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Influence of Macroeconomic Factors on the Performance of Sector Stock Indices

Evidence from the United States

by

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Abstract

The present paper aims to analyze the impact of eleven macroeconomic factors and the one-month lagged stock return on the performance of ten sectors within the United States. The set of potential factors is based on previous research as well as published methodologies of credit rating agencies. It includes the one-month lagged stock return, earnings per capita, consumer price index, private consumption, unemployment rate, labor costs, producer price index, oil price, gross domestic product, GDP deflator, interest rate and exchange rate. The assessed sectors are chosen in accordance to the Global Industrial Classification Standard (GICS) classification.

The results show that earnings per capita, consumer price index, private consumption, unemployment rate, producer price index, oil price, gross domestic product and exchange rate have a significant impact on at least one of the sectors, whereby earnings per capita is significant in eight sector models. Concluding, the estimated models can be used as a foundation for enhancing the transparency of credit rating agencies and for future research on the topic.

Keywords: Credit Rating, Industry Risk, Macroeconomics, Standard & Poor's, Moody's Corporation, GICS

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Abbreviations

BRP	Business Risk Profile
CP	Private Consumption
CPI	Consumer Price Index
CRA	Credit Rating Agencies
CSP	Correct Sign Prediction
EPC	Earnings per Capita
ER	Exchange Rate
FRP	Financial Risk Profile
GDP	Gross Domestic Product
GDP_D	GDP Deflator
GICS	Global Industry Classification Standard
IRS	Interest Rate Spread
IT	Information Technology
LC	Labor Cost
MAPE	Mean Absolute Percentage Error
MSE	Mean Squared Error
Moody's	Moody's Corporation
OLS	Ordinary Least Squares
OP	Oil Price
PPI	Producer Price Index
S&P	Standard & Poor's
UR	Unemployment Rate
US	United States

1 Introduction

Credit rating agencies (CRA) play an important role in the financial system, inter alia when it comes to overcoming information asymmetries in the market. (Levich, Majnoni & Reinhart, 2002). The current Basel regulations require financial institutions (Basel III, 2011) as well as other market participants in the financial industry (Solvency II, 2009), such as CRA, to disclose all information that is crucial to understand and reproduce the processes necessary within the core fields of business. When it comes to CRA disclosure, this led to a series of revised credit rating methodologies. In these methodologies, the analysis is generally divided into two, formally separated parts: The financial risk profile (FRP) and the business risk profile (BRP) (S&P, 2015a). The FRP is composed of a quantitative assessment of the profit- and loss-statement, the balance sheet and the cash flow statement and gives judgment about the profitability as well as the financial sustainability of the company. The BRP, on the other hand, covers a mainly qualitative assessment of the country risk, the risk connected to the specific industry as well as operational factors such as strategy, management team, internal risk management and controlling processes. This assessment is based on qualitative assumptions only. The factors influencing the different matters are, just as in the FRP, disclosed in the methodology, but the numerical assessment and weighting, leading to an adjustment of the rating notation is, for the time being, not possible to disclose transparently. This led to criticism towards CRA (Grene, 2014), as many financial transactions rely on the objectivity of credit ratings and hence the comprehensibility of the processes is crucial.

Since the industry risk assessment is a substantial part within the BRP, the aim of the present paper is to identify macroeconomic factors that have a significant impact on the industry performance. In addition, the paper aims to analyze the amplitude of this impact as well as to draw conclusions on how to adequately forecast it. Furthermore, the objective is to shed light on the analytical approach within the industry risk assessment of CRA, as it generally includes factors exceeding the standard set of factors in the empirical research. To meet these two aims, the authors generate ten separate sector models according to the Global Industrial Classification Standard (GICS) sector classification, in which an observed measure of industry risk is explained by several macroeconomic factors. Since most credit rating methodolo-

gies have been introduced within the past three years only, there is not enough data available to explain variation in the applied industry risk measure within the rating process directly. Hence, the performance of industry stock indices is applied as a proxy for an observed industry risk measure. The authors are aware that this substitution does not reflect all factors included into a proper industry risk analysis carried out by CRA. Nevertheless, they assume the findings to be an adequate proxy for future research on the topic.

This paper separately analyzes ten S&P 500 sector sub-indices' performance with twelve explanatory factors within the United States (US). These factors are gross domestic product (GDP), inflation, exchange, interest and unemployment rates, oil price, producer and consumer price indices, private consumption, earnings per capita, labor cost and one-month lagged stock return. The factors are selected thoroughly via an analysis of previous research as well as published credit rating methodologies. The selected time frame is 20 years (1995-2015). The methodology follows a multi-factor time series regression approach, where each individual S&P 500 sector is regressed against twelve factors over the estimation period starting from March 1995 until December 2011. Afterwards, the significant factors at a level of significance of up to 10 % are selected and tested between January 2012 and December 2015.

The paper contributes to the ongoing research about the impact of macroeconomic variables on stocks, stock indices or economies. Furthermore, it is supposed to enable and improve comprehensibility and transparency within the credit rating process, in order to support it as an objective, adequate risk measure within the financial industry. In addition to the contribution to the existing research, this study enables CRA to further improve their methodologies by giving quantified estimates of influencing factors for a variety of sectors.

In Chapter 2, a potential set of significant factors is discussed, based on previous research on the topic or related subjects and an analysis of CRA methodologies on how industries are assessed. Afterwards, Chapter 3 introduces the research methodology, covering the selection and collection of data as well as the implementation of the regression analysis. Finally, it ends by displaying the results of the main regressions, that where then used to derive the final ten sector models. These sector models are then discussed and analyzed in Chapter 4. The focus is thereby on the economic analysis and interpretation of the causalities between the significant factors and the respective sector. Concluding the thesis, Chapter 5 summarizes the research outcome, assesses the achievement of the aim and contribution of the paper and gives implications for future research on this topic.

2 Literature Review

The paper focuses on twelve factors, whereas the first six factors have been derived from previous empirical research and another six have been derived from published credit rating methodologies. In chapter 2.1, the authors examine the previous research about the impact of different macroeconomic factors on the development of different industry stock performances. The most commonly used factors are GDP, inflation, exchange rate, unemployment rate, oil price and one-month lagged stock return, which are therefore discussed in chapters 2.1.1 until 2.1.6. In chapter 2.2, the industry risk assessment criteria of the most relevant CRA, Standard & Poor's (S&P) and Moody's Corporation (Moody's), are scrutinized and six commonly applied factors are selected. Based on the analysis, the authors are able to identify the producer and consumer price indices, private consumption, earnings per capita, labor cost and interest rates as potentially significant factors.

2.1 Empirical Research

2.1.1 Gross Domestic Product

Malik et al. (2014) conduct research on which macroeconomic factors affect the renewable energy industry in Pakistan. They examine the relationship between population growth, urbanization, industrialization, exchange rate, price level, food production index and livestock production index with the industry between 1975 and 2012. The study concludes that GDP growth rate as a factor has the largest level of influence with a steady contribution to the renewable energy development with 34.41 %, whereas the influence of population (3.49 %), urbanization (4.97 %) and inflation (2.27 %) are lower. In addition, the paper by Nguyen (2006), focuses on macroeconomic factors and Japan's industry risk. The Japanese industries are analyzed over the period 1970-2005, comparing the relationship to the various factors such as GDP, exchange rate fluctuations and interest rate spread. As a result, the log difference of real GDP has an impact of 6.94 for retail and 8.52 for automotive industries at 1 % significance level and 4.46 for consumer electronic industry at 10 % significance level.

The third paper of consideration has a focus on the New Zealand market, in which Gan et al. (2006) examine potential correlations between the development of the New Zealand Stock Index and seven macroeconomic variables through applying a test for cointegration. This leads to two significant results. On the one hand, the interest rate, money supply and real GDP have an apparent impact on the stock index. On the other hand, the stock index does not act as an indicator for changes in any of the macroeconomic factors. It can therefore be concluded that GDP is proven to have a significant impact on several industries among various regions. Hence, it is chosen as a potentially significant factor in the present analysis.

2.1.2 Inflation Rate

In their research, Manolis et al. (2002) analyze the correlation between macroeconomic factors and international industry returns over the period from 1987-1997. The global macroeconomic factors are industrial production, inflation, oil prices, fluctuations in exchange rate against US dollar and a measure of credit risk. The outcome shows that the sensitivity of the industry returns towards the inflation rate is -3.867 for utilities and 6.586 for metals (nonferrous) industries' returns at 1 % significance level. For multi-industries the value is 2.83 and for electronic components and reproduction it is -3.62 at 5 % significance level. Business and public services has a sensitivity of -1.49, forest products and papers of 2.77 and music, materials and commodities of 1.77 all at 10 % significance level. Although expressed with different magnitudes and signs, the study shows that an impact of the inflation rate is eminent. Especially since the study is carried out on a multinational basis, transferring the conclusion to the US market seems promising.

2.1.3 Exchange Rate

Analyzing the relationship between macroeconomic factors and Japan's industry risk, Nguyen (2006) finds the logged difference in the yen's effective exchange rate to be -2.04 for machine tools, -1.43 for export and -1.06 for domestic trade at 1 % significance level. The respective difference for the automotive (-1.85), machinery (-1.37), consumer electronics (-1.94) and petroleum (-2.21) industries are at 5 % significance level and transport equipment (-2.04) and steel (-4.73) industries are at a 10 % significance level. A study similar in nature prepared by Manolis et al. (2002) on the correlation between macroeconomic factors and international industry returns over the period from 1987-1997 finds significant correlation be-

tween exchange rate and the textile and apparel industry with a sensitivity of -0.25 at 1 % significance level. Food and household products (0.08), materials and commodities (-0.09) and utilities (0.11) are also found significant at a 5 % significance level. Based on the outcomes of the studies as well as the role of the US dollar as an important lead currency on a global basis, exchange rate is included into the study.

2.1.4 Unemployment Rate

Amongst others, McQueen and Roley (1993) researche the impact of macroeconomic news on financial markets. Their dataset covers the years 1981 until 2005 with S&P 500 and Russel 2000 stock price indices, bond yields, actual values and survey-based expectations of announcements of unemployment rate and producer price index. The outcome of the research is that during the recession period, unemployment news has more impact on stock return volatility with 0.1775 at 1 % significance level than in expansion, where the sensitivity is 0.0369 at 5 % significance level for S&P 500. Whereas for the Russel 2000 index, in the recession the impact is 0.1437 at 1 % significance level and for expansion periods 0.025 at 5 % significance level. In comparison, Nielsen et al. (2015) analyze the relationship between macroeconomic and industry-specific business cycle indicators and related injuries among Danish construction workers within the 1984-2010-time period. They use GDP and the Danish unemployment rate as macroeconomic indicators and gross value added and the number of employees as the industry-specific indicators. The statistical outcome results in an intercorrelation of -0.83 among business cycle indicators and unemployment (all industries-construction-specific indicators) at 5 % significance level. Additionally, Wan et al. (2013) analyze the impact of macroeconomic announcements on the US forest products industry and find a significant impact of industrial production and unemployment rate related news. During an expansion period unemployment news have a negative impact on the portfolio returns of -0.024 and -0.026 for the full sample, both at 10 % significance level. Unemployment has a significant impact on the performance of several industries directly and also a behavioral aspect in consumer preferences. Hence, the inclusion of this factor promises to be valuable to the outcome of the study.

2.1.5 Oil Price

In the study by Elhusseiny, Attia and Almurshidee (2015), the authors pursue a rather comprehensive approach, examining the impact of macroeconomic factors on industry stock returns in the United Kingdom. They constructe different factors of economic risk, including industrial production, inflation, change of expected inflation, term structure, foreign exchange rate and oil price. These factors are regressed against the stock returns of the insurance, telecommunications, banking, chemicals and utilities industries. The analysis shows that an unexpected change in oil price of -0.073 is significant at 5 % level within the telecommunications industry stock returns. Another study by Kaneko and Lee (1995) in the US and Japanese stock markets find that for the period of 1985-1993, the international factors, such as changes in oil prices and exchange rates are significant in the stock return regression. The change in oil prices is the most significant variable in the forecast error variance decomposition of the stock returns with the forecast error variance of 13.45 for one month and 15.38 for 36 months. Especially based on Kaneko and Lee's (1995) findings, which are inter alia US based, the oil price is chosen to be included into the study.

2.1.6 One-Month Lagged Stock Return

Whilst Altinbas & Biskin (2015) use the Turkish stock index BIST 100 as the market indicator, they aim to find the factor significance by using a sequential forward selection algorithm. The outcome of their study is, that the one-month lagged market indicator index value is sufficient to predict the market indicator index's future value. In addition, according to Asgharian (2015, p. 12), when a return series is characterized as a stochastic process, the "best forecast of tomorrow's price is simply today's price". Hence, this economic intuition is also taken into account and the one-month lagged stock return is selected as a factor for the analysis.

2.2 Credit Rating Methodologies

After reviewing the empirical studies, the five macroeconomic factors in addition to one-month lagged stock return are selected. The second step is to analyze and select the appropriate macroeconomic factors from the credit rating methodologies. In the credit rating methodologies, the focus is on the risk assessment criteria of CRA, such as S&P and Moody's.

Starting with the corporate rating methodology of S&P (S&P, 2015a), the methodology outlines the BRP incorporating three key assessments. S&P combines industry risk, country risk and competitive position assessments. Additionally, the published industry rating methodology (S&P, 2015b) is valid for all non-financial industries. In summary, the industry risk assessment is divided into two main factors: *Cyclicality* and *Competitive risk and growth*. Figure 2.1 shows, how each factor is valued on a scale from 1 (very low risk) to 6 (very high risk), weighted and mapped against each other. The factor *Competitive risk and growth* is thereby given a higher weight, as it represents a forward-looking assessment, whereas the *Cyclicality* factor is based on historical figures. As a result, the industry is then again valued on a scale from 1 to 6.

Determining A Global Industry Risk Assessment						
	--Competitive risk and growth assessment--					
	Very low risk	Low risk	Intermediate risk	Moderately high risk	High risk	Very high risk
Cyclicality assessment						
Very low risk	1	2	3	4	5	6
Low risk	1	2	3	4	5	6
Intermediate risk	2	2	3	4	5	6
Moderately high risk	3	3	3	4	5	6
High risk	3	4	4	5	5	6
Very high risk	4	4	5	5	6	6

Figure 2.1 Factor-Weighting in the S&P Industry Risk Assessment (S&P, 2015b)

Taking a more detailed look into the two components, they are divided into several sub-factors, which are weighted and combined to an aggregated measure. The *Cyclicality* splits into the cyclicality of the industry revenue and profitability, whereas the *Competitive risk and growth* covers the barriers of entry, the forecasted growth and profitability as well as the like-

lihood of substitutions in terms of products, services or technologies. According to S&P, macroeconomic factors play an important role in the assessment of the current and forecasted industry growth and profitability. More precisely, factors such as level of competition, production input costs and volatility, asset and commodity price bubble-and-bust risk, labor costs, customer and supplier concentration, asset quality cost, catastrophic event risk, technological risk, legal risk, and government regulation and taxation are supposed to have a significant impact. Based on the ability to quantitatively measure these factors, the selected factors for the analysis are production input costs and volatility proxied by producer price index (PPI), asset and commodity price bubble-and-bust risk proxied by oil price and labor costs.

In contrast to the S&P approach, Moody's does not publish a general methodology for their industry risk assessment. On the contrary, they publish individual rating methodologies for corporates being active in the respective industry. As a simplified representation, the authors selected the published methodologies of the airline (Moody's, 2012), trading (Moody's, 2015), construction (Moody's, 2014), automotive (Moody's, 2011) and electric and gas utilities (Moody's, 2013) industries to analyze the herein mentioned factors. The choice of industries is made according to the intuition of covering the important sectors of transportation, retail, construction, manufacturing and energy.

Table 1 shows that whilst being rather concentrated on the research structure, the factors that are having an impact on the assessment of the respective industries can be divided into the two categories *Cyclicality* and *Economic and Financial Market Conditions*.

Table 1 Definition of significant macroeconomic variables by Moody's

Factor	**Sub-Factor**
Cyclicality	Price volatility
Economic and Financial Market Conditions	Private consumption Disposable income Interest rate

Concluding the credit rating methodologies, the following factors are selected for the current study: PPI, private consumption, earnings per capita, interest rate spread, consumer price index (CPI) and labor cost.

3 Methodology

The Methodology discusses the choice of the model and data as well as the implementation of the regression analysis. In chapter 3.1, the general model and chosen timeframe are introduced. Chapter 3.2 describes the choice of dependent and independent variables and their proxies. Whilst chapter 3.3 covers the obligatory tests for OLS assumptions, chapter 3.4 highlights the main regression results and in chapter 3.5 tests for validity and reliability are presented.

3.1 Model

The analysis, which factors have a significant impact on the performance of several industries within the US, is carried out through separate multi-factor time-series regressions. The choice of the model is based on the assumption that the focus of the present paper is rather on the economic analysis and interpretation of the regression than on the identification of the most suitable model to carry out this type of research. Hence, the authors decide to follow the approach first applied by Fama and French (1993). The method of choice is ordinary least squares (OLS). The applied time frame ranges from January 1995 until December 2015, whereby the time frame has been divided into a 16-year estimation-period (1995 until 2011) and a four-year test-period (2012 until 2015). The motivation for the specific choice of the periods is based on the effects of the financials crisis, which are observable mostly from 2008 until late 2011. Hence, the estimation-period can be seen as a through-the-cycle period, whereas the test-period is rather a period of economic stability. The general regression model is

$$R_{i,t} = \alpha_i + \sum_{t=1}^{N} \beta F_{i,t} + \varepsilon_{i,t},$$

where $R_{i,t}$ = monthly stock returns of S&P 500 sector sub-indices,

α_i = intercept term,

β = vector of sensitivity parameters for the macroeconomic factors,

$F_{i,t}$ = vector of factor realizations for the macroeconomic factors,

$\varepsilon_{i,t}$ = residual term,

i = subscript for the ten analyzed sectors

t = time subscript

N = subscript for the macroeconomic factors

The regression analysis is carried out in separate time series regressions in order to define the specific impact the macroeconomic factors have on the different sectors.

3.2 Data Collection

As the dependent variable for the regression, the returns on the ten S&P 500 sector sub-indices are chosen. These are based on the GICS and are therefore assumed to be a representative measure of the main sectors within the US economy. Hence, the database DataStream is used to retrieve the monthly stock prices of the following sub-indices:

- S&P 500 CONSUMER DISCRETIONARY (Ticker: S5COND)
- S&P 500 CONSUMER STAPLES (Ticker: S5CONS)
- S&P 500 ENERGY (Ticker: SPN)
- S&P 500 FINANCIALS (Ticker: SPF)
- S&P 500 HEALTH CARE (Ticker: S5HLTH)
- S&P 500 INDUSTRIALS (Ticker: S5INDU)
- S&P 500 INFORMATION TECHNOLOGY (Ticker: S5INFT)
- S&P 500 MATERIALS (Ticker: S5MATR)
- S&P 500 TELECOMMUNICATION SERVICES (Ticker: S5TELS)
- S&P 500 UTILITIES (Ticker: S5UTIL)

The literature review is used to identify a set of macroeconomic factors that could potentially have an impact on the performance of the target sectors. Based on the previous research on similar topics (see chapter 2.1), the following factors are identified:

- Gross domestic product (GDP)
- Inflation
- Exchange rate (ER)

- Unemployment rate (UR)
- Commodity risk
- One-month lagged stock return

Additionally, the analysis of the credit rating methodologies (see chapter 2.2) reveals the following set of factors:

- Disposable income
- Private consumption (CP)
- Price volatility
- Interest rate level
- Consumer price index (CPI)
- Labor costs (LC)

Since not all of these factors are directly observable, some factors are chosen to be represented by suitable proxies. This applies to inflation, exchange rate, disposable income, commodity risk, price volatility and the interest rate level, with the proxies GDP Deflator (GDP_D), US dollar index, earnings per capita (EPC), oil price (OP), producer price index (PPI) and the interest rate spread of a 10 year US treasury bond (IRS). Whilst most factors are equal in the cross-sectional dimension, the PPI has been chosen according to the closest fit to the respective industry. Finally, monthly prices on this set of macroeconomic factors are collected and transformed into returns.

3.3 Tests for OLS assumptions

Based on the general multi-factor model introduced in chapter 3.1 and the obtained macroeconomic factors in chapter 3.2, the following model is used as a basic model in the regression:

$$R_{i,t} = \alpha_i + \beta_1 R_{i,t-1} + \beta_2 EPC_t + \beta_3 CPI_t + \beta_4 CP_t + \beta_5 UR_t + \beta_6 LC_t + \beta_7 PPI_{i,t} + \beta_8 OP_t + \beta_9 GDP_t + \beta_{10} GDP\_D_t + \beta_{11} IRS_t + \beta_{12} ER_t + \varepsilon_{i,t}$$

where $R_{i,t}$ = monthly stock return of S&P 500 sector sub-indices,

α_i = intercept term,

β = sensitivity parameters,

$R_{i,t-1}$ = one-month lagged stock return of S&P 500 sector sub-indices,

EPC_t = monthly change in earnings per capita,

CPI_t = monthly change in consumer price index,

CP_t = monthly change in private consumption,

UR_t = monthly change in unemployment rate,

LC_t = monthly change in labor costs,

$PPI_{i,t}$ = monthly change in respective producer price index,

OP_t = monthly change in oil price,

GDP_t = monthly change in GDP,

GDP_D_t = monthly change in GDP deflator,

IRS_t = monthly change in interest rate spread,

ER_t = monthly change in US dollar index,

$\varepsilon_{i,t}$ = residual term,

i = subscript for the ten analyzed sectors

t = time subscript

The estimated models (Appendix A) are then tested for multicollinearity (Appendix B), autocorrelation (Appendix C), normality (Appendix D) and heteroscedasticity (Appendix E).

In order to test for multicollinearity, the testing procedure for near multicollinearity according to Brooks (2014) is applied, which involves displaying the macroeconomic factors for all ten sectors in a correlation matrix. Since none of the correlations exceeds the critical value of 0.8, multicollinearity is not present in either of the models.

To test whether or not the error terms of the estimated models are correlated amongst each other, i. e. whether or not autocorrelation is present and the third OLS assumption is violated, the Breusch-Godfrey test according to Brooks (2014) is applied. As the Breusch-Godfrey test is a more general test, it examines joint autocorrelation between several lags of the error term. Since the data has been collected with monthly frequency, autocorrelation up to lag 12 is tested, which defines the critical value of the χ^2-distribution with 12 degrees of freedom and a significance level of 95 % at 5.226. Table 2 displays the test results for the ten estimated models. According to the results, autocorrelation is detected in all models. Economic reasoning for this is on the one hand the cyclical patterns as well as the inclusion of the financial crisis in the estimation period, which causes momentum-type effects. Brooks (2014) recommends to use first differences as the dependent variable in the regression, which is already

done in the current models. Hence, according to common practice in applied research, no adjustments are made to the models.

Table 2 Results from Breusch-Godfrey test for autocorrelation

Sector	**Test-statistic**
Consumer Discretionary	14.9141
Consumer Staples	18.9130
Energy	13.6952
Financials	12.5929
Health Care	20.6145
Industrials	17.1487
Information Technology	12.1808
Materials	16.2014
Telecommunication Services	11.1400
Utilities	18.4158

The test for normality of the residuals is carried out by plotting a histogram of the residuals as well as carrying out the Jarque-Bera test according to Brooks (2014). Table 3 displays the observed test statistics, whereas the histograms are to be found in Appendix D. The corresponding critical value following a χ^2-distribution with 2 degrees of freedom and a significance level of 95 % is 0.1026. Hence, the null hypothesis of a normal distribution of the residuals can be rejected for all models and the residuals are not normally distributed. Following the central limit theorem, the violation of the normality assumption does not have significant consequences for sufficiently large sample sizes. Hence, the sample size of the estimated models is assumed to be sufficiently large and no adjustments to the models are made.

Table 3 Results from Jarque-Bera test for normality

Sector	**Test-statistic**
Consumer Discretionary	5.4887
Consumer Staples	30.4226
Energy	17.7939
Financials	35.5434
Health Care	7.1977
Industrials	3.7920
Information Technology	4.3433
Materials	20.5890
Telecommunication Services	122.3126
Utilities	9.3067

Finally, the estimated models are tested for constant variance amongst the residuals. To do so, a Breusch-Pagan-Godfrey test according to Brooks (2014) is carried out. Table 4 displays the obtained test statistics, whereby the critical value of the χ^2-distribution with 12 degrees of freedom (equal to the number of regressors excluding the constant) and a significance level of 95 % is 5.226. The results show that the null hypothesis of homoscedasticity of the residuals is to be rejected for all models. To account for this, Brooks (2014) recommends to use heteroscedasticity consistent standard error estimates, so called robust standard errors. Therefore, the models have been adjusted to account for the observed heteroscedasticity by introducing robust standard errors into the OLS regression.

Table 4 Results from Breusch-Pagan-Godfrey test for heteroscedasticity

Sector	**Test-statistic**
Consumer Discretionary	29.0527
Consumer Staples	15.2004
Energy	13.3444
Financials	42.8815
Health Care	17.1153
Industrials	32.0910
Information Technology	10.9672
Materials	31.7216
Telecommunication Services	6.6178
Utilities	19.7239

3.4 Regression results

After testing the estimated models for the basic OLS assumptions and accounting for the results, the regression for all ten sectors are repeated. A summary of the results is displayed in Table 5.

Table 5 Results from robust OLS regressions

Sector	α_i	β_1 $R_{i,t-1}$	β_2 EPC_t	β_3 CPI_t	β_4 CP_t	β_5 UR_t	β_6 LC_t	β_7 $PPI_{i,t}$	β_8 OP_t	β_9 GDP_t	β_{10} GDP_D_t	β_{11} IRS_t	β_{12} ER_t
Consumer Discretionary	-0.0005 (0.0097)	0.0114 (0.1062)	2.0145 (0.6712) ***	1.2110 (2.9545)	-0.6053 (1.2425)	-0.1749 (0.1745)	0.0100 (0.0320)	-0.2406 (0.7953)	0.0659 (0.0690)	1.6237 (0.0868) **	-1.4678 (3.4422)	-0.0018 (0.0038)	0.4370 (0.3431)
Consumer Staples	0.0063 (0.0053)	0.0285 (0.0895)	0.2107 (0.3796)	2.6310 (1.7144)	0.3688 (0.6068)	-0.1246 (0.1074)	-0.0058 (0.0248)	0.5640 (0.3322) *	-0.0242 (0.0408)	-0.0609 (0.4844)	-5.0160 (2.0503) **	-0.0021 (0.0030)	0.3789 (0.1706) **
Energy	-0.0040 (0.0075)	-0.1160 0.0641) *	0.9575 (0.3994) **	2.2447 (1.8762)	0.1078 (0.7518)	-0.0636 (0.1375)	-0.0158 (0.0329)	0.1425 (0.1696)	0.2900 (0.0595) ***	0.6182 (0.7907)	1.0329 (2.8468)	0.0018 (0.0029)	0.2302 (0.2805)
Financials	-0.0095 (0.0128)	-0.0756 (0.1405)	2.3338 (0.8932) *	2.2280 (3.4118)	1.2545 (1.1508)	-0.3789 (0.2228) *	-0.0061 (0.0508)	0.0129 (0.7833)	0.0516 (0.0961)	1.2534 (1.1689)	-2.8854 (4.0146)	-0.0062 (0.0046)	0.7469 (0.4748)
Health Care	-0.0029 (0.0073)	-0.1136 (0.0834)	0.5152 (0.4121)	4.4100 (1.5556) ***	1.4824 (0.7387) **	-0.0731 (0.1144)	-0.0151 (0.0289)	0.6879 (0.9771)	-0.0584 (0.0471)	0.4600 (0.6806)	-4.5297 (2.6346) *	-0.0042 (0.0032)	0.6627 (0.2457) ***
Industrials	0.0001 (0.0087)	-0.0065 (0.1120)	1.5979 (0.6577) **	0.5633 (2.2606)	-0.0073 (1.1613)	-0.3611 (0.1745) **	0.0116 (0.0345)	-0.9489 (1.2250)	0.1225 (0.0644) *	0.9845 (0.7928)	-0.2378 (3.2613)	-0.0019 (0.0033)	0.2777 (0.3619)
Information Technology	-0.0017 (0.0129)	-0.0855 (0.0989)	2.2842 (0.7900) ***	2.1457 (2.6530)	0.6614 (2.0524)	-0.2666 (0.2053)	0.0550 (0.0453)	-0.4381 (0.6100)	0.1519 (0.0870) *	1.2471 (1.1009)	-6.1513 (4.0260)	0.0031 (0.0066)	0.2285 (0.3810)
Materials	-0.0002 (0.0105)	-0.0608 (0.0918)	1.2402 (0.6567) *	2.9917 (2.7349)	0.4503 (1.2903)	-0.1288 (0.1826)	-0.0152 (0.0484)	-1.3176 (0.9540)	0.1494 (0.0815) *	0.1468 (1.0369)	-2.2941 (3.4070)	0.0046 (0.0038)	-0.0279 (0.3767)
Telecommunication Services	-0.0063 (0.0068)	0.0051 (0.0881)	1.1300 (0.3054) ***	-3.3342 (1.9387) *	1.9837 (0.9540) **	-0.1648 (0.1546)	-0.0114 (0.0303)	2.1086 (0.9428) **	0.0465 (0.0681)	1.5666 (0.7660) **	1.3613 (2.5884)	-0.0006 (0.0044)	0.0454 (0.2770)
Utilities	-0.0079 (0.0068)	-0.0243 (0.0816)	0.8480 (0.3825) **	4.4969 (1.6020) ***	-0.1115 (1.0254)	-0.0761 (0.1248)	-0.0257 (0.0328)	-0.0182 (0.1590)	0.0178 (0.0493)	0.5751 (0.6427)	-0.7488 (2.2059)	-0.0034 (0.0029)	0.3250 (0.2239)

Robust standard errors in parentheses
**** Significant at the 1 % level*
*** Significant at the 5 % level*
** Significant at the 10 % level*

In a next step, the results from the regressions in Table 5 are used to refine the models. Hence, all factors that proved to be statistically insignificant, are excluded from the regression and all models are reestimated including only the macroeconomic factors that prove to be significant at either 10 %, 5 % or 1 % levels. The results of these regressions are presented in Appendix G, whereas the respective descriptive statistics can be found in Appendix H. Whilst the decision to include factors with a statistical significance of up to 10 % can have a negative effect on the explanatory power of the individual factors, the involvement of at least two factors per model has an increasing effect on the prediction quality of the entire models.

3.5 Validity and Reliability

In order to test the final models for their reliability, the parameter estimates are used to forecast the returns on the respective S&P 500 sector sub-index during the test period between 2012 and 2015. Subsequently, these forecasts are evaluated making use of three different approaches: Mean Squared Error (MSE), Mean Absolute Percentage Error (MAPE) and Correct Sign Prediction (CSP), according to Brooks (2014).

The MSE is defined as $\frac{1}{N}\sum_{t=1}^{N}\left(y_{t+s} - f_{t,s}\right)^2$, where N is the number of observations, y_{t+s} is the observed value of the return series s steps into the forecast period and $f_{t,s}$ is the respective forecast by the model. Hence, whilst making no statement about the quality of an individual model, MSE enables a ranking amongst different models.

The MAPE is defined as $100x\frac{1}{N}\sum_{t=1}^{N}\left|\frac{y_{t+s}-f_{t,s}}{y_{t+s}}\right|$, where N is the number of observations, y_{t+s} is the observed value of the return series s steps into the forecast period and $f_{t,s}$ is the respective forecast by the model. It makes a statement about the relative accuracy, where the forecasted value matches the observed value and can, therefore, be used to value several models individually as well as in comparison to each other.

The CSP represents a relative measure of accuracy regarding the ability of a model to predict the sign of the return series. Therefore, it allows a direct and individual qualitative measure of an estimated model that does not rely on other models, whilst still permitting comparability amongst several models.

Analyzing the test results (Appendix I), the MSE result in values between 0.0011 and 0.0031 with an average value of 0.0020, whereby the models for Consumer Staples (0.0011), Health Care (0.0013) and Telecommunication Services (0.0018) perform best amongst the models. The MAPE shows prediction accuracies from 142.2 % up to 645.3 % with a mean value of 272.0 %. Whilst these values are characterized by some extreme outliers, it nevertheless shows that the ability to forecast precise returns for the respective indices is poor. Amongst these, Energy (142.2 %), Telecommunication Services (144.8 %) and Consumer Discretionary (153.1 %) show the highest prediction accuracy.

In contrast to the forecasting precision, the test for CSP shows more adequate results, ranging from 43.8 % up to 77.1 % with an average value of 56.5 %. The highest sign prediction accuracy is reached in Health Care (77.1 %), Energy (66.7 %) and Industrials (64.6 %). This shows, that although the estimated models are unable to predict reliable forecasts for the returns themselves, their ability of forecasting trends in the respective sectors can be assessed as adequate.

4 Analysis and Discussion

The analysis and discussion chapter is divided into two parts, including the analysis of the final sector models and a discussion of insignificant factors. In chapter 4.1, each S&P 500 sector model is analyzed individually. The individual model analysis includes a sector description, the estimated model, an argumentation and economic interpretation of the factors and the performance of the model, when forecasting in comparison to the observed stock values. The insignificant factors such as inflation, one-month lagged stock return, interest rate and labor costs are discussed in chapter 4.2.

4.1 Final Sector Models

4.1.1 Consumer Discretionary

According to the GICS, the Consumer Discretionary sector comprises several consumer-related industries that are assumed to be non-essential. Amongst others, this includes Automobiles and Components, Consumer Durables and Apparel, Consumer Services, Media as well as Retailing (GICS, 2006). Hence, the economic performance of the sector is expected to be highly volatile and a significant dependence on individual consumer preferences is presumed.

The regression results in the following sector model:

$$R_t = -0.0022 + 2.0236\, EPC_t + 1.5297\, GDP_t + \varepsilon_t$$

It shows that the sector generally followed a slightly negative trend in the estimation period. Since the estimation period includes the Dot-Com-Bubble in the early 21st century (Geier, 2015) as well as the global financial crisis (Swift, 2011), this can be seen as a potential sign for cyclicality of the sector, which supports the economic intuition. At the same time, the sector shows a strong dependence on EPC as well as GDP. The positive correlation with EPC could be an indication for a behavioral effect of wealth, leading to a general increase in individual living standards and therefore higher spendings on non-essential goods. The positive

correlation with GDP, on the other hand, again supports the above mentioned expectation about the cyclicality and dependency on general market conditions of the sector.

Figure 4.1 shows that the estimated model performs poorly in forecasting the performance of the sector sub-index. Whilst the general positive trend can be observed, the stock price at the end of the test period shows a deviation of 74.0 %. The overall positive trend of the sector is captured by the model, although the magnitude with an average monthly return of 0.5 % underestimates the observed average monthly return of 1.7 % significantly.

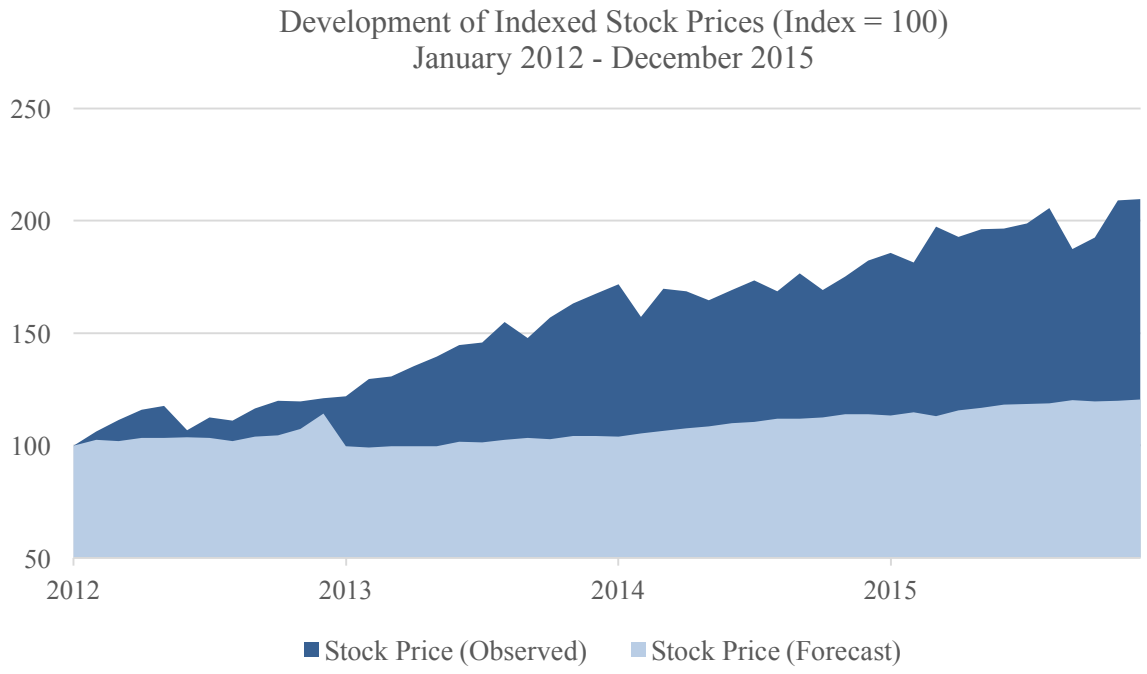

Figure 4.1 Comparison between observed and forecasted stock prices - Consumer Discretionary

4.1.2 Consumer Staples

In contrast to the Consumer Discretionary sector, Consumer Staples includes goods and services that are assumed to be essential in the day-to-day life. Hence, the subordinate sub-industries cover Food and Staples Retailing, Beverages, Food Products, Tobacco as well as Household Products (GICS, 2006). The economic performance is therefore expected to be less dependent on individual consumer preferences or the general economic market conditions, but rather on supply related factors that influence the cost structure of the suppliers.

The regression results in the following sector model:

$$R_t = 0.0052 + 0.6307\, PPI_t + \varepsilon_t$$

The model shows that the sector underwent a slightly positive development. PPI being the only factor having a significant impact on the sector performance is based on the fact that the pricing in the Consumer Staples sector is mostly independent from consumer preferences or economic conditions. Therefore, the market participants are able to adjust their turnover adequately in order to account for investments. The low magnitude of the factor sensitivity can be interpreted as a signal that these price changes have to be made within a reasonable range, otherwise they might lead to public criticism.

From Figure 4.2 it becomes obvious that the estimated model is able to predict the trend within the sector rather adequately. The higher variation of the observed stock price, which is mainly due to the monthly data as well as the economic upswing in the US in 2015, could not be captured, though. Taking into account the validity tests of the model, the Consumer Staples model shows a MAPE of 232.2 % and a CSP of 56.3 %. Whilst being ranked 7th in terms of MAPE amongst all the models, this shows the ability to predict the sign of the return. Hence, the general trend can compensate for the lack of accuracy and increase the prediction power of the model.

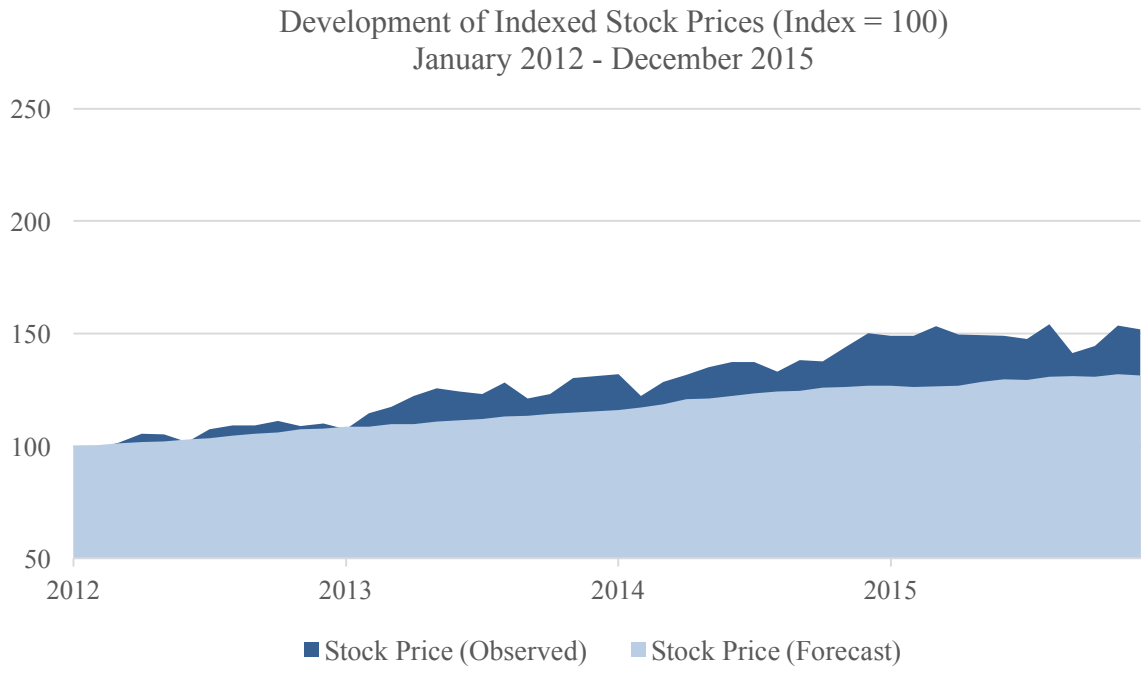

Figure 4.2 Comparison between observed and forecasted stock prices - Consumer Staples

4.1.3 Energy

The Energy sector comprises the Energy Equipment and Services as well as Oil, Gas and Consumable Fuels industries (GICS, 2006). It therefore mainly engages in the exploration, refinement and distribution of oil and gas. Economic intuition would expect the sector to depend on the development of commodity prices as well as other supply side factors. Due to the expected dependency on commodity prices, the volatility of the sector performance is likely to be high.

The regression results in the following sector model:

$$R_t = 0.0021 + 1.0169\, EPC_t + 0.3638\, OP_t + \varepsilon_t$$

Looking into the descriptive statistics, the return series shows a mean of 0.0101 and a standard deviation of 0.0621. Hence, the average deviation from the mean value equals more than six times the mean, which supports the expected high volatility of the sector. Since the sector engages in the exploration and distribution of oil and gas, the significance of the oil price as an influencing factor is expected and supports the economic intuition. The low magnitude indicates that positive changes in the oil price can only partly be passed on to the consumer.

Whilst producers participate the most from increasing oil prices due to a direct connection to turnover, distributors experience a negative effect on their cost structure, which lowers the positive effect of oil price changes for them. The positive correlation with EPC again indicates the previously discussed behavioral aspect of increasing wealth. Since GDP has not been significant in the previous regression displayed in Table 5, it becomes obvious that the distribution of wealth plays a significant role in explaining the dependence. An intuitive explanation is that increasing wealth decreases the consumer's desire to revise their personal budget for obligatory budgeting, like real estate and energy. Hence, when EPC rises, the oil and gas distributors seem to experience an increasing ability to participate from rising oil prices by passing those on through higher consumer prices.

From Figure 4.3 it becomes obvious, that the model's ability to forecast the performance of the sector can be assessed as good. Although the period of higher returns in the autumn and winter season 2014/15 could not be captured completely, it is able to forecast the variation even in the short term rather well. This is also in line with the validity test results, where the model has a MAPE of 144.2 % and therefore the second best amongst the estimated sector models. At the same time, due to a CSP of 66.7 % a good forecasting performance is expected.

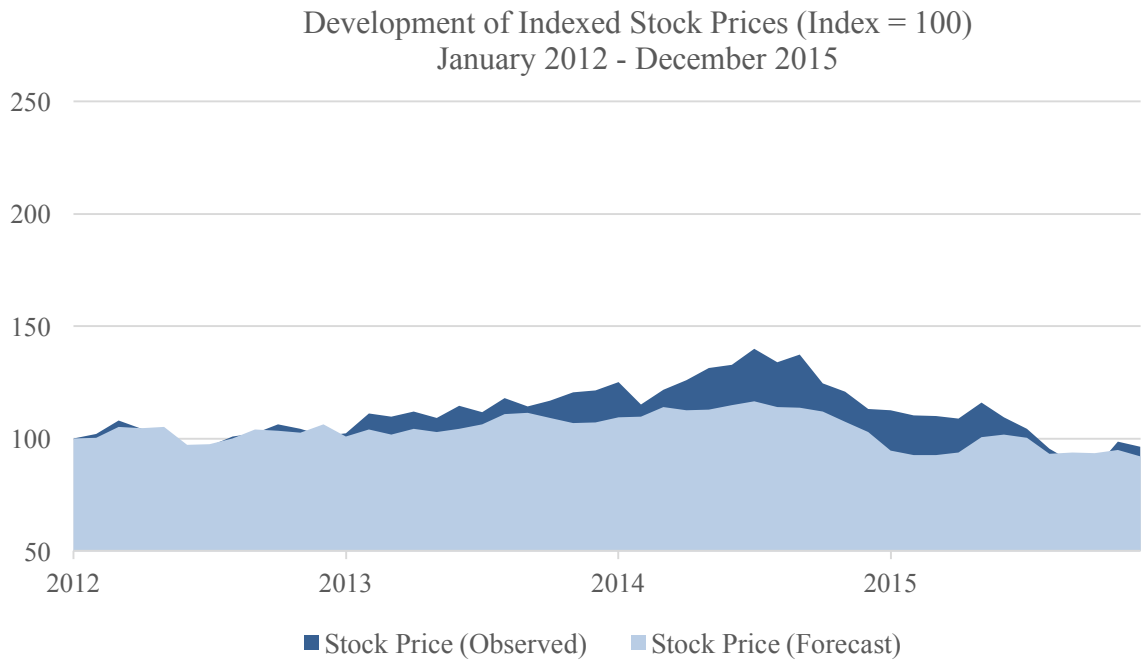

Figure 4.3 Comparison between observed and forecasted stock prices - Energy

4.1.4 Financials

Within the Financial sector, the GICS classification summarizes Banks, Insurances, Diversified Financials (i. e. Asset Manager, Broker, etc.) and Real Estate Participants (GICS, 2006). Intuitively, a strong correlation with the general state of the economy is expected, since both banks and insurers depend on deposits and economic growth, amongst others.

The regression results in the following sector model:

$$R_t = -0.0008 + 2.3229\, EPC_t - 0.4261\, UR_t + \varepsilon_t$$

The final model shows that the overall development of the sector is stable with a marginally negative tendency. A possible explanation could be that whilst the banking industry experienced a deep recession during the recent financial crisis (Wheelock, 2011), it led to an increase in potential business for insurers, brokers and other trade-related market participants (Simar, 2014). These effects could have offset each other, leading to the slight negative constant estimate. Additionally, a strong positive correlation towards EPC is discovered. In terms of business segments, the industry has several consumer oriented products, amongst others: the deposit business in the banking industry, the private insurance sector as well as private housing and real estate brokerage. Since these segments, or rather the products connected to it, are not affiliated with private consumption, a correlation with average consumer wealth is reasonable. Finally, the model shows a negative correlation with the unemployment rate meaning that in times of low unemployment, the sector performs well. Naturally, low unemployment is a consequence of an economic upswing, finally resulting in an increased need for external financing for companies.

From Figure 4.3 it becomes obvious that the model is able to outline the general trend of the sector performance. With a CSP of 60.4 %, this is as expected. Nevertheless, the forecasted stock price at the end of the test period deviates 33 % from the observed stock price, signaling a low forecasting accuracy.

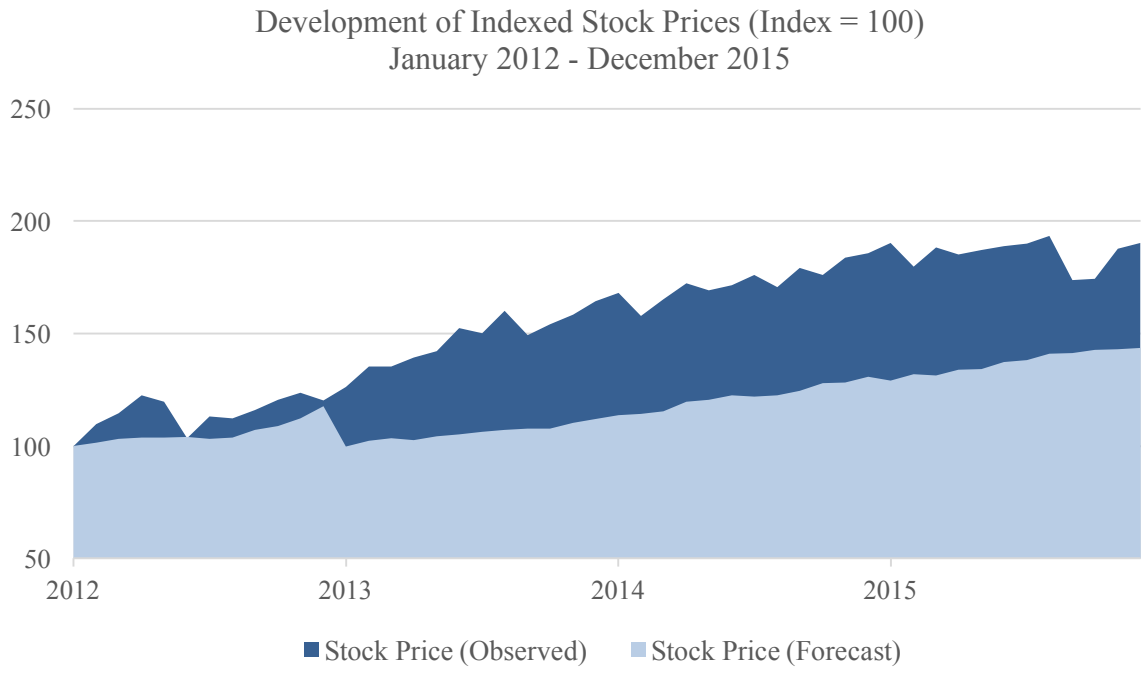

Figure 4.4 Comparison between observed and forecasted stock prices - Financials

4.1.5 Health Care

The Health Care sector includes Health Care Equipment and Services as well as Pharmaceuticals, Biotechnology and Life Sciences (GICS, 2006). It therefore not only covers hospitals, clinics and producers of health care equipment but also research, development and distribution of pharmaceuticals. The sector is generally assessed as capital and research intensive. Also, intuition would expect us to find little volatility in the sector returns.

The regression results in the following sector model:

$$R_t = -0.0031 + 2.4639\, CPI_t + 1.3590\, CP_t + 0.5371 ER_t + \varepsilon_t$$

The negative constant in the model can be explained by an overall increased price pressure in the pharmaceutical industry through new competitors from Asian markets. Due to the lower personnel costs in these emerging countries, research intensive industries are able to realize lower prices, while keeping profitability on a sustainable level (PwC, 2008). The positive correlation towards CPI and CP can be ascribed to the specific situation of the health care system in the US. During the estimation period, the country has not been equipped with a nationwide public health care system (DPE, 2014), making the usage of health care products as a part of

the private consumption budget. The positive coefficient towards the exchange rate can be interpreted as a consequence of the outsourcing of capital intensive production and research facilities, especially within the pharmaceutical industry (PwC, 2008). A strong local currency therefore leads to an effective decrease in production costs and improves profitability.

The significant positive trend the sector has taken during the test period could not be captured by the model, as it can be observed in Figure 4.5. In comparison to the previous models, this contradicts the intuition based on the CSP of 77.1 %. Taking a closer look at the forecast errors, a potential reason becomes obvious, since the model performs the worst in terms of MAPE amongst all sector model. The value is significantly influenced by large negative outliers in April 2014 and June 2015, which cause the forecasted stock price to remain on a relatively low overall level.

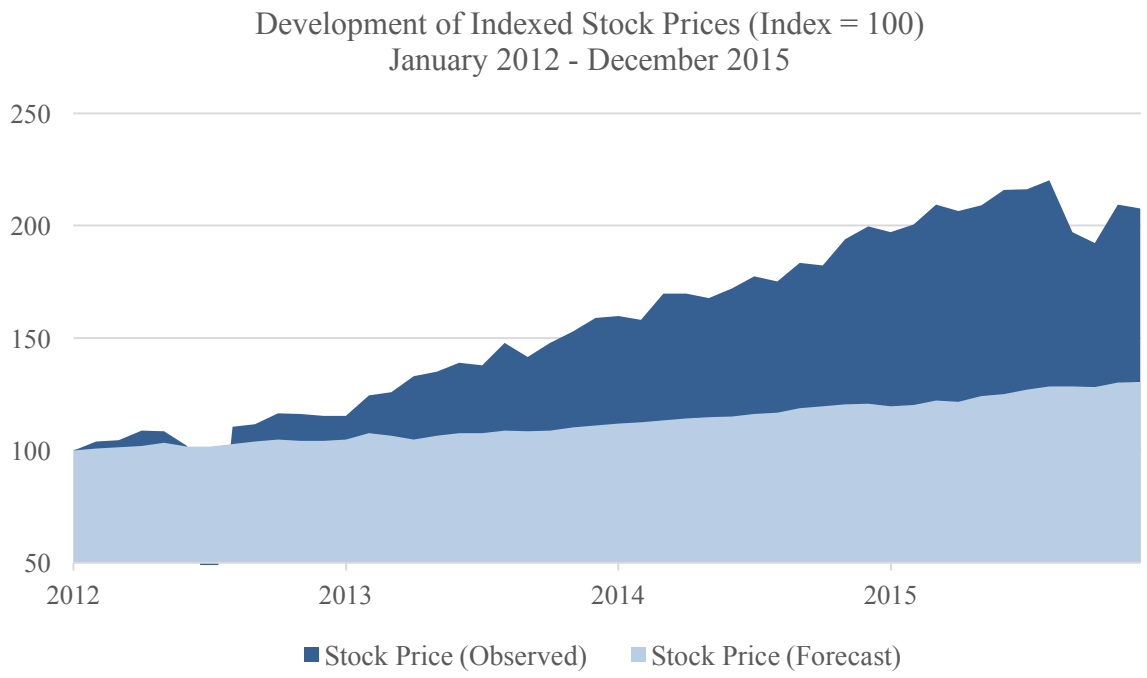

Figure 4.5 Comparison between observed and forecasted stock prices - Health Care

4.1.6 Industrials

The Industrial sector, according to GICS, includes the industry groups Capital Goods, Commercial Services and Supplies and Transportation. Each industry group is divided into several industries and later each industry has its own sub-industry. The Capital Goods sector includes seven industries such as Aerospace & Defense, Building Products, Construction & Engineering, Electrical Equipment, Industrial Conglomerates, Machinery, Trading Companies & Distributors. The Commercial Services & Supplies group allocates the same called industry. The Transportation group is divided into five industries that are Air Freight & Logistics, Airlines, Marine, Road & Rail and Transportation Infrastructure (GICS, 2006).

As a result of the data regression, the sector model is as follows:

$$R_t = 0.0014 + 1.5514\, EPC_t - 0.1294\, UR_t + 0.1294\, OP_t + \varepsilon_t$$

The model shows that the Industrials sector has experienced a slightly positive development, which indicates that it has been less affected by the economic crises within the estimation period. The factors with significant positive correlation are EPC and OP. The positive correlation of EPC indicates the previously mentioned behavioral aspect of increasing wealth. This significance caused by the indirect effect of GDP, which is not appearing to be significant, as presented in the previous regression displayed in Table 5, however causing the distribution of wealth playing a significant role in explaining the dependence. At the same time, a negative correlation is observed with UR. Unemployment is a signal of economic turbulence since it is a direct outcome of companies being in a bad state of development. The Industrials sector is one of the main sectors in the US, therefore a correlation to the unemployment rate is expected. The positive sensitivity towards oil price changes can be interpreted as a result of a need for operational streamlining in the sector. Since the Industrials sector is capital intensive and relies heavily on the production of goods, whereas its oil consumption is above average. Therefore, the rise in the oil price forces companies to streamline their production in order to account for the higher input costs.

From Figure 4.6, a relatively close trend for 2012 can be detected for the stock price forecast with regards to the observed prices. The forecasted values are rising, however less than the observed values for the test period and the model is predicting the general trend. The high forecast deviation from the observed values results in a MAPE of 213.2 %, whereas the sign

prediction is represented by CSP with 64.6 %. The Figure 4.6 shows that the model is capable to forecast and predict the sign of the return series on relative accuracy.

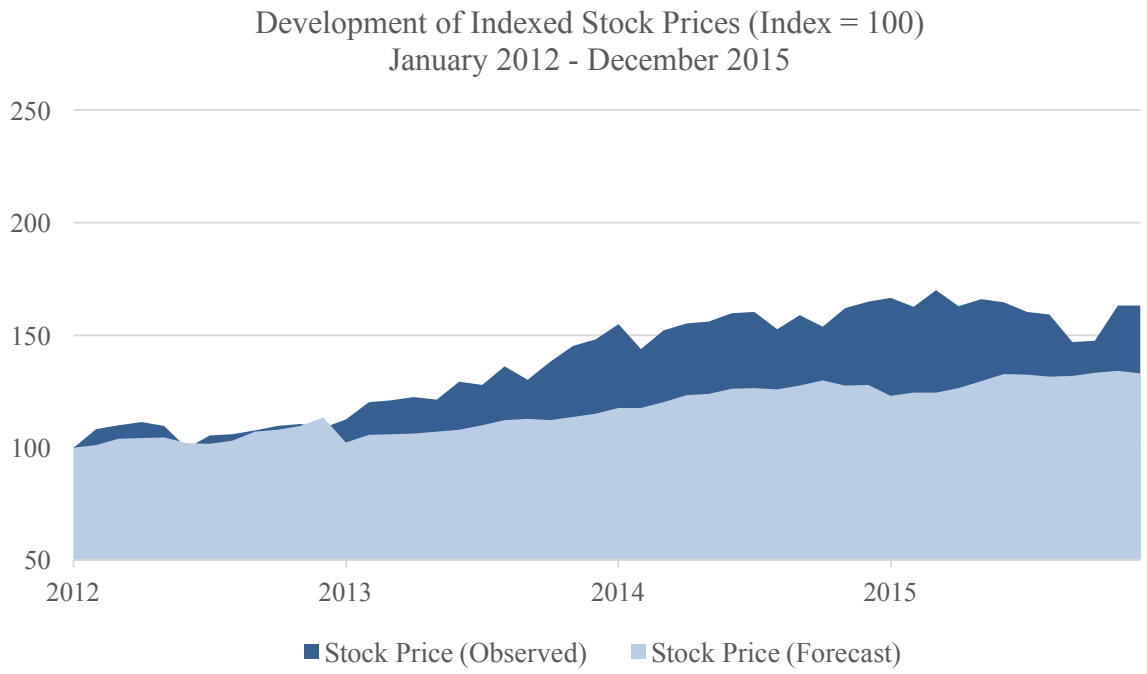

Figure 4.6 Comparison between observed and forecasted stock prices - Industrials

4.1.7 Information Technology

The Information Technology (IT) sector accommodates three industry groups, such as Software & Services, Technology Hardware & Equipment and Semiconductors & Semiconductor Equipment (GICS, 2006).

As a result of the data regression the following sector model is presented:

$$R_t = 0.0011 + 2.1871\, EPC_t + 0.2043\, OP_t + \varepsilon_t$$

The IT sector is generally characterized as a small, fast and cheap sector, whereas the competition within this sector is based on the lowest price and the newest technology (Sallomi, 2016). A potential interpretation for the significance of EPC is that since IT products are not part of the consumption basket, with which private consumption is measured. Hence, the increased wealth level shifts the consumers' attention rather towards non-essential, luxury products like the ones the IT sector produces. The slight positive impact of the oil price can be

explained by the fact that, amongst others, semiconductors are of great necessity in the Energy sector, in order to automatize the oil and gas exploration processes. Consequently, if the oil price rises, the Energy sector needs to invest in the production facilities, increasing the demand for semiconductors and other IT hardware and software.

According to Figure 4.7, the prediction quality of the model is poor. This is expected taking into account the validity tests, where the model results in a MAPE of 579.5 %. Also the CSP of 56.3 % signals the weak ability to forecast the general trend, which becomes obvious, when comparing the forecast to the observed values.

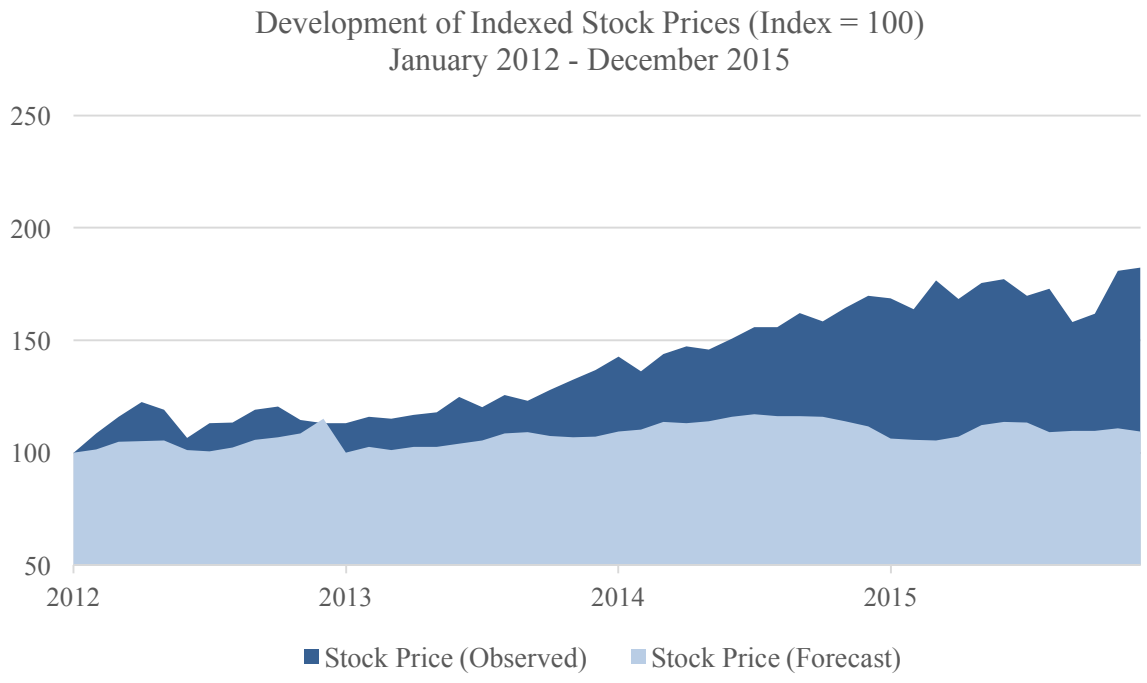

Figure 4.7 Comparison between observed and forecasted stock prices - Information Technology

4.1.8 Materials

The Materials sector is divided into five industries such as Chemicals, Construction Materials, Containers & Packaging, Metals & Mining, Paper & Forest Products (GICS, 2006). Subsequently the Materials sector contains capital-intensive industries that engage in the exploration and distribution of metals, fertilizers, chemicals and gasses. The development of the sector depends on the development of commodity prices as well as other supply-side factors. Also the volatility is expected to be high.

The following sector model is estimated:

$$R_t = -0.0008 + 1.3920\ EPC_t + 0.2063\ OP_t + \varepsilon_t$$

The model shows that the sector performed with a slightly negative trend. A potential interpretation of this trend can be given by the twofold nature of the business model, which is, on the one hand, consumer dependent and, on the other hand, industry dependent as well. The consumer dependency is based on the containers and packaged goods that are produced for the distribution of the consumer goods. Due to the general societal trend, of the aging (Mather, Jacobsen and Pollard, 2015) and the single household oriented (US Census, 2015) societies, this results in cost-cutting programs in consumer oriented industries that are then passed down the supply chain. The metals and containers produced for the business sector experienced a decrease due to the general economic downturn in the aftermath of the economic crises in the estimation period. The positive sensitivity of the sector towards EPC signals an anticyclical supply management within the sector. Since the products are part of the supply chain of many consumer goods, the producers of containers and packaging have to anticipate the periods of the rising demand in order to prepare for production peaks. Hence, the rise in EPC can be interpreted as the predictor of rising consumption, triggering the higher production volumes. The positive significance of the oil price changes can be explained by oil being one of the main constituents of plastic containers and packages. Hence, the rise in the oil price does affect the industry in terms of rising input costs. These have to be matched by price increases as well as production streamlining processes, resulting in a potential increase of the operating margins.

According to the Figure 4.8, the forecasting accuracy of the model is inadequate. Whilst the forecasted stock performed almost flat in the entire test period, the observed values experience the increase until 2014 and the drop in 2015. This inability to forecast the trend can be expected, taking into account the low CSP of 47.9 %. Since the MAPE of 208 % is, compared to the other models, relatively low, this explains the low deviation at the end of the period.

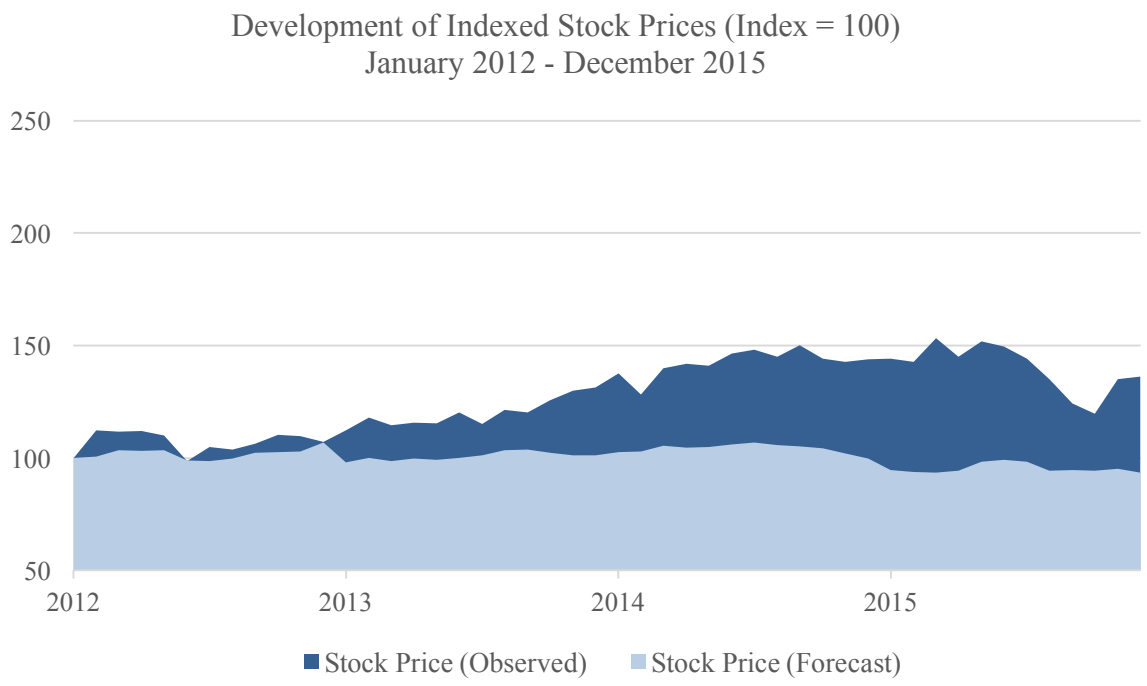

Figure 4.8 Comparison between observed and forecasted stock prices - Materials

4.1.9 Telecommunication Services

The Telecommunication Services incorporates the alike called industry group and this group is divided into Diversified Telecommunication Services and Wireless Telecommunication Services (GICS, 2006). The performance of the sector is highly dependent on public and private investments into the infrastructure, changing consumer demands as well as the general market conditions.

The regression resulted in the following sector model:

$$R_t = -0.0075 + 1.151\, EPC_t - 2.096\, CPI_t + 2.259\, CP_t + 2.134\, PPI_t + 1.563\, GDP_t + \varepsilon_t$$

In this sector model, the economic performance of the sector is observed to be in slight decline. This is due to the general decrease in the price level of telecommunication services (Economist, 2011). The telecommunication services are not necessity products, however they are provided for both private households and corporates. Therefore, they have dependency on five factors, such as wealth distribution, consumer price index, private consumption, producer price index and GDP. The positive sensitivity towards EPC can be explained by the fact that the sector's products are assessed as non-essential. Hence, in times of economic stability, con-

sumers tend towards investing in new telecommunication products and services rather than in an economic downturn. However, the negative sensitivity towards CPI also supports the previous statement about the consumption of non-essential products, as consumers tend to cut their budget on these when essential consumer prices rise. The supply side is represented by PPI in this case, meaning that the rise in the production price affects positively the sector performance. The analysis of PPI is discussed in the context of the Law of Supply and Demand (Krugman & Wells, 2012). If demand, or private consumption in this case, rises, meaning that the people are willing to pay more for the product, producers increase the supply and thereby raising their prices in order to use the opportunity to maximize profits in high demand event. The positive significance of PPI in the model can be explained by the fact that the estimation period includes the market introduction and expansion of internet services. This development required extraordinary amounts of invested capital, which are able to earn adequate returns. Hence, the positive coefficient tells us that the Telecommunication Services sector has been able to earn returns outperforming the required investments in the past. The sensitivity towards positive changes in the GDP can also be interpreted intuitively. Since the sector depends on public infrastructure investments, high GDP implies higher tax expenses on the earned returns. These tax expenses enable the government to increase its investments in the infrastructure, in order to support economic growth.

From Figure 4.9 it becomes obvious that the estimated model is able to predict the general trend of the sector performance adequately. The low CSP of 45.8 % can explain the weak performance when capturing the development in 2013 and 2014, which is almost opposite. On the other hand, the low MAPE of 153 % can explain the precise mid-term forecast at the end of the period.

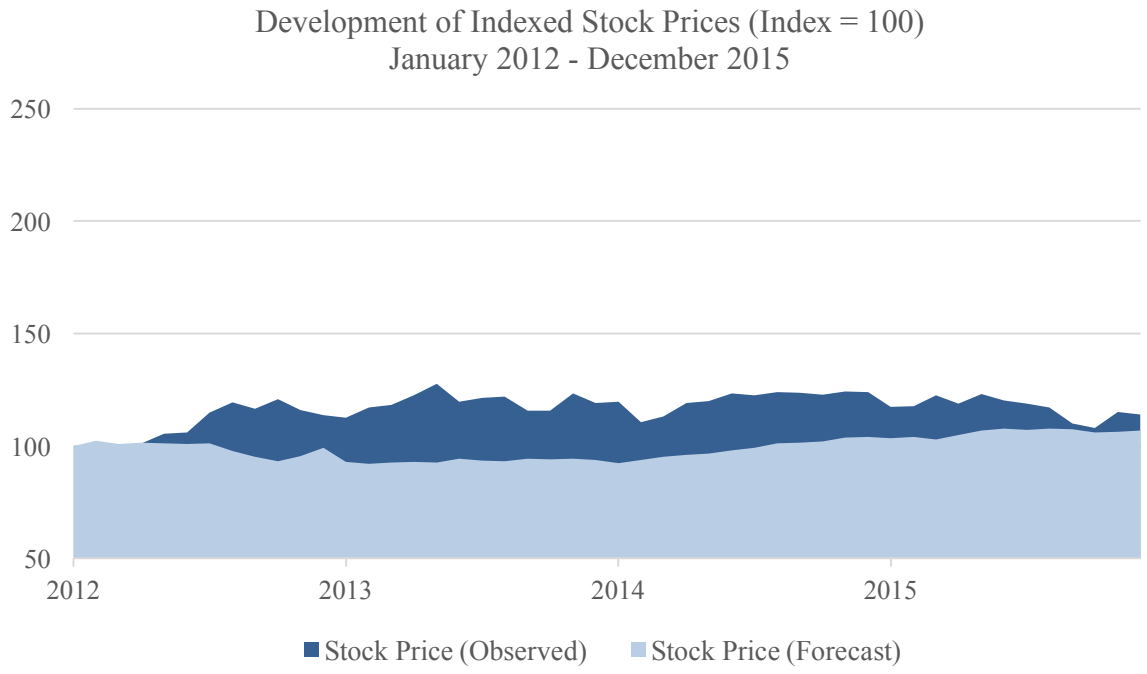

Figure 4.9 Comparison between observed and forecasted stock prices - Telecommunication Services

4.1.10 Utilities

According to the GICS, the Utilities sector is divided into five industries such as Electric Utilities, Gas Utilities, Multi-Utilities, Water Utilities and Independent Power Producers & Energy Traders (GICS, 2006). The sector is characterized through a strong resilience against economic downturns since price changes are generally accepted by the consumer.

The following model is estimated for the sector:

$$R_t = -0.0080 + 0.7761\, EPC_t + 4.5658\, CPI_t + \varepsilon_t$$

From the above model, it can be analyzed that the Utilities sector follows a minor downward sloping trend. The cause of it is that the recession during the recent financial crisis led to a decrease in drilling rig and production of gas, increasing the respective input costs for producers (Aleklett, 2013). The positive sensitivity towards EPC can be explained by the intuition that price changes tend to be accepted by consumers more frequently, when the average wealth is higher. CPI is a factor representing the price changes associated with the cost of living. According to the Bureau of Labor Statistics (2015), CPI is classified into more than 200 catego-

ries that are arranged into eight major groups, where utility expenses are part of the housing group. Therefore, if the cost of living rises, the Utility sector returns increase as the result.

Figure 4.10 depicts that the estimated model performs poor in estimating the performance of the sector. The general trend cannot be observed and the forecasted stock price at the end of the test period shows high deviation from the observed series. This is in line with the validity test outputs, where MAPE results in 216.1 % on forecast accuracy and CSP results in 43.8 % on the accuracy of the model to predict the trend sign.

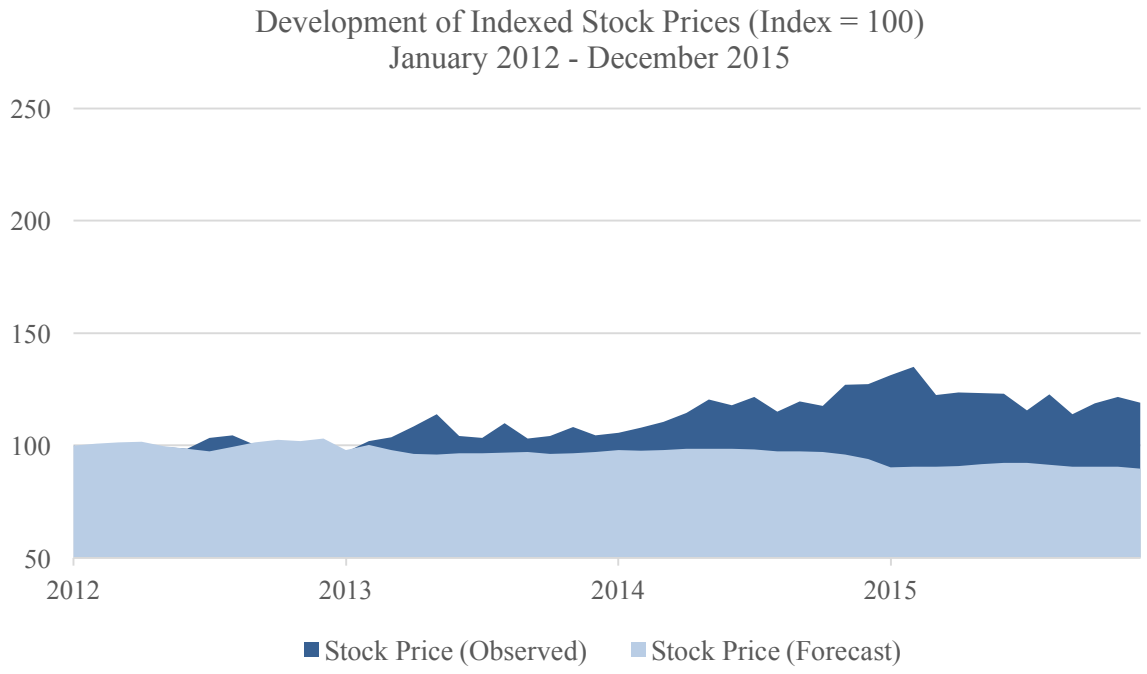

Figure 4.10 Comparison between observed and forecasted stock prices - Utilities

4.2 Discussion of Insignificant Factors

Taking a look into the final models of all ten sectors covered, it becomes obvious, that most of the twelve initial factors identified as potentially significant are proven to be so in at least one of the sector models. Nevertheless, the factors, such as inflation, interest rate, labor costs and one-month lagged stock return are shown not to have significant impact on any of the sectors.

Whilst Manolis et al. (2002) found significant positive as well as negative correlation between the inflation rate and several industries, however it does not appear within the estimated models in the current paper. A potential reason could be, that the effects of the inflation on the wealth and consumption are already captured by the demand-driven factors EPC, CPI and CP, leading the inflation itself remain insignificant. This intuitive argument is supported by the correlation matrices used in testing the OLS assumptions. Amongst all the correlations between inflation and the other macroeconomic factors, the coefficients with CPI and CP are the highest.

The inclusion of the interest rate as a potential factor is based on the practical implementation within the credit rating framework. Whilst being intuitively reasonable, the data is not able to show a significant impact on any of the sectors. Since the interest rate spread on a 10 year US treasury bond is used as a proxy for the factor, the reason for the insignificance might be simply an inadequate proxy-choice.

The labor cost factor is included into the regression, also because of the common practice in the credit rating methodologies. Labor costs are typically similar within the domestic scale, therefore the factor does not have significant impact on the performance, when analyzing the US market individually, resulting in no significant influence on the sector performances. When comparing the performance of entire economies on a global basis, the factor might lead to a locational advantage and can therefore be of significance.

According to Altinbas & Biskin (2015), the one-month lagged stock return was able to explain most of the variation in the Turkish stock index. Transferring this outcome to the US market failed as the factor shows to be insignificant for all sectors. Nevertheless, this does not mean it is incapable of being significant in other regions.

5 Conclusion

Analyzing the industry risk, as part of the BRP, is a crucial step in the credit rating analysis. Since the lack of transparency in the process led to criticism against CRA in the past, the present paper is aimed to contribute to enhance the transparency and therefore increase the credibility of the credit rating. To reach this aim, the paper explains, which macroeconomic factors have significant impact on the performance of the ten main sectors within the US. In order to do so, monthly returns on the S&P 500 sector sub-indices are analyzed against a set of eleven macroeconomic factors as well as the one-month lagged stock return of the respective index. Each sector is regressed individually through a multifactor time-series regression. The results show, that whilst not all models are able to forecast the performance of the sectors accurately, most of them are able to capture the overall trend rather well. Nevertheless, all models underestimate the stock price at the end of the test period. Also it shows that within the set of potential factors: earnings per capita, consumer price index, private consumption, unemployment rate, producer price index, oil price, gross domestic product and exchange rate do have significant impact on at least one of the analyzed sectors.

Since the envisaged contribution of the paper is to enhance transparency and comprehensibility of the industry risk assessment within the credit rating process, the choice of the factors is based on the methodologies of the leading CRA, as well as previous research carried out on related topics. Since eight of the analyzed twelve factors show to be significant in at least one of the ten sector models, this enables the conclusion, that the additional factors used by the CRA add significant value to the standard values frequently used in the academic research. Especially EPC, which is significant in eight sector models, is proven to be highly important when analyzing sector performance. Hence, the results from the regressions carried out in the present paper, as well as the economic interpretation of the causalities, are adequate to be implemented into future versions of the credit rating methodologies, in order to make the exact weighting of the different factors more transparent and enhance the possibility to reapply the methods used by CRA.

In summary, the aim of the paper is not reached completely. Whilst the estimated models are able to forecast the general trend of the sectors, the statistical validity and reliability is inade-

quate in order to be implemented into practice. In the opinion of the authors, this is mainly due to the generalized research approach which chooses the ten main sectors within the US as the dependent variable. In chapters 4.1.1 to 4.1.10 it becomes obvious that the chosen sectors aggregate numerous industries that are themselves characterized through partially contradicting attributes. Hence, estimating a model that is able to explain the performance of the sector, disregarding the intrasectoral diversity is expected to be challenging. Nevertheless, the estimated models can be viewed upon as the foundation of the structural decision about how a more detailed analysis of the industry risk should be carried out. Also, the study is able to prove that the factors outlined in the published credit rating methodologies do have significant impact on the performance of respective industries. The targeted contribution towards enhancing transparency and comprehensibility of the credit rating process is therefore achieved.

Obviously, the estimated sector models are merely the foundation for an entire set of future research projects. First of all, the sector models can be used as a base estimate to analyze the respective industry groups and sub-industries according to the GICS classification. Also, since some of the factors are proxied in the present regressions, a more detailed analysis, of whether or not more suitable proxies exist, is necessary. Finally, since EPC is proven to be significant in most of the estimated models, research on the behavioral implications of increasing wealth with regards to different sectors and private consumption can be valuable.

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Appendix A – OLS Regressions

Consumer Discretionary

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 16:06
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000545	0.007345	-0.074246	0.9409
S_P_500___1_	0.011361	0.070633	0.160844	0.8724
EPC	2.014531	0.611441	3.294728	0.0012
CPI	1.211013	2.069907	0.585056	0.5592
CP	-0.605273	1.085248	-0.557728	0.5777
UR	-0.174924	0.147721	-1.184155	0.2378
LC	0.010038	0.035344	0.284008	0.7767
PPI	-0.240644	0.720815	-0.333850	0.7389
OP	0.065878	0.055676	1.183243	0.2382
GDP	1.623729	0.799363	2.031278	0.0436
GDP_D	-1.467844	3.272202	-0.448580	0.6542
IRS	-0.001841	0.004032	-0.456584	0.6485
ER	0.436951	0.276529	1.580127	0.1157

R-squared	0.113045	Mean dependent var	0.007224
Adjusted R-squared	0.056730	S.D. dependent var	0.059127
S.E. of regression	0.057425	Akaike info criterion	-2.814472
Sum squared resid	0.623258	Schwarz criterion	-2.601564
Log likelihood	297.2617	Hannan-Quinn criter.	-2.728329
F-statistic	2.007383	Durbin-Watson stat	1.913781
Prob(F-statistic)	0.025576		

Consumer Staples

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 16:43
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006297	0.004833	1.302895	0.1942
S_P_500___1_	0.028468	0.073101	0.389431	0.6974
EPC	0.210674	0.416533	0.505780	0.6136
CPI	2.630975	1.413263	1.861632	0.0642
CP	0.368756	0.754672	0.488631	0.6257
UR	-0.124602	0.101398	-1.228844	0.2207
LC	-0.005760	0.024136	-0.238642	0.8116
PPI	0.563995	0.342639	1.646032	0.1014
OP	-0.024182	0.038449	-0.628948	0.5301
GDP	-0.060876	0.543970	-0.111910	0.9110
GDP_D	-5.015979	2.210137	-2.269533	0.0244
IRS	-0.002099	0.002762	-0.759954	0.4482
ER	0.378887	0.187907	2.016353	0.0452

R-squared	0.076963	Mean dependent var	0.006575
Adjusted R-squared	0.018357	S.D. dependent var	0.039729
S.E. of regression	0.039363	Akaike info criterion	-3.569790
Sum squared resid	0.292845	Schwarz criterion	-3.356882
Log likelihood	373.5488	Hannan-Quinn criter.	-3.483647
F-statistic	1.313231	Durbin-Watson stat	1.925809
Prob(F-statistic)	0.213647		

Energy

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 16:56
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004001	0.006608	-0.605470	0.5456
S_P_500___1_	-0.115967	0.059846	-1.937766	0.0541
EPC	0.957470	0.530710	1.804131	0.0728
CPI	2.244704	2.158519	1.039928	0.2997
CP	0.107780	0.952042	0.113209	0.9100
UR	-0.063616	0.130688	-0.486776	0.6270
LC	-0.015835	0.031105	-0.509074	0.6113
PPI	0.142455	0.174835	0.814794	0.4162
OP	0.290005	0.051901	5.587689	0.0000
GDP	0.618218	0.696613	0.887463	0.3760
GDP_D	1.032877	2.842955	0.363311	0.7168
IRS	0.001753	0.003525	0.497415	0.6195
ER	0.230155	0.241389	0.953460	0.3416

R-squared	0.383741	Mean dependent var	0.010094
Adjusted R-squared	0.344614	S.D. dependent var	0.062089
S.E. of regression	0.050265	Akaike info criterion	-3.080842
Sum squared resid	0.477513	Schwarz criterion	-2.867934
Log likelihood	324.1650	Hannan-Quinn criter.	-2.994699
F-statistic	9.807451	Durbin-Watson stat	1.991600
Prob(F-statistic)	0.000000		

Financials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 17:12
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.009473	0.008979	-1.055004	0.2928
S_P_500___1_	-0.075634	0.069830	-1.083121	0.2801
EPC	2.333757	0.765093	3.050294	0.0026
CPI	2.228042	2.564311	0.868866	0.3860
CP	1.254497	1.368286	0.916838	0.3604
UR	-0.378866	0.186029	-2.036595	0.0431
LC	-0.006086	0.044090	-0.138032	0.8904
PPI	0.012932	0.838137	0.015429	0.9877
OP	0.051633	0.070293	0.734534	0.4635
GDP	1.253351	0.992091	1.263343	0.2080
GDP_D	-2.885356	4.058204	-0.710993	0.4780
IRS	-0.006169	0.005085	-1.213281	0.2265
ER	0.746908	0.346887	2.153176	0.0326

R-squared	0.132223	Mean dependent var	0.005307
Adjusted R-squared	0.077126	S.D. dependent var	0.075165
S.E. of regression	0.072208	Akaike info criterion	-2.356343
Sum squared resid	0.985442	Schwarz criterion	-2.143435
Log likelihood	250.9906	Hannan-Quinn criter.	-2.270200
F-statistic	2.399827	Durbin-Watson stat	1.963553
Prob(F-statistic)	0.006541		

Health Care

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 09:41
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002912	0.005922	-0.491660	0.6235
S_P_500___1_	-0.113558	0.069413	-1.635976	0.1035
EPC	0.515160	0.481723	1.069412	0.2862
CPI	4.410004	1.624671	2.714397	0.0073
CP	1.482415	0.869353	1.705194	0.0898
UR	-0.073063	0.117345	-0.622634	0.5343
LC	-0.015100	0.028032	-0.538673	0.5907
PPI	0.687850	0.916173	0.750786	0.4537
OP	-0.058390	0.044352	-1.316506	0.1896
GDP	0.459951	0.628093	0.732298	0.4649
GDP_D	-4.529671	2.622264	-1.727389	0.0857
IRS	-0.004223	0.003207	-1.316886	0.1895
ER	0.662702	0.218525	3.032609	0.0028

R-squared	0.121779	Mean dependent var	0.007620
Adjusted R-squared	0.066019	S.D. dependent var	0.047271
S.E. of regression	0.045684	Akaike info criterion	-3.271954
Sum squared resid	0.394445	Schwarz criterion	-3.059046
Log likelihood	343.4673	Hannan-Quinn criter.	-3.185811
F-statistic	2.183992	Durbin-Watson stat	1.919962
Prob(F-statistic)	0.013986		

Industrials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 09:51
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000130	0.007095	0.018385	0.9854
S_P_500___1_	-0.006517	0.070283	-0.092723	0.9262
EPC	1.597850	0.591712	2.700383	0.0076
CPI	0.563261	2.034105	0.276909	0.7822
CP	-0.007333	1.072673	-0.006836	0.9946
UR	-0.361143	0.144593	-2.497661	0.0134
LC	0.011609	0.034225	0.339200	0.7348
PPI	-0.948892	1.314879	-0.721657	0.4714
OP	0.122450	0.054578	2.243584	0.0260
GDP	0.984462	0.765568	1.285924	0.2000
GDP_D	-0.237824	3.437698	-0.069181	0.9449
IRS	-0.001888	0.003944	-0.478714	0.6327
ER	0.277666	0.267385	1.038451	0.3004

R-squared	0.145385	Mean dependent var	0.006925
Adjusted R-squared	0.091123	S.D. dependent var	0.058604
S.E. of regression	0.055870	Akaike info criterion	-2.869398
Sum squared resid	0.589949	Schwarz criterion	-2.656489
Log likelihood	302.8092	Hannan-Quinn criter.	-2.783255
F-statistic	2.679345	Durbin-Watson stat	1.975882
Prob(F-statistic)	0.002377		

Information Technology

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:05
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001650	0.012532	-0.131633	0.8954
S_P_500___1_	-0.085456	0.069723	-1.225639	0.2219
EPC	2.284166	0.866013	2.637564	0.0090
CPI	2.145731	2.911689	0.736937	0.4621
CP	0.661387	1.538214	0.429971	0.6677
UR	-0.266613	0.210707	-1.265322	0.2073
LC	0.055044	0.050187	1.096776	0.2741
PPI	-0.438141	0.585379	-0.748473	0.4551
OP	0.151933	0.079168	1.919120	0.0565
GDP	1.247061	1.124090	1.109396	0.2687
GDP_D	-6.151307	4.585313	-1.341524	0.1814
IRS	0.003124	0.005711	0.546962	0.5851
ER	0.228505	0.391606	0.583507	0.5602

R-squared	0.132795	Mean dependent var	0.010633
Adjusted R-squared	0.077735	S.D. dependent var	0.084885
S.E. of regression	0.081519	Akaike info criterion	-2.113764
Sum squared resid	1.255977	Schwarz criterion	-1.900856
Log likelihood	226.4902	Hannan-Quinn criter.	-2.027621
F-statistic	2.411802	Durbin-Watson stat	1.908641
Prob(F-statistic)	0.006267		

Materials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:13
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000187	0.008100	-0.023120	0.9816
S_P_500___1_	-0.060789	0.069722	-0.871870	0.3844
EPC	1.240153	0.681851	1.818803	0.0705
CPI	2.991721	2.320828	1.289075	0.1989
CP	0.450302	1.217799	0.369768	0.7120
UR	-0.128815	0.165632	-0.777716	0.4377
LC	-0.015205	0.039330	-0.386617	0.6995
PPI	-1.317609	1.269906	-1.037564	0.3008
OP	0.149383	0.062433	2.392675	0.0177
GDP	0.146842	0.882865	0.166325	0.8681
GDP_D	-2.294072	3.669635	-0.625150	0.5326
IRS	0.004575	0.004524	1.011384	0.3131
ER	-0.027907	0.306623	-0.091014	0.9276

R-squared	0.142347	Mean dependent var	0.006207
Adjusted R-squared	0.087893	S.D. dependent var	0.067372
S.E. of regression	0.064343	Akaike info criterion	-2.586991
Sum squared resid	0.782460	Schwarz criterion	-2.374083
Log likelihood	274.2861	Hannan-Quinn criter.	-2.500848
F-statistic	2.614066	Durbin-Watson stat	2.095589
Prob(F-statistic)	0.003018		

Telecommunication Services

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:27
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.006287	0.007237	-0.868804	0.3861
S_P_500___1_	0.005140	0.071203	0.072190	0.9425
EPC	1.130004	0.626994	1.802257	0.0731
CPI	-3.334174	2.119825	-1.572853	0.1174
CP	1.983694	1.145844	1.731208	0.0850
UR	-0.164813	0.152002	-1.084282	0.2796
LC	-0.011433	0.036116	-0.316565	0.7519
PPI	2.108608	0.986986	2.136412	0.0339
OP	0.046531	0.057581	0.808098	0.4201
GDP	1.566585	0.809608	1.934991	0.0545
GDP_D	1.361288	3.335141	0.408165	0.6836
IRS	-0.000572	0.004133	-0.138391	0.8901
ER	0.045415	0.282566	0.160722	0.8725

R-squared	0.107307	Mean dependent var	0.002704
Adjusted R-squared	0.050628	S.D. dependent var	0.060517
S.E. of regression	0.058965	Akaike info criterion	-2.761552
Sum squared resid	0.657129	Schwarz criterion	-2.548644
Log likelihood	291.9168	Hannan-Quinn criter.	-2.675409
F-statistic	1.893251	Durbin-Watson stat	2.066480
Prob(F-statistic)	0.037377		

Utilities

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:41
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.007900	0.005672	-1.392691	0.1653
S_P_500___1_	-0.024344	0.072062	-0.337814	0.7359
EPC	0.848010	0.487443	1.739713	0.0835
CPI	4.496898	1.654673	2.717696	0.0072
CP	-0.111519	0.874324	-0.127548	0.8986
UR	-0.076118	0.120203	-0.633242	0.5273
LC	-0.025685	0.028252	-0.909156	0.3644
PPI	-0.018170	0.163757	-0.110955	0.9118
OP	0.017760	0.044756	0.396810	0.6920
GDP	0.575060	0.631305	0.910906	0.3635
GDP_D	-0.748788	2.589406	-0.289174	0.7728
IRS	-0.003404	0.003241	-1.050420	0.2949
ER	0.325040	0.220001	1.477450	0.1412

R-squared	0.120102	Mean dependent var	0.003704
Adjusted R-squared	0.064235	S.D. dependent var	0.047620
S.E. of regression	0.046065	Akaike info criterion	-3.255332
Sum squared resid	0.401056	Schwarz criterion	-3.042423
Log likelihood	341.7885	Hannan-Quinn criter.	-3.169189
F-statistic	2.149798	Durbin-Watson stat	1.917933
Prob(F-statistic)	0.015742		

Appendix B – Test for Multicollinearity

Consumer Discretionary

Correlation

	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.107928	0.114320	0.048617	-0.090715	-0.014882	-0.024333	0.044638	-0.009856	0.017139	-0.056830	0.074295
EPC	0.107928	1.000000	0.076435	0.150103	-0.050621	0.133534	-0.176493	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.114320	0.076435	1.000000	0.380306	-0.072189	-0.123041	0.047284	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.048617	0.150103	0.380306	1.000000	-0.117456	-0.015252	-0.154430	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.090715	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	0.069523	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	-0.014882	0.133534	-0.123041	-0.015252	-0.087507	1.000000	-0.126158	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	-0.024333	-0.176493	0.047284	-0.154430	0.069523	-0.126158	1.000000	0.008534	-0.165245	-0.082922	-0.012229	0.050123
OP	0.044638	0.057374	0.626947	0.320789	-0.063909	0.013274	0.008534	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	-0.009856	0.010575	-0.010381	0.343483	-0.066368	-0.097658	-0.165245	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	0.017139	0.018705	0.438849	0.287204	-0.062564	-0.005354	-0.082922	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.056830	-0.002204	-0.024241	0.033993	-0.044067	0.040984	-0.012229	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	0.074295	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	0.050123	-0.157725	-0.151082	0.033265	0.046062	1.000000

Consumer Staples

Correlation

	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.051424	0.032752	0.114926	-0.044555	-0.100353	-0.057459	-0.072808	-0.051893	0.063166	-0.058638	0.052626
EPC	0.051424	1.000000	0.076435	0.150103	-0.050621	0.133534	0.048472	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.032752	0.076435	1.000000	0.380306	-0.072189	-0.123041	0.192940	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.114926	0.150103	0.380306	1.000000	-0.117456	-0.015252	0.060917	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.044555	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	-0.089953	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	-0.100353	0.133534	-0.123041	-0.015252	-0.087507	1.000000	-0.042786	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	-0.057459	0.048472	0.192940	0.060917	-0.089953	-0.042786	1.000000	0.109414	0.024718	0.100604	0.022303	-0.063397
OP	-0.072808	0.057374	0.626947	0.320789	-0.063909	0.013274	0.109414	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	-0.051893	0.010575	-0.010381	0.343483	-0.066368	-0.097658	0.024718	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	0.063166	0.018705	0.438849	0.287204	-0.062564	-0.005354	0.100604	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.058638	-0.002204	-0.024241	0.033993	-0.044067	0.040984	0.022303	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	0.052626	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	-0.063397	-0.157725	-0.151082	0.033265	0.046062	1.000000

Energy

Correlation

	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.040844	0.205891	0.113204	-0.153754	-0.014607	0.151981	0.055665	-0.074393	0.088774	-0.034555	-0.014464
EPC	0.040844	1.000000	0.076435	0.150103	-0.050621	0.133534	0.077756	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.205891	0.076435	1.000000	0.380306	-0.072189	-0.123041	0.778307	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.113204	0.150103	0.380306	1.000000	-0.117456	-0.015252	0.348767	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.153754	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	-0.074474	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	-0.014607	0.133534	-0.123041	-0.015252	-0.087507	1.000000	-0.159024	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	0.151981	0.077756	0.778307	0.348767	-0.074474	-0.159024	1.000000	0.647087	0.053650	0.375029	-0.027301	-0.216275
OP	0.055665	0.057374	0.626947	0.320789	-0.063909	0.013274	0.647087	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	-0.074393	0.010575	-0.010381	0.343483	-0.066368	-0.097658	0.053650	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	0.088774	0.018705	0.438849	0.287204	-0.062564	-0.005354	0.375029	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.034555	-0.002204	-0.024241	0.033993	-0.044067	0.040984	-0.027301	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	-0.014464	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	-0.216275	-0.157725	-0.151082	0.033265	0.046062	1.000000

Financials

Correlation

	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.121610	0.110419	0.102293	-0.116716	0.013145	-0.067436	0.084811	0.014865	0.050745	-0.085481	0.050505
EPC	0.121610	1.000000	0.076435	0.150103	-0.050621	0.133534	-0.068990	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.110419	0.076435	1.000000	0.380306	-0.072189	-0.123041	0.007353	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.102293	0.150103	0.380306	1.000000	-0.117456	-0.015252	-0.028780	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.116716	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	0.044330	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	0.013145	0.133534	-0.123041	-0.015252	-0.087507	1.000000	0.025595	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	-0.067436	-0.068990	0.007353	-0.028780	0.044330	0.025595	1.000000	0.053852	0.019349	0.055971	0.010110	0.087953
OP	0.084811	0.057374	0.626947	0.320789	-0.063909	0.013274	0.053852	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	0.014865	0.010575	-0.010381	0.343483	-0.066368	-0.097658	0.019349	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	0.050745	0.018705	0.438849	0.287204	-0.062564	-0.005354	0.055971	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.085481	-0.002204	-0.024241	0.033993	-0.044067	0.040984	0.010110	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	0.050505	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	0.087953	-0.157725	-0.151082	0.033265	0.046062	1.000000

Health Care

Correlation

	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.038607	0.036197	0.077363	-0.050201	-0.069493	-0.051101	-0.024174	-0.028908	-0.001242	-0.059619	0.077289
EPC	0.038607	1.000000	0.076435	0.150103	-0.050621	0.133534	-0.063320	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.036197	0.076435	1.000000	0.380306	-0.072189	-0.123041	0.017223	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.077363	0.150103	0.380306	1.000000	-0.117456	-0.015252	-0.054737	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.050201	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	0.069521	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	-0.069493	0.133534	-0.123041	-0.015252	-0.087507	1.000000	-0.022345	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	-0.051101	-0.063320	0.017223	-0.054737	0.069521	-0.022345	1.000000	-0.029040	-0.100846	0.176024	-0.022968	0.009013
OP	-0.024174	0.057374	0.626947	0.320789	-0.063909	0.013274	-0.029040	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	-0.028908	0.010575	-0.010381	0.343483	-0.066368	-0.097658	-0.100846	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	-0.001242	0.018705	0.438849	0.287204	-0.062564	-0.005354	0.176024	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.059619	-0.002204	-0.024241	0.033993	-0.044067	0.040984	-0.022968	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	0.077289	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	0.009013	-0.157725	-0.151082	0.033265	0.046062	1.000000

Industrials

Correlation												
	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.113278	0.181323	0.107407	-0.108914	0.011386	-0.014763	0.086174	-0.016072	0.101934	-0.114239	0.015919
EPC	0.113278	1.000000	0.076435	0.150103	-0.050621	0.133534	-0.045842	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.181323	0.076435	1.000000	0.380306	-0.072189	-0.123041	-0.064976	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.107407	0.150103	0.380306	1.000000	-0.117456	-0.015252	-0.131595	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.108914	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	-0.056644	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	0.011386	0.133534	-0.123041	-0.015252	-0.087507	1.000000	0.002487	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	-0.014763	-0.045842	-0.064976	-0.131595	-0.056644	0.002487	1.000000	-0.031564	-0.091196	0.280181	-0.013171	0.113365
OP	0.086174	0.057374	0.626947	0.320789	-0.063909	0.013274	-0.031564	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	-0.016072	0.010575	-0.010381	0.343483	-0.066368	-0.097658	-0.091196	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	0.101934	0.018705	0.438849	0.287204	-0.062564	-0.005354	0.280181	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.114239	-0.002204	-0.024241	0.033993	-0.044067	0.040984	-0.013171	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	0.015919	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	0.113365	-0.157725	-0.151082	0.033265	0.046062	1.000000

Information Technology

Correlation												
	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.087244	0.053812	0.021009	-0.108008	0.071587	-0.003572	-0.001101	0.070097	-0.000226	0.001730	0.089373
EPC	0.087244	1.000000	0.076435	0.150103	-0.050621	0.133534	0.012953	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.053812	0.076435	1.000000	0.380306	-0.072189	-0.123041	-0.118484	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.021009	0.150103	0.380306	1.000000	-0.117456	-0.015252	-0.023808	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.108008	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	-0.009783	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	0.071587	0.133534	-0.123041	-0.015252	-0.087507	1.000000	0.090153	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	-0.003572	0.012953	-0.118484	-0.023808	-0.009783	0.090153	1.000000	-0.090912	0.019526	-0.023514	0.017960	0.031965
OP	-0.001101	0.057374	0.626947	0.320789	-0.063909	0.013274	-0.090912	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	0.070097	0.010575	-0.010381	0.343483	-0.066368	-0.097658	0.019526	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	-0.000226	0.018705	0.438849	0.287204	-0.062564	-0.005354	-0.023514	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	0.001730	-0.002204	-0.024241	0.033993	-0.044067	0.040984	0.017960	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	0.089373	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	0.031965	-0.157725	-0.151082	0.033265	0.046062	1.000000

Materials

Correlation												
	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.066162	0.220713	0.101665	-0.067402	-0.039350	0.008622	0.089987	-0.042227	0.091396	-0.064473	-0.048214
EPC	0.066162	1.000000	0.076435	0.150103	-0.050621	0.133534	-0.100171	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.220713	0.076435	1.000000	0.380306	-0.072189	-0.123041	0.138820	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.101665	0.150103	0.380306	1.000000	-0.117456	-0.015252	-0.018559	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.067402	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	0.066919	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	-0.039350	0.133534	-0.123041	-0.015252	-0.087507	1.000000	-0.006693	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	0.008622	-0.100171	0.138820	-0.018559	0.066919	-0.006693	1.000000	0.055017	-0.050866	0.206930	0.031043	-0.009580
OP	0.089987	0.057374	0.626947	0.320789	-0.063909	0.013274	0.055017	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	-0.042227	0.010575	-0.010381	0.343483	-0.066368	-0.097658	-0.050866	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	0.091396	0.018705	0.438849	0.287204	-0.062564	-0.005354	0.206930	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.064473	-0.002204	-0.024241	0.033993	-0.044067	0.040984	0.031043	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	-0.048214	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	-0.009580	-0.157725	-0.151082	0.033265	0.046062	1.000000

Telecommunication Services

Correlation												
	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.119065	0.094748	0.070383	-0.090234	-0.013636	-0.059164	-0.018117	-0.020337	0.001232	-0.003451	0.051466
EPC	0.119065	1.000000	0.076435	0.150103	-0.050621	0.133534	-0.053746	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.094748	0.076435	1.000000	0.380306	-0.072189	-0.123041	-0.020336	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.070383	0.150103	0.380306	1.000000	-0.117456	-0.015252	-0.217396	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.090234	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	0.039893	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	-0.013636	0.133534	-0.123041	-0.015252	-0.087507	1.000000	-0.067198	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	-0.059164	-0.053746	-0.020336	-0.217396	0.039893	-0.067198	1.000000	-0.033201	-0.075220	0.002060	0.019279	0.052200
OP	-0.018117	0.057374	0.626947	0.320789	-0.063909	0.013274	-0.033201	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	-0.020337	0.010575	-0.010381	0.343483	-0.066368	-0.097658	-0.075220	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	0.001232	0.018705	0.438849	0.287204	-0.062564	-0.005354	0.002060	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.003451	-0.002204	-0.024241	0.033993	-0.044067	0.040984	0.019279	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	0.051466	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	0.052200	-0.157725	-0.151082	0.033265	0.046062	1.000000

Utilities

Correlation												
	S_P_500__...	EPC	CPI	CP	UR	LC	PPI	OP	GDP	GDP_D	IRS	ER
S_P_500__...	1.000000	0.096585	0.162767	0.189961	-0.157330	-0.111792	0.108134	0.082351	0.057304	0.094865	-0.076279	0.018749
EPC	0.096585	1.000000	0.076435	0.150103	-0.050621	0.133534	0.164044	0.057374	0.010575	0.018705	-0.002204	-0.067342
CPI	0.162767	0.076435	1.000000	0.380306	-0.072189	-0.123041	0.076968	0.626947	-0.010381	0.438849	-0.024241	-0.199936
CP	0.189961	0.150103	0.380306	1.000000	-0.117456	-0.015252	-0.000964	0.320789	0.343483	0.287204	0.033993	-0.130539
UR	-0.157330	-0.050621	-0.072189	-0.117456	1.000000	-0.087507	0.050775	-0.063909	-0.066368	-0.062564	-0.044067	-0.000436
LC	-0.111792	0.133534	-0.123041	-0.015252	-0.087507	1.000000	0.022965	0.013274	-0.097658	-0.005354	0.040984	0.046540
PPI	0.108134	0.164044	0.076968	-0.000964	0.050775	0.022965	1.000000	0.024996	-0.036178	0.087199	-0.032597	0.047493
OP	0.082351	0.057374	0.626947	0.320789	-0.063909	0.013274	0.024996	1.000000	0.043555	0.180218	0.040992	-0.157725
GDP	0.057304	0.010575	-0.010381	0.343483	-0.066368	-0.097658	-0.036178	0.043555	1.000000	-0.129965	0.066278	-0.151082
GDP_D	0.094865	0.018705	0.438849	0.287204	-0.062564	-0.005354	0.087199	0.180218	-0.129965	1.000000	-0.061402	0.033265
IRS	-0.076279	-0.002204	-0.024241	0.033993	-0.044067	0.040984	-0.032597	0.040992	0.066278	-0.061402	1.000000	0.046062
ER	0.018749	-0.067342	-0.199936	-0.130539	-0.000436	0.046540	0.047493	-0.157725	-0.151082	0.033265	0.046062	1.000000

Appendix C – Test for Autocorrelation

Consumer Discretionary

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.175841	Prob. F(12,177)	0.3036
Obs*R-squared	14.91412	Prob. Chi-Square(12)	0.2462

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 10:19
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003128	0.007571	0.413120	0.6800
S_P_500___1_	-0.376776	0.227527	-1.655967	0.0995
EPC	-0.177737	0.643735	-0.276103	0.7828
CPI	0.550191	2.154914	0.255319	0.7988
CP	0.227257	1.104866	0.205687	0.8373
UR	-0.044639	0.155363	-0.287318	0.7742
LC	0.014335	0.036228	0.395682	0.6928
PPI	-0.025923	0.739993	-0.035032	0.9721
OP	-0.003645	0.056900	-0.064056	0.9490
GDP	-0.034010	0.831175	-0.040918	0.9674
GDP_D	-1.113289	3.319782	-0.335350	0.7378
IRS	-0.000539	0.004100	-0.131390	0.8956
ER	0.039017	0.279096	0.139798	0.8890
RESID(-1)	0.444578	0.241573	1.840347	0.0674
RESID(-2)	-0.152942	0.078139	-1.957300	0.0519
RESID(-3)	0.023850	0.080554	0.296069	0.7675
RESID(-4)	0.098135	0.079528	1.233969	0.2189
RESID(-5)	-0.050257	0.079839	-0.629476	0.5298
RESID(-6)	-0.022378	0.079539	-0.281349	0.7788
RESID(-7)	0.062956	0.079123	0.795674	0.4273
RESID(-8)	-0.046609	0.081008	-0.575367	0.5658
RESID(-9)	0.070993	0.080092	0.886395	0.3766
RESID(-10)	-0.002054	0.080535	-0.025502	0.9797
RESID(-11)	-0.004291	0.079440	-0.054018	0.9570
RESID(-12)	0.100691	0.079913	1.260001	0.2093

Consumer Staples

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.523686	Prob. F(12,177)	0.1192
Obs*R-squared	18.91302	Prob. Chi-Square(12)	0.0906

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 10:23
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002343	0.004932	0.474998	0.6354
S_P_500___1_	-0.359742	0.266776	-1.348481	0.1792
EPC	-0.219960	0.424197	-0.518533	0.6047
CPI	0.082834	1.436588	0.057660	0.9541
CP	0.016547	0.753596	0.021958	0.9825
UR	-0.011627	0.104772	-0.110977	0.9118
LC	0.005501	0.024576	0.223843	0.8231
PPI	0.182484	0.344802	0.529241	0.5973
OP	0.007518	0.039510	0.190273	0.8493
GDP	0.002959	0.549789	0.005381	0.9957
GDP_D	-0.031992	2.209707	-0.014478	0.9885
IRS	0.000103	0.002899	0.035553	0.9717
ER	-0.005355	0.190447	-0.028118	0.9776
RESID(-1)	0.397599	0.276051	1.440308	0.1515
RESID(-2)	-0.033513	0.076443	-0.438406	0.6616
RESID(-3)	-0.158420	0.077561	-2.042512	0.0426
RESID(-4)	0.103037	0.080201	1.284728	0.2006
RESID(-5)	0.043989	0.077503	0.567582	0.5710
RESID(-6)	-0.000481	0.077587	-0.006204	0.9951
RESID(-7)	0.122363	0.078211	1.564525	0.1195
RESID(-8)	-0.046920	0.079521	-0.590037	0.5559
RESID(-9)	-0.080892	0.077298	-1.046493	0.2968
RESID(-10)	-0.068267	0.078157	-0.873468	0.3836
RESID(-11)	-0.051379	0.077900	-0.659548	0.5104
RESID(-12)	0.101943	0.077891	1.308794	0.1923

Energy

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.072750	Prob. F(12,177)	0.3857
Obs*R-squared	13.69519	Prob. Chi-Square(12)	0.3206

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 10:24
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000346	0.006798	-0.050895	0.9595
S_P_500___1_	-0.029383	0.104405	-0.281430	0.7787
EPC	0.201026	0.553224	0.363372	0.7168
CPI	0.468116	2.346344	0.199509	0.8421
CP	0.069139	0.964375	0.071693	0.9429
UR	-0.037769	0.137486	-0.274713	0.7839
LC	-0.006574	0.031868	-0.206290	0.8368
PPI	0.018751	0.181023	0.103581	0.9176
OP	-0.014400	0.052883	-0.272301	0.7857
GDP	-0.107598	0.722734	-0.148877	0.8818
GDP_D	-0.485754	2.889771	-0.168094	0.8667
IRS	0.000302	0.003704	0.081595	0.9351
ER	0.055234	0.246506	0.224067	0.8230
RESID(-1)	-0.001763	0.130431	-0.013520	0.9892
RESID(-2)	-0.072256	0.079744	-0.906107	0.3661
RESID(-3)	-0.133683	0.079552	-1.680446	0.0946
RESID(-4)	0.035498	0.080902	0.438770	0.6614
RESID(-5)	0.071404	0.079149	0.902141	0.3682
RESID(-6)	0.104041	0.081049	1.283683	0.2009
RESID(-7)	0.003242	0.081268	0.039894	0.9682
RESID(-8)	-0.087236	0.081556	-1.069638	0.2862
RESID(-9)	-0.045914	0.082994	-0.553222	0.5808
RESID(-10)	-0.096455	0.080635	-1.196194	0.2332
RESID(-11)	-0.004022	0.080408	-0.050022	0.9602
RESID(-12)	0.043893	0.082543	0.531762	0.5956

Financials

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.980665	Prob. F(12,177)	0.4691
Obs*R-squared	12.59288	Prob. Chi-Square(12)	0.3993

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 10:25
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003908	0.009197	0.424875	0.6714
S_P_500___1_	-0.093494	0.205753	-0.454398	0.6501
EPC	-0.181977	0.801588	-0.227020	0.8207
CPI	-0.396351	2.767974	-0.143192	0.8863
CP	-0.066056	1.385980	-0.047660	0.9620
UR	-0.013817	0.195658	-0.070616	0.9438
LC	0.015139	0.045531	0.332494	0.7399
PPI	-0.371074	0.867236	-0.427881	0.6693
OP	0.025278	0.074134	0.340971	0.7335
GDP	0.033218	1.072883	0.030961	0.9753
GDP_D	-1.149262	4.140961	-0.277535	0.7817
IRS	-0.002475	0.005277	-0.468939	0.6397
ER	0.066998	0.351447	0.190635	0.8490
RESID(-1)	0.118009	0.221689	0.532317	0.5952
RESID(-2)	-0.111728	0.077327	-1.444886	0.1503
RESID(-3)	0.066902	0.078270	0.854761	0.3938
RESID(-4)	0.094374	0.080939	1.165983	0.2452
RESID(-5)	0.100159	0.079839	1.254506	0.2113
RESID(-6)	-0.129861	0.079958	-1.624104	0.1061
RESID(-7)	-0.013911	0.079530	-0.174919	0.8613
RESID(-8)	-0.033740	0.081727	-0.412845	0.6802
RESID(-9)	0.056544	0.081474	0.694012	0.4886
RESID(-10)	-0.068488	0.080842	-0.847188	0.3980
RESID(-11)	0.083830	0.080598	1.040096	0.2997
RESID(-12)	0.000847	0.080943	0.010466	0.9917

Health Care

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.676337	Prob. F(12,177)	0.0754
Obs*R-squared	20.61446	Prob. Chi-Square(12)	0.0563

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 10:29
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001916	0.005965	0.321271	0.7484
S_P_500___1_	-0.414524	0.209841	-1.975419	0.0498
EPC	-0.236847	0.482519	-0.490856	0.6241
CPI	0.825040	1.696128	0.486426	0.6273
CP	-0.120156	0.881419	-0.136321	0.8917
UR	-0.064716	0.121925	-0.530784	0.5962
LC	0.011209	0.028506	0.393196	0.6946
PPI	-0.270341	0.945315	-0.285980	0.7752
OP	-0.013178	0.045664	-0.288595	0.7732
GDP	0.060770	0.648895	0.093651	0.9255
GDP_D	0.976428	2.650695	0.368367	0.7130
IRS	-0.000132	0.003214	-0.041148	0.9672
ER	0.140885	0.221198	0.636917	0.5250
RESID(-1)	0.484706	0.225551	2.148982	0.0330
RESID(-2)	-0.101783	0.079219	-1.284830	0.2005
RESID(-3)	0.076992	0.076808	1.002391	0.3175
RESID(-4)	-0.114777	0.079965	-1.435340	0.1530
RESID(-5)	0.132299	0.078012	1.695866	0.0917
RESID(-6)	-0.141139	0.077720	-1.815986	0.0711
RESID(-7)	0.161633	0.079503	2.033058	0.0435
RESID(-8)	0.100499	0.080055	1.255371	0.2110
RESID(-9)	0.029522	0.078849	0.374410	0.7085
RESID(-10)	-0.141055	0.080193	-1.758928	0.0803
RESID(-11)	-0.015522	0.079212	-0.195950	0.8449
RESID(-12)	-0.038314	0.080748	-0.474487	0.6357

Industrials

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.368360	Prob. F(12,177)	0.1849
Obs*R-squared	17.14869	Prob. Chi-Square(12)	0.1441

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 10:30
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000774	0.007211	0.107288	0.9147
S_P_500___1_	-0.002144	0.193034	-0.011106	0.9912
EPC	0.037836	0.604066	0.062635	0.9501
CPI	-0.260264	2.125276	-0.122461	0.9027
CP	-0.154913	1.080342	-0.143392	0.8861
UR	-0.026674	0.149110	-0.178891	0.8582
LC	0.002190	0.034932	0.062691	0.9501
PPI	0.064369	1.332583	0.048304	0.9615
OP	0.027258	0.055775	0.488714	0.6256
GDP	0.328928	0.784983	0.419026	0.6757
GDP_D	-0.556686	3.463322	-0.160737	0.8725
IRS	0.000224	0.004007	0.055852	0.9555
ER	0.092424	0.271954	0.339854	0.7344
RESID(-1)	0.013143	0.208662	0.062989	0.9498
RESID(-2)	-0.175543	0.077588	-2.262507	0.0249
RESID(-3)	-0.081813	0.081092	-1.008891	0.3144
RESID(-4)	0.174605	0.079223	2.203975	0.0288
RESID(-5)	-0.008807	0.081250	-0.108393	0.9138
RESID(-6)	-0.041952	0.083339	-0.503390	0.6153
RESID(-7)	-0.002961	0.082234	-0.036005	0.9713
RESID(-8)	0.009873	0.082902	0.119089	0.9053
RESID(-9)	-0.039084	0.081326	-0.480581	0.6314
RESID(-10)	-0.037936	0.081299	-0.466625	0.6413
RESID(-11)	-0.023771	0.080944	-0.293668	0.7694
RESID(-12)	-0.040614	0.081583	-0.497825	0.6192

Information Technology

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.946515	Prob. F(12,177)	0.5020
Obs*R-squared	12.18080	Prob. Chi-Square(12)	0.4313

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 11:00
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003606	0.013004	-0.277328	0.7819
S_P_500___1_	-0.465281	0.211979	-2.194935	0.0295
EPC	0.069149	0.893877	0.077358	0.9384
CPI	1.637307	3.103149	0.527628	0.5984
CP	0.836714	1.617007	0.517446	0.6055
UR	-0.026916	0.224186	-0.120063	0.9046
LC	0.014317	0.051896	0.275888	0.7830
PPI	-0.208343	0.611623	-0.340640	0.7338
OP	-0.030289	0.082306	-0.368005	0.7133
GDP	-0.292690	1.156618	-0.253057	0.8005
GDP_D	0.087952	4.707728	0.018682	0.9851
IRS	0.000858	0.005917	0.144971	0.8849
ER	-0.056289	0.399472	-0.140908	0.8881
RESID(-1)	0.526173	0.225487	2.333500	0.0207
RESID(-2)	-0.065294	0.077269	-0.845018	0.3992
RESID(-3)	0.059751	0.078347	0.762647	0.4467
RESID(-4)	-0.010706	0.077836	-0.137541	0.8908
RESID(-5)	0.025442	0.077249	0.329348	0.7423
RESID(-6)	0.078871	0.075904	1.039097	0.3002
RESID(-7)	0.037275	0.076512	0.487176	0.6267
RESID(-8)	-0.114048	0.079069	-1.442390	0.1510
RESID(-9)	0.110554	0.077442	1.427571	0.1552
RESID(-10)	0.037487	0.076586	0.489480	0.6251
RESID(-11)	-0.043117	0.076495	-0.563653	0.5737
RESID(-12)	0.034952	0.076981	0.454033	0.6504

Materials

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.286180	Prob. F(12,177)	0.2301
Obs*R-squared	16.20139	Prob. Chi-Square(12)	0.1822

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 11:03
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002637	0.008286	0.318199	0.7507
S_P_500___1_	0.385795	0.202036	1.909536	0.0578
EPC	-0.250292	0.700669	-0.357219	0.7214
CPI	-1.478198	2.450687	-0.603177	0.5472
CP	-0.162654	1.229947	-0.132245	0.8949
UR	-0.061808	0.173659	-0.355918	0.7223
LC	-0.005716	0.040587	-0.140835	0.8882
PPI	0.241338	1.286752	0.187556	0.8514
OP	0.018137	0.063579	0.285264	0.7758
GDP	-0.644497	0.945566	-0.681600	0.4964
GDP_D	0.234688	3.679731	0.063778	0.9492
IRS	0.000108	0.004655	0.023208	0.9815
ER	-0.081957	0.308454	-0.265703	0.7908
RESID(-1)	-0.437045	0.214692	-2.035688	0.0433
RESID(-2)	-0.059014	0.078160	-0.755039	0.4512
RESID(-3)	-0.071897	0.080373	-0.894547	0.3722
RESID(-4)	0.064189	0.077737	0.825719	0.4101
RESID(-5)	-0.064042	0.077621	-0.825063	0.4104
RESID(-6)	-0.075748	0.078454	-0.965509	0.3356
RESID(-7)	0.056479	0.078787	0.716860	0.4744
RESID(-8)	-0.077870	0.080676	-0.965219	0.3358
RESID(-9)	-0.054765	0.079210	-0.691381	0.4902
RESID(-10)	-0.142439	0.079319	-1.795759	0.0742
RESID(-11)	0.076566	0.079898	0.958305	0.3392
RESID(-12)	0.062568	0.080728	0.775050	0.4393

Telecommunication Services

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.860919	Prob. F(12,177)	0.5878
Obs*R-squared	11.14000	Prob. Chi-Square(12)	0.5170

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 11:05
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003695	0.007571	-0.488115	0.6261
S_P_500___1_	0.256052	0.230758	1.109610	0.2687
EPC	-0.060259	0.649453	-0.092785	0.9262
CPI	-0.568662	2.265295	-0.251032	0.8021
CP	0.560798	1.231592	0.455344	0.6494
UR	0.071523	0.160181	0.446513	0.6558
LC	-0.016802	0.037542	-0.447563	0.6550
PPI	0.204099	1.038575	0.196518	0.8444
OP	-0.004366	0.060441	-0.072233	0.9425
GDP	-0.111475	0.854242	-0.130495	0.8963
GDP_D	1.301478	3.436420	0.378731	0.7053
IRS	-0.001233	0.004268	-0.288991	0.7729
ER	0.050654	0.289670	0.174866	0.8614
RESID(-1)	-0.279716	0.242393	-1.153977	0.2501
RESID(-2)	-0.088339	0.077004	-1.147202	0.2528
RESID(-3)	0.113051	0.077926	1.450759	0.1486
RESID(-4)	-0.069600	0.077769	-0.894950	0.3720
RESID(-5)	0.050000	0.078341	0.638235	0.5241
RESID(-6)	0.009011	0.077511	0.116254	0.9076
RESID(-7)	0.131507	0.079888	1.646133	0.1015
RESID(-8)	0.045321	0.080465	0.563244	0.5740
RESID(-9)	-0.049145	0.078871	-0.623114	0.5340
RESID(-10)	0.010081	0.077334	0.130357	0.8964
RESID(-11)	-0.042231	0.077918	-0.541994	0.5885
RESID(-12)	0.015407	0.079607	0.193543	0.8468

Utilities

Breusch-Godfrey Serial Correlation LM Test:

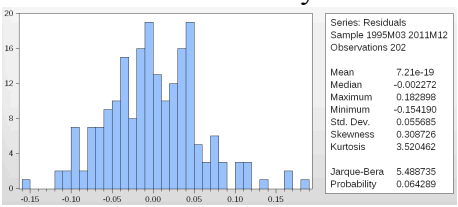
F-statistic	1.479606	Prob. F(12,177)	0.1355
Obs*R-squared	18.41576	Prob. Chi-Square(12)	0.1036

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/04/16 Time: 11:07
Sample: 1995M03 2011M12
Included observations: 202
Presample missing value lagged residuals set to zero.

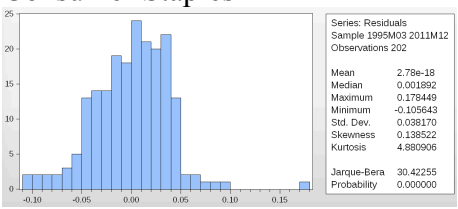
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000365	0.005732	0.063629	0.9493
S_P_500___1_	-0.351993	0.211347	-1.665472	0.0976
EPC	-0.091839	0.493655	-0.186038	0.8526
CPI	0.274872	1.784267	0.154053	0.8777
CP	0.010841	0.881955	0.012292	0.9902
UR	-0.030247	0.123118	-0.245674	0.8062
LC	0.006356	0.028373	0.224013	0.8230
PPI	-0.008566	0.163607	-0.052357	0.9583
OP	0.010961	0.046225	0.237119	0.8128
GDP	0.042792	0.643457	0.066503	0.9471
GDP_D	0.238398	2.625352	0.090806	0.9277
IRS	-0.001883	0.003305	-0.569759	0.5696
ER	0.068155	0.221565	0.307609	0.7587
RESID(-1)	0.366801	0.221213	1.658134	0.0991
RESID(-2)	-0.053871	0.077235	-0.697492	0.4864
RESID(-3)	0.032063	0.075450	0.424958	0.6714
RESID(-4)	0.030259	0.076170	0.397251	0.6917
RESID(-5)	0.151542	0.074485	2.034521	0.0434
RESID(-6)	0.003748	0.075176	0.049862	0.9603
RESID(-7)	0.034374	0.076172	0.451271	0.6523
RESID(-8)	0.149820	0.077572	1.931368	0.0550
RESID(-9)	-0.012881	0.076425	-0.168550	0.8663
RESID(-10)	-0.152648	0.075118	-2.032122	0.0436
RESID(-11)	-0.066874	0.075548	-0.885184	0.3773
RESID(-12)	-0.070992	0.076450	-0.928615	0.3544

Appendix D – Test for normality

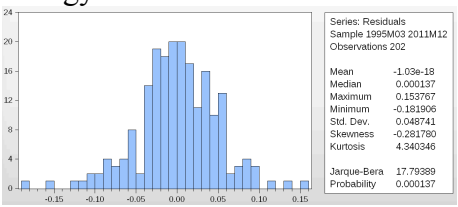
Consumer Discretionary



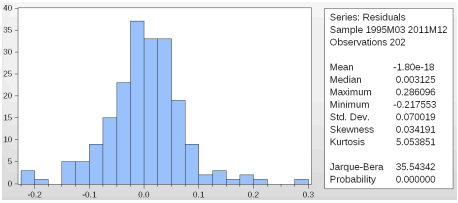
Consumer Staples



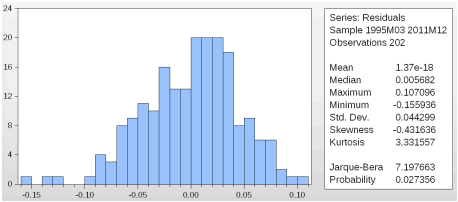
Energy



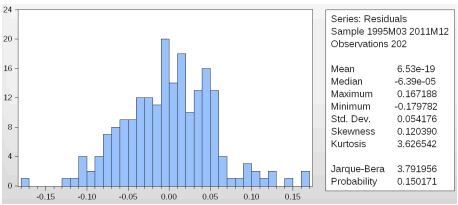
Financials



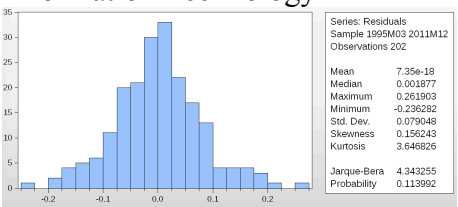
Health Care



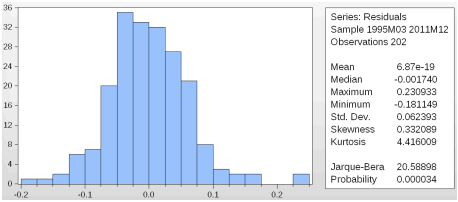
Industrials



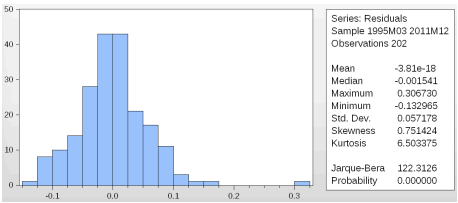
Information Technology



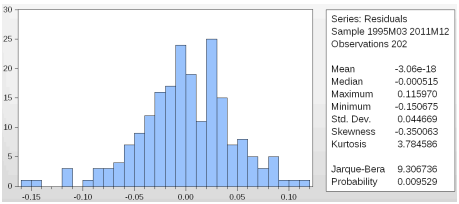
Materials



Telecommunication Services



Utilities



Appendix E – Test for Heteroscedasticity

Consumer Discretionary

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.645773	Prob. F(12,189)	0.0027
Obs*R-squared	29.05266	Prob. Chi-Square(12)	0.0039
Scaled explained SS	32.05213	Prob. Chi-Square(12)	0.0014

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/02/16 Time: 16:06
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004225	0.000599	7.049422	0.0000
S_P_500___1_	-0.020286	0.005764	-3.519664	0.0005
EPC	-0.011330	0.049892	-0.227088	0.8206
CPI	-0.367026	0.168900	-2.173031	0.0310
CP	-0.094701	0.088554	-1.069415	0.2862
UR	0.018908	0.012054	1.568621	0.1184
LC	-0.003278	0.002884	-1.136597	0.2571
PPI	0.028238	0.058817	0.480098	0.6317
OP	0.005694	0.004543	1.253289	0.2116
GDP	-0.011562	0.065226	-0.177263	0.8595
GDP_D	0.014738	0.267005	0.055197	0.9560
IRS	1.43E-05	0.000329	0.043553	0.9653
ER	0.001655	0.022564	0.073338	0.9416

R-squared	0.143825	Mean dependent var	0.003085
Adjusted R-squared	0.089465	S.D. dependent var	0.004911
S.E. of regression	0.004686	Akaike info criterion	-7.826373
Sum squared resid	0.004150	Schwarz criterion	-7.613464
Log likelihood	803.4636	Hannan-Quinn criter.	-7.740230
F-statistic	2.645773	Durbin-Watson stat	1.601490
Prob(F-statistic)	0.002688		

Consumer Staples

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.281618	Prob. F(12,189)	0.2322
Obs*R-squared	15.20037	Prob. Chi-Square(12)	0.2307
Scaled explained SS	25.82130	Prob. Chi-Square(12)	0.0114

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/02/16 Time: 16:44
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001748	0.000349	5.014645	0.0000
S_P_500___1_	-0.014990	0.005273	-2.842945	0.0050
EPC	0.000527	0.030045	0.017548	0.9860
CPI	-0.009533	0.101940	-0.093519	0.9256
CP	-0.023246	0.054435	-0.427032	0.6698
UR	-0.002929	0.007314	-0.400413	0.6893
LC	-0.002436	0.001741	-1.399137	0.1634
PPI	-0.050070	0.024715	-2.025889	0.0442
OP	0.000957	0.002773	0.344945	0.7305
GDP	0.001882	0.039237	0.047977	0.9618
GDP_D	-0.006950	0.159419	-0.043595	0.9653
IRS	-0.000222	0.000199	-1.112317	0.2674
ER	0.007095	0.013554	0.523477	0.6013

R-squared	0.075249	Mean dependent var	0.001450
Adjusted R-squared	0.016535	S.D. dependent var	0.002863
S.E. of regression	0.002839	Akaike info criterion	-8.828332
Sum squared resid	0.001524	Schwarz criterion	-8.615424
Log likelihood	904.6616	Hannan-Quinn criter.	-8.742189
F-statistic	1.281618	Durbin-Watson stat	1.991878
Prob(F-statistic)	0.232168		

Energy

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.114065	Prob. F(12,189)	0.3508
Obs*R-squared	13.34441	Prob. Chi-Square(12)	0.3445
Scaled explained SS	19.51110	Prob. Chi-Square(12)	0.0769

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/02/16 Time: 16:57
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003383	0.000568	5.961045	0.0000
S_P_500___1_	-0.002697	0.005139	-0.524847	0.6003
EPC	-0.015170	0.045575	-0.332857	0.7396
CPI	0.059963	0.185365	0.323489	0.7467
CP	-0.019651	0.081758	-0.240362	0.8103
UR	-0.017706	0.011223	-1.577663	0.1163
LC	-0.005590	0.002671	-2.092531	0.0377
PPI	-0.007849	0.015014	-0.522754	0.6018
OP	-0.000279	0.004457	-0.062545	0.9502
GDP	-0.050800	0.059822	-0.849190	0.3969
GDP_D	-0.477108	0.244142	-1.954225	0.0521
IRS	0.000218	0.000303	0.720320	0.4722
ER	0.009526	0.020729	0.459541	0.6464

R-squared	0.066061	Mean dependent var	0.002364
Adjusted R-squared	0.006764	S.D. dependent var	0.004331
S.E. of regression	0.004317	Akaike info criterion	-7.990544
Sum squared resid	0.003522	Schwarz criterion	-7.777636
Log likelihood	820.0450	Hannan-Quinn criter.	-7.904401
F-statistic	1.114065	Durbin-Watson stat	1.966011
Prob(F-statistic)	0.350792		

Financials

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	4.244534	Prob. F(12,189)	0.0000
Obs*R-squared	42.88151	Prob. Chi-Square(12)	0.0000
Scaled explained SS	76.09020	Prob. Chi-Square(12)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/02/16 Time: 17:13
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008173	0.001121	7.292528	0.0000
S_P_500___1_	-0.027579	0.008716	-3.164259	0.0018
EPC	-0.086788	0.095493	-0.908835	0.3646
CPI	-0.309383	0.320058	-0.966647	0.3350
CP	-0.197384	0.170779	-1.155785	0.2492
UR	0.070450	0.023219	3.034172	0.0028
LC	-0.014033	0.005503	-2.550099	0.0116
PPI	0.029812	0.104610	0.284983	0.7760
OP	0.010041	0.008773	1.144471	0.2539
GDP	-0.085479	0.123825	-0.690321	0.4908
GDP_D	-0.980912	0.506515	-1.936590	0.0543
IRS	0.000229	0.000635	0.360326	0.7190
ER	-0.045767	0.043296	-1.057077	0.2918

R-squared	0.212285	Mean dependent var	0.004878
Adjusted R-squared	0.162271	S.D. dependent var	0.009847
S.E. of regression	0.009012	Akaike info criterion	-6.518227
Sum squared resid	0.015351	Schwarz criterion	-6.305319
Log likelihood	671.3410	Hannan-Quinn criter.	-6.432084
F-statistic	4.244534	Durbin-Watson stat	1.136090
Prob(F-statistic)	0.000006		

Health Care

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.458018	Prob. F(12,189)	0.1433
Obs*R-squared	17.11525	Prob. Chi-Square(12)	0.1453
Scaled explained SS	17.46707	Prob. Chi-Square(12)	0.1329

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/03/16 Time: 09:41
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002564	0.000382	6.707877	0.0000
S_P_500___1_	-0.012907	0.004481	-2.880428	0.0044
EPC	-0.020667	0.031097	-0.664599	0.5071
CPI	-0.074012	0.104877	-0.705701	0.4812
CP	-0.018831	0.056119	-0.335560	0.7376
UR	-0.003956	0.007575	-0.522276	0.6021
LC	-0.004064	0.001810	-2.245902	0.0259
PPI	0.037464	0.059142	0.633458	0.5272
OP	0.001410	0.002863	0.492432	0.6230
GDP	-0.035252	0.040545	-0.869451	0.3857
GDP_D	-0.156381	0.169275	-0.923830	0.3568
IRS	-6.59E-05	0.000207	-0.318277	0.7506
ER	0.005339	0.014106	0.378503	0.7055

R-squared	0.084729	Mean dependent var	0.001953
Adjusted R-squared	0.026617	S.D. dependent var	0.002989
S.E. of regression	0.002949	Akaike info criterion	-8.752497
Sum squared resid	0.001644	Schwarz criterion	-8.539588
Log likelihood	897.0022	Hannan-Quinn criter.	-8.666354
F-statistic	1.458018	Durbin-Watson stat	1.949725
Prob(F-statistic)	0.143318		

Industrials

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.974724	Prob. F(12,189)	0.0008
Obs*R-squared	32.09096	Prob. Chi-Square(12)	0.0013
Scaled explained SS	36.89418	Prob. Chi-Square(12)	0.0002

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/03/16 Time: 09:52
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004154	0.000570	7.289679	0.0000
S_P_500___1_	-0.018282	0.005646	-3.238240	0.0014
EPC	0.005860	0.047530	0.123301	0.9020
CPI	-0.192294	0.163392	-1.176893	0.2407
CP	-0.058957	0.086164	-0.684246	0.4947
UR	0.024655	0.011615	2.122752	0.0351
LC	-0.005825	0.002749	-2.118783	0.0354
PPI	0.016648	0.105619	0.157624	0.8749
OP	0.004487	0.004384	1.023521	0.3074
GDP	-0.041760	0.061495	-0.679085	0.4979
GDP_D	-0.334814	0.276137	-1.212496	0.2268
IRS	0.000170	0.000317	0.536653	0.5921
ER	-0.018151	0.021478	-0.845096	0.3991

R-squared	0.158866	Mean dependent var	0.002921
Adjusted R-squared	0.105461	S.D. dependent var	0.004745
S.E. of regression	0.004488	Akaike info criterion	-7.912722
Sum squared resid	0.003807	Schwarz criterion	-7.699813
Log likelihood	812.1849	Hannan-Quinn criter.	-7.826578
F-statistic	2.974724	Durbin-Watson stat	1.467770
Prob(F-statistic)	0.000795		

Information Technology

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.903333	Prob. F(12,189)	0.5447
Obs*R-squared	10.95716	Prob. Chi-Square(12)	0.5326
Scaled explained SS	12.69446	Prob. Chi-Square(12)	0.3916

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/03/16 Time: 10:05
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006010	0.001563	3.843869	0.0002
S_P_500___1_	-0.009780	0.008699	-1.124286	0.2623
EPC	-0.078243	0.108042	-0.724196	0.4698
CPI	0.179389	0.363256	0.493838	0.6220
CP	0.052891	0.191904	0.275611	0.7831
UR	0.028331	0.026287	1.077732	0.2825
LC	0.008071	0.006261	1.289048	0.1990
PPI	-0.072345	0.073031	-0.990610	0.3231
OP	-0.014935	0.009877	-1.512099	0.1322
GDP	-0.145086	0.140239	-1.034563	0.3022
GDP_D	-0.312708	0.572053	-0.546641	0.5853
IRS	-0.000189	0.000712	-0.265178	0.7912
ER	0.010908	0.048856	0.223259	0.8236

R-squared	0.054243	Mean dependent var	0.006218
Adjusted R-squared	-0.005805	S.D. dependent var	0.010141
S.E. of regression	0.010170	Akaike info criterion	-6.276527
Sum squared resid	0.019549	Schwarz criterion	-6.063619
Log likelihood	646.9292	Hannan-Quinn criter.	-6.190384
F-statistic	0.903333	Durbin-Watson stat	1.395559
Prob(F-statistic)	0.544714		

Materials

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.934112	Prob. F(12,189)	0.0009
Obs*R-squared	31.72163	Prob. Chi-Square(12)	0.0015
Scaled explained SS	47.43135	Prob. Chi-Square(12)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/03/16 Time: 10:14
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005633	0.000855	6.584894	0.0000
S_P_500___1_	-0.029551	0.007364	-4.013140	0.0001
EPC	-0.010601	0.072013	-0.147207	0.8831
CPI	-0.371500	0.245110	-1.515644	0.1313
CP	-0.012003	0.128616	-0.093327	0.9257
UR	0.013271	0.017493	0.758668	0.4490
LC	-0.009871	0.004154	-2.376528	0.0185
PPI	-0.063126	0.134119	-0.470670	0.6384
OP	0.012468	0.006594	1.890825	0.0602
GDP	-0.001901	0.093242	-0.020392	0.9838
GDP_D	-0.477501	0.387562	-1.232061	0.2195
IRS	0.000321	0.000478	0.672462	0.5021
ER	0.002454	0.032383	0.075765	0.9397

R-squared	0.157038	Mean dependent var	0.003874
Adjusted R-squared	0.103516	S.D. dependent var	0.007177
S.E. of regression	0.006795	Akaike info criterion	-7.082932
Sum squared resid	0.008728	Schwarz criterion	-6.870023
Log likelihood	728.3761	Hannan-Quinn criter.	-6.996789
F-statistic	2.934112	Durbin-Watson stat	1.645740
Prob(F-statistic)	0.000926		

Telecommunication Services

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.533465	Prob. F(12,189)	0.8911
Obs*R-squared	6.617756	Prob. Chi-Square(12)	0.8818
Scaled explained SS	15.94156	Prob. Chi-Square(12)	0.1939

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/03/16 Time: 10:28
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003462	0.000952	3.635315	0.0004
S_P_500___1_	-0.017218	0.009370	-1.837660	0.0677
EPC	0.007509	0.082508	0.091006	0.9276
CPI	0.100749	0.278953	0.361169	0.7184
CP	0.025904	0.150784	0.171792	0.8638
UR	0.015051	0.020002	0.752476	0.4527
LC	1.84E-05	0.004753	0.003873	0.9969
PPI	-0.024781	0.129880	-0.190799	0.8489
OP	-0.005600	0.007577	-0.739065	0.4608
GDP	-0.092427	0.106538	-0.867548	0.3867
GDP_D	-0.191242	0.438879	-0.435750	0.6635
IRS	-0.000209	0.000544	-0.384411	0.7011
ER	0.024147	0.037184	0.649397	0.5169

R-squared	0.032761	Mean dependent var	0.003253
Adjusted R-squared	-0.028651	S.D. dependent var	0.007651
S.E. of regression	0.007759	Akaike info criterion	-6.817643
Sum squared resid	0.011379	Schwarz criterion	-6.604735
Log likelihood	701.5819	Hannan-Quinn criter.	-6.731500
F-statistic	0.533465	Durbin-Watson stat	1.784766
Prob(F-statistic)	0.891106		

Utilities

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.704288	Prob. F(12,189)	0.0685
Obs*R-squared	19.72388	Prob. Chi-Square(12)	0.0725
Scaled explained SS	24.04052	Prob. Chi-Square(12)	0.0201

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/03/16 Time: 10:42
Sample: 1995M03 2011M12
Included observations: 202

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002569	0.000401	6.411547	0.0000
S_P_500___1_	0.004671	0.005090	0.917660	0.3600
EPC	-0.036163	0.034429	-1.050380	0.2949
CPI	-0.341863	0.116871	-2.925116	0.0039
CP	0.144096	0.061755	2.333371	0.0207
UR	0.011447	0.008490	1.348269	0.1792
LC	-0.002799	0.001995	-1.402778	0.1623
PPI	-0.002853	0.011566	-0.246645	0.8055
OP	0.006536	0.003161	2.067622	0.0400
GDP	-0.070602	0.044590	-1.583362	0.1150
GDP_D	-0.199213	0.182893	-1.089233	0.2774
IRS	-8.73E-06	0.000229	-0.038163	0.9696
ER	-0.008609	0.015539	-0.554024	0.5802

R-squared	0.097643	Mean dependent var	0.001985
Adjusted R-squared	0.040350	S.D. dependent var	0.003321
S.E. of regression	0.003254	Akaike info criterion	-8.555899
Sum squared resid	0.002001	Schwarz criterion	-8.342991
Log likelihood	877.1458	Hannan-Quinn criter.	-8.469756
F-statistic	1.704288	Durbin-Watson stat	1.687701
Prob(F-statistic)	0.068517		

Appendix F – Robust OLS Regressions

Consumer Discretionary

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 16:07
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000545	0.009656	-0.056471	0.9550
S_P_500___1_	0.011361	0.106241	0.106936	0.9150
EPC	2.014531	0.671191	3.001427	0.0031
CPI	1.211013	2.954486	0.409889	0.6824
CP	-0.605273	1.242516	-0.487135	0.6267
UR	-0.174924	0.174453	-1.002703	0.3173
LC	0.010038	0.032043	0.313265	0.7544
PPI	-0.240644	0.795284	-0.302589	0.7625
OP	0.065878	0.068989	0.954905	0.3408
GDP	1.623729	0.806759	2.012658	0.0456
GDP_D	-1.467844	3.442171	-0.426430	0.6703
IRS	-0.001841	0.003801	-0.484295	0.6287
ER	0.436951	0.343090	1.273574	0.2044

R-squared	0.113045	Mean dependent var	0.007224
Adjusted R-squared	0.056730	S.D. dependent var	0.059127
S.E. of regression	0.057425	Akaike info criterion	-2.814472
Sum squared resid	0.623258	Schwarz criterion	-2.601564
Log likelihood	297.2617	Hannan-Quinn criter.	-2.728329
F-statistic	2.007383	Durbin-Watson stat	1.913781
Prob(F-statistic)	0.025576	Wald F-statistic	1.664775
Prob(Wald F-statistic)	0.077464		

Consumer Staples

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 16:45
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006297	0.005296	1.188989	0.2359
S_P_500___1_	0.028468	0.089491	0.318109	0.7508
EPC	0.210674	0.379649	0.554918	0.5796
CPI	2.630975	1.714438	1.534599	0.1266
CP	0.368756	0.606788	0.607719	0.5441
UR	-0.124602	0.107402	-1.160147	0.2475
LC	-0.005760	0.024766	-0.232578	0.8163
PPI	0.563995	0.332220	1.697655	0.0912
OP	-0.024182	0.040754	-0.593379	0.5536
GDP	-0.060876	0.484408	-0.125671	0.9001
GDP_D	-5.015979	2.050270	-2.446497	0.0153
IRS	-0.002099	0.002972	-0.706308	0.4809
ER	0.378887	0.170596	2.220952	0.0275

R-squared	0.076963	Mean dependent var	0.006575
Adjusted R-squared	0.018357	S.D. dependent var	0.039729
S.E. of regression	0.039363	Akaike info criterion	-3.569790
Sum squared resid	0.292845	Schwarz criterion	-3.356882
Log likelihood	373.5488	Hannan-Quinn criter.	-3.483647
F-statistic	1.313231	Durbin-Watson stat	1.925809
Prob(F-statistic)	0.213647	Wald F-statistic	1.701173
Prob(Wald F-statistic)	0.069187		

Energy

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 17:05
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004001	0.007478	-0.535092	0.5932
S_P_500___1_	-0.115967	0.064125	-1.808452	0.0721
EPC	0.957470	0.399376	2.397413	0.0175
CPI	2.244704	1.876216	1.196399	0.2330
CP	0.107780	0.751761	0.143370	0.8862
UR	-0.063616	0.137500	-0.462659	0.6441
LC	-0.015835	0.032896	-0.481366	0.6308
PPI	0.142455	0.169577	0.840059	0.4019
OP	0.290005	0.059544	4.870431	0.0000
GDP	0.618218	0.790749	0.781814	0.4353
GDP_D	1.032877	2.846849	0.362814	0.7171
IRS	0.001753	0.002876	0.609614	0.5428
ER	0.230155	0.280494	0.820533	0.4129

R-squared	0.383741	Mean dependent var	0.010094
Adjusted R-squared	0.344614	S.D. dependent var	0.062089
S.E. of regression	0.050265	Akaike info criterion	-3.080842
Sum squared resid	0.477513	Schwarz criterion	-2.867934
Log likelihood	324.1650	Hannan-Quinn criter.	-2.994699
F-statistic	9.807451	Durbin-Watson stat	1.991600
Prob(F-statistic)	0.000000	Wald F-statistic	11.69473
Prob(Wald F-statistic)	0.000000		

Financials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 17:13
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.009473	0.012773	-0.741626	0.4592
S_P_500___1_	-0.075634	0.140460	-0.538478	0.5909
EPC	2.333757	0.893203	2.612796	0.0097
CPI	2.228042	3.411788	0.653042	0.5145
CP	1.254497	1.150763	1.090143	0.2770
UR	-0.378866	0.222780	-1.700629	0.0907
LC	-0.006086	0.050839	-0.119708	0.9048
PPI	0.012932	0.783318	0.016509	0.9868
OP	0.051633	0.096067	0.537463	0.5916
GDP	1.253351	1.168868	1.072277	0.2850
GDP_D	-2.885356	4.014611	-0.718714	0.4732
IRS	-0.006169	0.004640	-1.329717	0.1852
ER	0.746908	0.474802	1.573093	0.1174

R-squared	0.132223	Mean dependent var	0.005307
Adjusted R-squared	0.077126	S.D. dependent var	0.075165
S.E. of regression	0.072208	Akaike info criterion	-2.356343
Sum squared resid	0.985442	Schwarz criterion	-2.143435
Log likelihood	250.9906	Hannan-Quinn criter.	-2.270200
F-statistic	2.399827	Durbin-Watson stat	1.963553
Prob(F-statistic)	0.006541	Wald F-statistic	1.406996
Prob(Wald F-statistic)	0.165513		

Health Care

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 09:42
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002912	0.007339	-0.396734	0.6920
S_P_500___1_	-0.113558	0.083439	-1.360973	0.1751
EPC	0.515160	0.412078	1.250150	0.2128
CPI	4.410004	1.555558	2.834998	0.0051
CP	1.482415	0.738674	2.006859	0.0462
UR	-0.073063	0.114427	-0.638509	0.5239
LC	-0.015100	0.028852	-0.523359	0.6013
PPI	0.687850	0.977070	0.703993	0.4823
OP	-0.058390	0.047113	-1.239365	0.2167
GDP	0.459951	0.680558	0.675844	0.5000
GDP_D	-4.529671	2.634618	-1.719290	0.0872
IRS	-0.004223	0.003208	-1.316313	0.1897
ER	0.662702	0.245718	2.697008	0.0076

R-squared	0.121779	Mean dependent var	0.007620
Adjusted R-squared	0.066019	S.D. dependent var	0.047271
S.E. of regression	0.045684	Akaike info criterion	-3.271954
Sum squared resid	0.394445	Schwarz criterion	-3.059046
Log likelihood	343.4673	Hannan-Quinn criter.	-3.185811
F-statistic	2.183992	Durbin-Watson stat	1.919962
Prob(F-statistic)	0.013986	Wald F-statistic	2.058468
Prob(Wald F-statistic)	0.021520		

Industrials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 09:52
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000130	0.008699	0.014994	0.9881
S_P_500___1_	-0.006517	0.111978	-0.058198	0.9537
EPC	1.597850	0.657685	2.429506	0.0161
CPI	0.563261	2.260581	0.249167	0.8035
CP	-0.007333	1.161321	-0.006314	0.9950
UR	-0.361143	0.174494	-2.069655	0.0398
LC	0.011609	0.034549	0.336012	0.7372
PPI	-0.948892	1.224980	-0.774618	0.4395
OP	0.122450	0.064352	1.902820	0.0586
GDP	0.984462	0.792847	1.241679	0.2159
GDP_D	-0.237824	3.261280	-0.072923	0.9419
IRS	-0.001888	0.003259	-0.579423	0.5630
ER	0.277666	0.361887	0.767272	0.4439

R-squared	0.145385	Mean dependent var	0.006925
Adjusted R-squared	0.091123	S.D. dependent var	0.058604
S.E. of regression	0.055870	Akaike info criterion	-2.869398
Sum squared resid	0.589949	Schwarz criterion	-2.656489
Log likelihood	302.8092	Hannan-Quinn criter.	-2.783255
F-statistic	2.679345	Durbin-Watson stat	1.975882
Prob(F-statistic)	0.002377	Wald F-statistic	2.063372
Prob(Wald F-statistic)	0.021164		

Information Technology

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:05
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001650	0.012885	-0.128028	0.8983
S_P_500___1_	-0.085456	0.098940	-0.863710	0.3888
EPC	2.284166	0.789962	2.891489	0.0043
CPI	2.145731	2.652957	0.808807	0.4196
CP	0.661387	2.052375	0.322255	0.7476
UR	-0.266613	0.205299	-1.298652	0.1956
LC	0.055044	0.045268	1.215961	0.2255
PPI	-0.438141	0.608951	-0.719501	0.4727
OP	0.151933	0.086984	1.746688	0.0823
GDP	1.247061	1.100894	1.132770	0.2587
GDP_D	-6.151307	4.025979	-1.527903	0.1282
IRS	0.003124	0.006551	0.476840	0.6340
ER	0.228505	0.380989	0.599766	0.5494

R-squared	0.132795	Mean dependent var	0.010633
Adjusted R-squared	0.077735	S.D. dependent var	0.084885
S.E. of regression	0.081519	Akaike info criterion	-2.113764
Sum squared resid	1.255977	Schwarz criterion	-1.900856
Log likelihood	226.4902	Hannan-Quinn criter.	-2.027621
F-statistic	2.411802	Durbin-Watson stat	1.908641
Prob(F-statistic)	0.006267	Wald F-statistic	2.375535
Prob(Wald F-statistic)	0.007133		

Materials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:14
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000187	0.010488	-0.017856	0.9858
S_P_500___1_	-0.060789	0.091810	-0.662112	0.5087
EPC	1.240153	0.656661	1.888575	0.0605
CPI	2.991721	2.734935	1.093891	0.2754
CP	0.450302	1.290288	0.348994	0.7275
UR	-0.128815	0.182631	-0.705329	0.4815
LC	-0.015205	0.048443	-0.313886	0.7540
PPI	-1.317609	0.953982	-1.381168	0.1689
OP	0.149383	0.081509	1.832714	0.0684
GDP	0.146842	1.036925	0.141613	0.8875
GDP_D	-2.294072	3.406965	-0.673348	0.5015
IRS	0.004575	0.003806	1.202072	0.2308
ER	-0.027907	0.376651	-0.074093	0.9410

R-squared	0.142347	Mean dependent var	0.006207
Adjusted R-squared	0.087893	S.D. dependent var	0.067372
S.E. of regression	0.064343	Akaike info criterion	-2.586991
Sum squared resid	0.782460	Schwarz criterion	-2.374083
Log likelihood	274.2861	Hannan-Quinn criter.	-2.500848
F-statistic	2.614066	Durbin-Watson stat	2.095589
Prob(F-statistic)	0.003018	Wald F-statistic	2.011959
Prob(Wald F-statistic)	0.025185		

Telecommunication Services

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:28
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.006287	0.006825	-0.921211	0.3581
S_P_500___1_	0.005140	0.088137	0.058319	0.9536
EPC	1.130004	0.305401	3.700062	0.0003
CPI	-3.334174	1.938749	-1.719756	0.0871
CP	1.983694	0.953957	2.079438	0.0389
UR	-0.164813	0.154598	-1.066077	0.2877
LC	-0.011433	0.030251	-0.377946	0.7059
PPI	2.108608	0.942761	2.236630	0.0265
OP	0.046531	0.068133	0.682948	0.4955
GDP	1.566585	0.766049	2.045018	0.0422
GDP_D	1.361288	2.588361	0.525926	0.5996
IRS	-0.000572	0.004414	-0.129597	0.8970
ER	0.045415	0.277014	0.163944	0.8700

R-squared	0.107307	Mean dependent var	0.002704
Adjusted R-squared	0.050628	S.D. dependent var	0.060517
S.E. of regression	0.058965	Akaike info criterion	-2.761552
Sum squared resid	0.657129	Schwarz criterion	-2.548644
Log likelihood	291.9168	Hannan-Quinn criter.	-2.675409
F-statistic	1.893251	Durbin-Watson stat	2.066480
Prob(F-statistic)	0.037377	Wald F-statistic	3.341593
Prob(Wald F-statistic)	0.000199		

Utilities

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:42
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.007900	0.006780	-1.165152	0.2454
S_P_500___1_	-0.024344	0.081605	-0.298311	0.7658
EPC	0.848010	0.382517	2.216922	0.0278
CPI	4.496898	1.602041	2.806980	0.0055
CP	-0.111519	1.025410	-0.108755	0.9135
UR	-0.076118	0.124814	-0.609846	0.5427
LC	-0.025685	0.032804	-0.782990	0.4346
PPI	-0.018170	0.158966	-0.114299	0.9091
OP	0.017760	0.049272	0.360440	0.7189
GDP	0.575060	0.642723	0.894724	0.3721
GDP_D	-0.748788	2.205947	-0.339441	0.7347
IRS	-0.003404	0.002934	-1.160082	0.2475
ER	0.325040	0.223943	1.451440	0.1483

R-squared	0.120102	Mean dependent var	0.003704
Adjusted R-squared	0.064235	S.D. dependent var	0.047620
S.E. of regression	0.046065	Akaike info criterion	-3.255332
Sum squared resid	0.401056	Schwarz criterion	-3.042423
Log likelihood	341.7885	Hannan-Quinn criter.	-3.169189
F-statistic	2.149798	Durbin-Watson stat	1.917933
Prob(F-statistic)	0.015742	Wald F-statistic	2.415816
Prob(Wald F-statistic)	0.006178		

Appendix G – Final models

Consumer Discretionary

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 16:07
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002217	0.005269	-0.420736	0.6744
EPC	2.023579	0.688841	2.937658	0.0037
GDP	1.529722	0.767377	1.993443	0.0476

R-squared	0.076198	Mean dependent var	0.007224
Adjusted R-squared	0.066913	S.D. dependent var	0.059127
S.E. of regression	0.057114	Akaike info criterion	-2.872778
Sum squared resid	0.649150	Schwarz criterion	-2.823646
Log likelihood	293.1506	Hannan-Quinn criter.	-2.852899
F-statistic	8.207033	Durbin-Watson stat	1.985893
Prob(F-statistic)	0.000376	Wald F-statistic	5.897897
Prob(Wald F-statistic)	0.003248		

Consumer Staples

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 16:47
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005212	0.003067	1.699630	0.0908
PPI	0.630727	0.309369	2.038753	0.0428

R-squared	0.017606	Mean dependent var	0.006575
Adjusted R-squared	0.012694	S.D. dependent var	0.039729
S.E. of regression	0.039476	Akaike info criterion	-3.616378
Sum squared resid	0.311676	Schwarz criterion	-3.583623
Log likelihood	367.2542	Hannan-Quinn criter.	-3.603126
F-statistic	3.584393	Durbin-Watson stat	1.882463
Prob(F-statistic)	0.059769	Wald F-statistic	4.156512
Prob(Wald F-statistic)	0.042791		

Energy

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 16:58
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002144	0.003972	0.539848	0.5899
EPC	1.016871	0.402764	2.524735	0.0124
OP	0.363784	0.039731	9.156198	0.0000

R-squared	0.347219	Mean dependent var	0.010094
Adjusted R-squared	0.340659	S.D. dependent var	0.062089
S.E. of regression	0.050416	Akaike info criterion	-3.122277
Sum squared resid	0.505812	Schwarz criterion	-3.073145
Log likelihood	318.3500	Hannan-Quinn criter.	-3.102398
F-statistic	52.92483	Durbin-Watson stat	2.248962
Prob(F-statistic)	0.000000	Wald F-statistic	45.16476
Prob(Wald F-statistic)	0.000000		

Financials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/02/16 Time: 17:14
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000792	0.006107	-0.129697	0.8969
EPC	2.322915	0.862367	2.693651	0.0077
UR	-0.426091	0.252253	-1.689137	0.0928

R-squared	0.073989	Mean dependent var	0.005307
Adjusted R-squared	0.064682	S.D. dependent var	0.075165
S.E. of regression	0.072693	Akaike info criterion	-2.390401
Sum squared resid	1.051572	Schwarz criterion	-2.341269
Log likelihood	244.4305	Hannan-Quinn criter.	-2.370522
F-statistic	7.950106	Durbin-Watson stat	2.135323
Prob(F-statistic)	0.000477	Wald F-statistic	4.323563
Prob(Wald F-statistic)	0.014519		

Health Care

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 09:43
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003050	0.005407	-0.564056	0.5734
CPI	2.463909	1.250755	1.969937	0.0502
CP	1.358995	0.703090	1.932889	0.0547
ER	0.537050	0.251962	2.131475	0.0343

R-squared	0.071734	Mean dependent var	0.007620
Adjusted R-squared	0.057670	S.D. dependent var	0.047271
S.E. of regression	0.045888	Akaike info criterion	-3.305642
Sum squared resid	0.416922	Schwarz criterion	-3.240132
Log likelihood	337.8699	Hannan-Quinn criter.	-3.279137
F-statistic	5.100321	Durbin-Watson stat	2.102989
Prob(F-statistic)	0.002019	Wald F-statistic	3.120784
Prob(Wald F-statistic)	0.027105		

Industrials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 09:53
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001371	0.004563	0.300476	0.7641
EPC	1.551434	0.622304	2.493049	0.0135
UR	-0.368903	0.174316	-2.116285	0.0356
OP	0.129422	0.048295	2.679802	0.0080

R-squared	0.128781	Mean dependent var	0.006925
Adjusted R-squared	0.115581	S.D. dependent var	0.058604
S.E. of regression	0.055113	Akaike info criterion	-2.939265
Sum squared resid	0.601410	Schwarz criterion	-2.873754
Log likelihood	300.8657	Hannan-Quinn criter.	-2.912759
F-statistic	9.755930	Durbin-Watson stat	2.024390
Prob(F-statistic)	0.000005	Wald F-statistic	6.450674
Prob(Wald F-statistic)	0.000345		

Information Technology

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:06
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001144	0.006616	0.172840	0.8630
EPC	2.187069	0.738222	2.962618	0.0034
OP	0.204281	0.064355	3.174276	0.0017

R-squared	0.092139	Mean dependent var	0.010633
Adjusted R-squared	0.083015	S.D. dependent var	0.084885
S.E. of regression	0.081285	Akaike info criterion	-2.166958
Sum squared resid	1.314859	Schwarz criterion	-2.117826
Log likelihood	221.8628	Hannan-Quinn criter.	-2.147079
F-statistic	10.09832	Durbin-Watson stat	2.061865
Prob(F-statistic)	0.000067	Wald F-statistic	8.651572
Prob(Wald F-statistic)	0.000250		

Materials

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:15
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000836	0.005142	-0.162517	0.8711
EPC	1.391962	0.646580	2.152807	0.0325
OP	0.206302	0.061011	3.381379	0.0009

R-squared	0.115086	Mean dependent var	0.006207
Adjusted R-squared	0.106193	S.D. dependent var	0.067372
S.E. of regression	0.063694	Akaike info criterion	-2.654710
Sum squared resid	0.807330	Schwarz criterion	-2.605578
Log likelihood	271.1257	Hannan-Quinn criter.	-2.634831
F-statistic	12.94033	Durbin-Watson stat	2.162792
Prob(F-statistic)	0.000005	Wald F-statistic	7.434301
Prob(Wald F-statistic)	0.000770		

Telecommunication Services

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:29
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.007470	0.006105	-1.223736	0.2225
EPC	1.151030	0.326670	3.523525	0.0005
CPI	-2.095779	1.214289	-1.725931	0.0859
CP	2.258606	0.843182	2.678669	0.0080
PPI	2.134310	0.930019	2.294909	0.0228
GDP	1.563311	0.704243	2.219845	0.0276

R-squared	0.097128	Mean dependent var	0.002704
Adjusted R-squared	0.074096	S.D. dependent var	0.060517
S.E. of regression	0.058232	Akaike info criterion	-2.819521
Sum squared resid	0.664622	Schwarz criterion	-2.721256
Log likelihood	290.7717	Hannan-Quinn criter.	-2.779763
F-statistic	4.217026	Durbin-Watson stat	2.078086
Prob(F-statistic)	0.001157	Wald F-statistic	6.591886
Prob(Wald F-statistic)	0.000011		

Utilities

Dependent Variable: S_P_500
Method: Least Squares
Date: 05/03/16 Time: 10:42
Sample: 1995M03 2011M12
Included observations: 202
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.007990	0.004429	-1.803987	0.0727
EPC	0.776101	0.381262	2.035609	0.0431
CPI	4.565769	1.000416	4.563869	0.0000

R-squared	0.095804	Mean dependent var	0.003704
Adjusted R-squared	0.086716	S.D. dependent var	0.047620
S.E. of regression	0.045508	Akaike info criterion	-3.327101
Sum squared resid	0.412131	Schwarz criterion	-3.277968
Log likelihood	339.0372	Hannan-Quinn criter.	-3.307222
F-statistic	10.54246	Durbin-Watson stat	1.952394
Prob(F-statistic)	0.000044	Wald F-statistic	11.36263
Prob(Wald F-statistic)	0.000021		

Appendix H – Descriptive statistics

Consumer Discretionary

	S_P_500	EPC	GDP
Mean	0.007224	0.003110	0.002058
Median	0.009538	0.003144	0.002269
Maximum	0.193909	0.051897	0.018535
Minimum	-0.198952	-0.033448	-0.016961
Std. Dev.	0.059127	0.006858	0.005771
Skewness	-0.121367	1.322304	-0.157454
Kurtosis	4.121666	21.65394	3.664514
Jarque-Bera	11.08520	2987.610	4.551268
Probability	0.003916	0.000000	0.102732
Sum	1.459261	0.628129	0.415768
Sum Sq. Dev.	0.702694	0.009453	0.006694
Observations	202	202	202

Consumer Staples

	S_P_500	PPI
Mean	0.006575	0.002161
Median	0.009350	0.001974
Maximum	0.189144	0.034778
Minimum	-0.122567	-0.029289
Std. Dev.	0.039729	0.008358
Skewness	-0.025405	-0.089239
Kurtosis	5.171705	4.848564
Jarque-Bera	39.71727	29.02945
Probability	0.000000	0.000000
Sum	1.328203	0.436534
Sum Sq. Dev.	0.317262	0.014041
Observations	202	202

Energy

	S_P_500	EPC	OP
Mean	0.010094	0.003110	0.013159
Median	0.011348	0.003144	0.012839
Maximum	0.186372	0.051897	0.359771
Minimum	-0.183922	-0.033448	-0.351365
Std. Dev.	0.062089	0.006858	0.097336
Skewness	-0.372695	1.322304	-0.085073
Kurtosis	3.962206	21.65394	3.865452
Jarque-Bera	12.46884	2987.610	6.547802
Probability	0.001961	0.000000	0.037858
Sum	2.038901	0.628129	2.658143
Sum Sq. Dev.	0.774858	0.009453	1.904332
Observations	202	202	202

Financials

	S_P_500	EPC	UR
Mean	0.005307	0.003110	0.002637
Median	0.009571	0.003144	0.000000
Maximum	0.295522	0.051897	0.080000
Minimum	-0.327501	-0.033448	-0.085106
Std. Dev.	0.075165	0.006858	0.028070
Skewness	-0.575033	1.322304	0.329236
Kurtosis	7.016692	21.65394	3.479284
Jarque-Bera	146.9252	2987.610	5.582771
Probability	0.000000	0.000000	0.061336
Sum	1.072093	0.628129	0.532762
Sum Sq. Dev.	1.135593	0.009453	0.158372
Observations	202	202	202

Health Care

	S_P_500	CPI	CP	ER
Mean	0.007620	0.002033	0.003972	0.000493
Median	0.009100	0.001935	0.004193	0.000434
Maximum	0.136033	0.013768	0.027701	0.071079
Minimum	-0.172592	-0.017705	-0.013228	-0.042564
Std. Dev.	0.047271	0.002915	0.004539	0.015351
Skewness	-0.393878	-1.578607	-0.128605	0.651751
Kurtosis	3.914287	14.98941	8.242085	5.318741
Jarque-Bera	12.25872	1293.760	231.8422	59.55361
Probability	0.002178	0.000000	0.000000	0.000000
Sum	1.539295	0.410585	0.802269	0.099524
Sum Sq. Dev.	0.449141	0.001708	0.004141	0.047364
Observations	202	202	202	202

Industrials

	S_P_500	EPC	UR	OP
Mean	0.008925	0.003110	0.002637	0.013159
Median	0.010507	0.003144	0.000000	0.012839
Maximum	0.184725	0.051897	0.080000	0.359771
Minimum	-0.214861	-0.033448	-0.085106	-0.351365
Std. Dev.	0.058604	0.006858	0.028070	0.097336
Skewness	-0.361611	1.322304	0.329236	-0.085073
Kurtosis	4.749687	21.65394	3.479284	3.865452
Jarque-Bera	30.16915	2987.610	5.582771	6.547802
Probability	0.000000	0.000000	0.061336	0.037858
Sum	1.398939	0.628129	0.532762	2.658143
Sum Sq. Dev.	0.690309	0.009453	0.158372	1.904332
Observations	202	202	202	202

Information Technology

	S_P_500	EPC	OP
Mean	0.010633	0.003110	0.013159
Median	0.012733	0.003144	0.012839
Maximum	0.242135	0.051897	0.359771
Minimum	-0.259131	-0.033448	-0.351365
Std. Dev.	0.084885	0.006858	0.097336
Skewness	-0.091711	1.322304	-0.085073
Kurtosis	3.539829	21.65394	3.865452
Jarque-Bera	2.735906	2987.610	6.547802
Probability	0.254628	0.000000	0.037858
Sum	2.147767	0.628129	2.658143
Sum Sq. Dev.	1.448305	0.009453	1.904332
Observations	202	202	202

Materials

	S_P_500	EPC	OP
Mean	0.006207	0.003110	0.013159
Median	0.007806	0.003144	0.012839
Maximum	0.267793	0.051897	0.359771
Minimum	-0.215322	-0.033448	-0.351365
Std. Dev.	0.067372	0.006858	0.097336
Skewness	0.160353	1.322304	-0.085073
Kurtosis	5.380932	21.65394	3.865452
Jarque-Bera	48.57840	2987.610	6.547802
Probability	0.000000	0.000000	0.037858
Sum	1.253895	0.628129	2.658143
Sum Sq. Dev.	0.912326	0.009453	1.904332
Observations	202	202	202

Telecommunication Services

	S_P_500	EPC	CPI	CP	PPI	GDP
Mean	0.002704	0.003110	0.002033	0.003972	-0.000625	0.002058
Median	0.007895	0.003144	0.001935	0.004193	0.000000	0.002269
Maximum	0.306115	0.051897	0.013768	0.027701	0.008840	0.018535
Minimum	-0.143158	-0.033448	-0.017705	-0.013228	-0.031489	-0.018961
Std. Dev.	0.060517	0.006858	0.002915	0.004539	0.004370	0.005771
Skewness	0.394466	1.322304	-1.578607	-0.128605	-2.861645	-0.157454
Kurtosis	5.501767	21.65394	14.98941	8.242085	17.71024	3.664514
Jarque-Bera	57.91719	2987.610	1293.760	231.8422	2096.988	4.551268
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.102732
Sum	0.546111	0.628129	0.410585	0.802269	-0.126206	0.415768
Sum Sq. Dev.	0.736120	0.009453	0.001708	0.004141	0.003838	0.006694
Observations	202	202	202	202	202	202

Utilities

	S_P_500	EPC	CPI
Mean	0.003704	0.003110	0.002033
Median	0.007353	0.003144	0.001935
Maximum	0.125189	0.051897	0.013768
Minimum	-0.166350	-0.033448	-0.017705
Std. Dev.	0.047620	0.006858	0.002915
Skewness	-0.580167	1.322304	-1.578607
Kurtosis	4.158998	21.65394	14.98941
Jarque-Bera	22.63789	2987.610	1293.760
Probability	0.000012	0.000000	0.000000
Sum	0.748199	0.628129	0.410585
Sum Sq. Dev.	0.455798	0.009453	0.001708
Observations	202	202	202

Appendix I – Validity tests

Model	MSE	MAPE	CSP
Consumer Discretionary	0.0025	176.6 %	45.8 %
Consumer Staples	0.0011	232.2 %	56.3 %
Energy	0.0019	144.8 %	66.7 %
Financials	0.0031	142.2 %	60.4 %
Health Care	0.0013	654.3 %	77.1 %
Industrials	0.0020	213.2 %	64.6 %
Information Technology	0.0023	579.5 %	56.3 %
Materials	0.0023	208.0 %	47.9 %
Telecommunication Services	0.0018	153.1 %	45.8 %
Utilities	0.0019	216.1 %	43.8 %
Average	**0.0020**	**272.0 %**	**56.5 %**