Subsector (Level 4)
Akzo Nobel Aperam Arcelor Mittal DSM	Basic Materials	1357 Specialty Chemicals 1757 Iron & Steel 1757 Iron & Steel 1357 Specialty Chemicals
Heineken Philips Unilever	Consumer Goods	3533 Brewers 3743 Consumer Electronics 3577 Food Products
Ahold Air France-KLM Reed Elsevier Wolters Kluwer	Consumer Services	5337 Food Retailers & Wholesalers 5751 Airlines 5557 Publishing 5557 Publishing
AEGON Corio ING Unibail-Rodamco	Financials	8575 Life Insurance 8672 Retail REITs 8575 Life Insurance 8672 Retail REITs
Boskalis PostNL Randstad TNT Express	Industrials	2357 Heavy Construction 2771 Delivery Services 2793 Business Training & Employment Agencies 2771 Delivery Services
Fugro Royal Dutch Shell-A (NL) SBM Offshore	Oil & Gas	0573 Oil Equipment & Services 0537 Integrated Oil & Gas 0573 Oil Equipment & Services
ASML Holding TomTom	Technology	9576 Semiconductors 9578 Telecommunications Equipment
KPN	Telecommunications	6535 Fixed Line Telecommunications

## Appendix B: Correlation Matrix

	Basic Materials	Consumer Goods	Consumer Services	Financials	Industrials	Oil & Gas	Technology	Telecom	Copper	Gas	Gold	Oil	Soy	Wheat	Energy	Agriculture	GDP	Market cap (%GDP)	Credit by banks (%GDP)	Short Rate	Foreign Influences	
<b>Basic Materials</b>	1.00																					
<b>Consumer Goods</b>	0.60	1.00																				
<b>Consumer Services</b>	0.70	0.69	1.00																			
<b>Financials</b>	0.75	0.63	0.75	1.00																		
<b>Industrials</b>	0.71	0.65	0.79	0.78	1.00																	
<b>Oil &amp; Gas</b>	0.58	0.50	0.59	0.46	0.51	1.00																
<b>Technology</b>	0.62	0.60	0.75	0.73	0.85	0.43	1.00															
<b>Telecom</b>	0.36	0.36	0.59	0.46	0.51	0.36	0.54	1.00														
<b>Copper</b>	0.47	0.26	0.23	0.39	0.31	0.19	0.32	0.17	1.00													
<b>Gas</b>	0.11	0.10	-0.00	-0.07	0.08	0.16	0.02	0.06	0.06	1.00												
<b>Gold</b>	0.16	-0.03	-0.10	0.02	-0.08	-0.01	-0.09	-0.02	0.32	0.15	1.00											
<b>Oil</b>	0.32	0.13	0.07	0.15	0.14	0.31	0.07	-0.00	0.42	0.24	0.21	1.00										
<b>Soy</b>	0.29	0.05	0.06	0.16	0.20	0.19	0.17	0.09	0.25	0.06	0.19	0.11	1.00									
<b>Wheat</b>	0.17	-0.05	-0.03	0.06	0.05	0.01	0.09	0.11	0.27	0.11	0.21	0.09	0.41	1.00								
<b>Energy</b>	0.27	0.14	0.04	0.06	0.14	0.30	0.05	0.04	0.31	0.79	0.23	0.79	0.11	0.13	1.00							
<b>Agriculture</b>	0.27	-0.00	0.02	0.13	0.15	0.12	0.16	0.12	0.31	0.10	0.24	0.12	0.84	0.84	0.14	1.00						
<b>GDP</b>	0.12	0.10	0.08	0.10	0.09	0.08	0.04	0.13	0.13	0.07	0.01	0.15	0.09	0.17	0.14	0.16	1.00					
<b>Market cap (%GDP)</b>	0.17	0.18	0.12	0.13	0.06	0.06	0.07	0.02	0.07	-0.02	0.01	0.07	0.08	0.09	0.03	0.10	0.53	1.00				
<b>Credit by banks (%GDP)</b>	-0.04	-0.05	-0.10	-0.03	-0.08	-0.07	-0.09	-0.19	-0.03	0.03	-0.05	0.00	-0.04	-0.05	0.02	-0.05	-0.11	0.16	1.00			
<b>Short Rate</b>	-0.17	-0.21	-0.22	-0.25	-0.23	-0.17	-0.26	-0.15	-0.26	-0.04	-0.09	-0.12	0.01	0.02	-0.10	0.02	0.03	0.16	0.06	1.00		
<b>Foreign Influences</b>	0.78	0.68	0.73	0.87	0.80	0.56	0.77	0.49	0.43	0.05	0.09	0.17	0.28	0.12	0.14	0.24	0.13	0.14	-0.05	-0.27	1.00	

## Appendix C: Principal Component Analysis

*Principal Component Analysis for Gas and Oil series. Component number 1 is used as the component Energy.*

Eigenvalues: (Sum = 2, Average = 1)					
Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	1.241155	0.482309	0.6206	1.241155	0.6206
2	0.758845	---	0.3794	2.000000	1.0000

Eigenvectors (loadings):		
Variable	PC 1	PC 2
GAS	0.707107	-0.707107
OIL	0.707107	0.707107

*Principal Component Analysis for Soy and Wheat series. Component number 1 is used as the component Agriculture.*

Eigenvalues: (Sum = 2, Average = 1)					
Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	1.408080	0.816160	0.7040	1.408080	0.7040
2	0.591920	---	0.2960	2.000000	1.0000

Eigenvectors (loadings):		
Variable	PC 1	PC 2
SOY	0.707107	-0.707107
WHEAT	0.707107	0.707107

*Principal Component Analysis for S&P500, DAX and MSCI World Index. Component number 1 is used as the component Foreign Influence.*

Eigenvalues: (Sum = 3, Average = 1)					
Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	2.780532	2.585183	0.9268	2.780532	0.9268
2	0.195350	0.171232	0.0651	2.975882	0.9920
3	0.024118	---	0.0080	3.000000	1.0000

Eigenvectors (loadings):			
Variable	PC 1	PC 2	PC 3
DAX	0.557943	0.829466	0.026198
S_P	0.585906	-0.416076	0.695410
MSCI	0.587719	-0.372649	-0.718136

The last column of every illustration shows the percentage of variance included in the created component. This always sums up to one, representing 100% of the available variance. Because the analysis is performed on a correlation matrix (in which variances are always 1), the total variance to be captured equals the number of variables included in the analysis. The Energy component includes

62% of the variance originated in the Gas and Oil series. 70 percent of the variance in the Soy and Wheat series is captured by the component Agriculture. The component created out of the three foreign stock indices contains 93% of the original variance. The components from one table are uncorrelated amongst each other, although this study only uses the first component created in every table. This is the case because the original variance covered is high (62% - 93%). In the regressions these components replace the original series of commodities and indices.

## Appendix D: Eviews Programming

For this study I used a self-written program in Eviews for running regressions. This method took some time to understand, but in the end it saved a lot of time. A program works if you use groups in Eviews. First I created a group called sectors, including all 8 AEX sectors. A second group was called control, containing every control variable. After that several groups were made, all including one or more commodities or components, and all control variables. In this way Eviews knows to take which group when. The program I used is the following:

```
matrix(10,8) coefs
matrix(10,8) tstats
vector(8) r2s

!rowcounter=1

equation eq

for !i=1 to sectors.@count
  %iname = sectors.@seriesname(!i)
  %coppercontrol = coppercontrol.@members
  equation eq_{%iname}.ls(n) {%iname} c {%coppercontrol}
  colplace(coefs, eq_{%iname}.@coefs, !i)
  colplace(tstats, eq_{%iname}.@tstats, !i)
  r2s(!rowcounter) = eq_{%iname}.@r2
  !rowcounter = !rowcounter+1
next
```

The first three rows of this program create empty matrixes and a vector to save data in. The matrixes are called coefs (from: coefficients) and tstats (from: t-statistics) where the vector is called r2s (from: R-squared). The next row creates a command which makes sure Eviews places an R-squared measure under the last one in the vector r2s every time (otherwise it would place them on top of each other so that only the last value will be visible). Also an empty equation “eq” is created. After that, the real program begins. With the command “for” I started a loop, a process that runs again and again. The “sectors.@count” command tells Eviews to use the first column of the group “Sectors” in the first loop, and the second column of this group in the second loop and so forth.

“%iname = sectors.@seriesname(!i)” shows what %iname means (this is used in the equation line later on in the program). In this way it means Eviews uses only one column/series from the group sectors due the command “@seriesname(!i)”. Eviews starts at the left-hand side, using the sector Basic Materials first. So for the first regression only, %iname = Basic Materials. The command on the next line is %coppercontrol = coppercontrol.@members. This line states once again with what %coppercontrol means. In the workfile a group called “Control” has been created containing all control variables used in every regression. To add a commodity, the original group has to be

expanded with one which in this case is copper. Therefore the new name for this group is “coppercontrol” (also the groupnames “gascontrol”, “goldcontrol” etc exist) The next line shows the real equation which is estimated.

The first part (equation eq\_{%iname}) shows the name of the equation that appears in the workfile once the user runs the program. As stated above, the first regression will be called “eq\_Basic\_Materials”. The next part (.ls(n)) tells Eviews to use the Least Squares method and the Newey-West algorithm to create HAC-Standard Errors. The last part of this line ({%iname} c {%coppercontrol}) shows the real equation. %sector is the dependent variable, c is the constant and %control represents all the control variables available in the group “control”. Now Eviews is able to run the program, but it only runs the regressions itself. But I let Eviews create matrixes and a vector to store important data from my regressions.

The command to store the coefficients of every regression in the “coefs” matrix is the following: colplace(coefs, eq\_{%iname}.@coefs, !i). This command makes Eviews store the coefficients from the regression in the “coefs” matrix in this corresponding column (!i). The command to store t-statistics in the right matrix is almost identical to the one above, only the term “coefs” is replaced by “tstats”. Because this is still inside the loop, it only counts for one regression. In the second round of this loop, the coefficients and t-statistics are stored again, but in the second column because those results belong to another regression. The command on the next line is somewhat different because it stores data into a vector and not a matrix, but basically does the same; storing R-squares into a single vector for every regression in another cell. The term “next” makes an end to the loop and forces Eviews to run through the loop again until all the “seriesnames” from the group “sectors” are used (8).