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How Differences in Forecasted and Actual Values of Macroeconomic Indicators Influences the Stock Market

A Study of the United States Equity Market

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ABSTRACT

The objective of this thesis is to analyse if macroeconomic announcements have a significant influence on the stock prices on the S&P 500 index. It is investigated by various correlation tests, descriptive statistics tables and multiple OLS-regressions containing variables about economic activity, inflation and unemployment rates. Further OLS-regressions are also conducted together with a crisis dummy variable that tests and compares the different effects during times of economic growth and times of financial distress. The results of this thesis varied in terms of significance and this is partly in consensus with previous literature. Only the unemployment rate had a significant effect on the S&P 500 index and all OLS-regressions containing the crisis dummy variable generated insignificant coefficients. Thus, indicating an interesting but difficult topic to research.

Keywords: Macroeconomic variables, Macroeconomic news, S&P 500, Survey forecasts

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1. INTRODUCTION

1.1. Background

When it comes to the subject of finance, expectations and predictions are a large part of it. Analysts try to determine the future value of certain stocks within the market by looking at previous financial reports and implementing models to calculate the future expected results, a process which in itself is complex. When these conclusions are published afterwards and reach the average citizen, the expectations start to build up and even more variables are added to how the stock value will develop (Tangjitprom, 2012). Clearly the predictions are extremely hard to get exactly correct and thus expectations are rarely perfectly met either.

There is a general knowledge in finance that macroeconomic news tends to influence asset prices. Based on this knowledge there is a belief that good news will have a positive correlation with rising stock prices and the same will be true for bad news and falling stock prices. This belief and market behaviour is consistent with standard finance theories that suggest that rate of return on an asset is determined by systematic economic news, while no extra reward can be earned for diversifiable risk. However, there still exists a big gap in the empirical identification of the state variables that determine the asset pricing. It is also said that although the press is suggesting a strong association between movements in stock prices and macroeconomic announcements, the evidence that exists about this theory is hardly enough to prove that stock prices respond to general macroeconomic news apart from some types of monetary information (Li and Hu, 1998).

A substantial body of literature on macroeconomic variables and its influence on the stock market exists and the research interest dates back to Jaffe and Mandelker (1976). The literature stream tends to focus on stock markets in the United States (e.g., Fama, 1981; Hardouvelis, 1987; Li and Hu, 1998) and stock markets in less developed countries (e.g., Tangjitprom, 2012, Arnes, 2014). Macroeconomic factors of economic activity, inflation and employment rates are the most examined variables in the literature but other variables such as lending rates and exchange rates have also been examined. There has also been a focus on different states of the economy in some of the literature (e.g., Li and Hu, 1998) where they analyse if the macroeconomic variables affect the stock market differently during periods of economic downturn.

This thesis follows previous literature in the sense of analysing the U.S. stock market with macroeconomic variables of economic activity, inflation, and unemployment rates. In contrast to earlier literature, this thesis will examine this subject during periods of financial stability and during three periods of financial distress. These are the dot-com bubble, the 2008 financial crisis and the Covid-19 crisis. This is done to capture differences between the reaction of the economy when in the different states of booms and recessions. This differs from previous studies where the analysis focuses on upturn and downturn of the stock market in periods of financial stability. By examining this effect, this thesis adds new insights into this research field of macroeconomic indicators' effect on the stock market and the incongruity between different states of the economy.

1.2. Problem Analysis & Research Question

Predictions are an important part of the financial market, creating speculation of the future uncertainty within the market, where predictions cause an immediate change in asset price because of the belief that future price will go up or down.

There might be an additional effect from this. If the predictions ultimately differ from the outcome, there could be additional fluctuations in the asset price due to these positive or negative surprises. By studying the differences we want to find out if macroeconomic announcements create such surprises and therefore influence the stock market prices.

Our research questions are the following:

- Do the Purchasing Managers' Index (PMI), the Consumer Price Index (CPI) and unemployment rates have an influence on the U.S. stock index S&P 500?
- Do any of the macroeconomic indicators have a larger impact on the S&P 500 index during periods of financial distress?

1.3. Purpose of the Thesis

The purpose of the thesis is to observe differences in forecasted values and actual values of Purchasing Managers' Index, unemployment and Consumer Price Index. These differences are used in order to conduct a study to see the reaction of the stock market when the actual values do not coincide with the forecasted values. The thesis aims to see if there is a systematic correlation between the market movements and this difference in the macroeconomic indicators. Furthermore, a target is to analyse if the indicator differences have a more influential effect on the stock market during periods with financial distress.

By examining various types of macroeconomic announcements this thesis further extends the working field of studies where announcements of macroeconomic indicators has an effect on stock prices. It helps investors to see the short-run impact on the stock market due to announcements of macroeconomic indicators. This thesis also aids investors to decide if there is an over- or underreaction on the stock market indices when the survey values of macroeconomic indicators are not aligned with actual values. Furthermore, it is going to generate a clear picture of to what extent each indicator has an influence on the stock market for investors interested in forecasting stock price reactions.

1.4. Limitations of the Thesis

- This thesis relies on the assumption of efficient markets. Meaning that relevant information about the stock market will be incorporated in the stock prices. In practice, all markets are not completely efficient where stock prices are unable to reflect all available information instantaneously. Hence, this is an important factor to consider in this thesis.

- Even though the variables that have been chosen for the thesis are great indicators of market activity, it is still important to remember that almost all theories and models are simplifications of reality and therefore making the result of our research subject to certain omitted-variable bias. The reason this thesis contains relatively few variables

is that survey data is missing from a lot of variables in the Bloomberg Terminal, thus the variables used are the only ones with consistent survey data.

1.5. Structure of the Thesis

The structure of the thesis is as presented in the table of contents. *Literature Review & Theoretical Framework* present the previous research that has inspired and helped us and is presented to endorse the authors who laid the foundation to this thesis. Further on the theories that have been used to shape study, such as the *Efficient Market Hypothesis*, will also be presented. The next section, *Data, Method & Model* shows how the data have been collected and then processed to assess the *Empirical Results* in the following section. After this, the thesis contains a *Discussion* together with *Conclusions* of the results provided earlier. The final part is the *Further Studies* section which presents the different ways to develop this thesis into a more advanced paper.

2. LITERATURE REVIEW & THEORETICAL FRAMEWORK

2.1. Previous Literature

This thesis is related to previous studies regarding the impact of macroeconomic indicators on stock prices. There are various reports discussing the effects of macroeconomic variables and this subject has been in increasing interest since the later half of the 20th century. Multiple conclusions have been drawn and evidence that macroeconomic variables are helpful in order to forecast future stock price changes have been gathered.

Three important studies conducted by Jaffe and Mandelker (1976), Fama and Schwert (1977) and Nelson (1977) all came to the conclusion that stock returns are negatively correlated to expected and unexpected inflation rates. This indicates that the macroeconomic variable of inflation has a significant effect on stock prices which is not in line with the Efficient Market Hypothesis (EMH). EMH which states that all available relevant information is reflected in stock prices would not expect the stock prices to change if the market is efficient. In addition to these studies, Chopin and Zhong found a similar negative relationship between inflation and stock returns. This study is written in the book *Advances in Investment Analysis and Portfolio Management* made by Cheng-Few Lee (2001).

Li and Hu (1998) base their thoughts on earlier literature from Fama and Schwert (1977) and argue in their IMF working paper that interest rates and stock prices are influenced by money supply announcements due to inflationary expectations. They also mean that inflation can influence the stock market through multiple channels. For instance, one way for inflation to influence stock prices is through a positive surprise in announced inflation. This surprise may induce financial agents to raise their expected inflation and thus there will be changes in the stock prices. Additionally, a positive surprise in inflation can influence the saving choice of agents. This would potentially result in an increase in interest rates and thus a decrease in stock prices. Lastly, Li and Hu describe that there is a possibility that an unanticipated increase in inflation may indicate a change to a more restrictive monetary policy. This would result in reduced cash flows and thus lower stock prices.

Fama (1981) examined the correlation between stock prices and real variables. For instance, money supply, interest rate and lagged inflation amongst others were examined as variables of real activity and the conclusion was that there is a strong positive correlation between the real variables and stock prices.

Hardouvelis (1987) examined the stock price response to monetary and nonmonetary news in the United States. The results showed that the stock prices responded primarily to monetary news but also for specific nonmonetary news. What is most interesting to our thesis is the conclusion about the nonmonetary news where the results showed that the stock prices were influenced by unemployment rates, personal income and trade deficit. Furthermore, Cheng (1995) came to the conclusion that there is a positive correlation between unemployment and stock prices. Cheng also found that money supply and government securities price index had a positive relationship with stock prices. The literature regarding the impact of money supply on stock prices is well established. For instance, in the study made by Urich and Wachtel (1981) they found that the announcement of money supply had a significant effect on the financial markets where the markets reacted quickly to new information. They also found that the unanticipated changes in money supply had the most consistent effect on interest rates and thus an effect on the stock market.

Worth noting is that some studies regarding the influence of macroeconomic variables on stock prices generated insignificant results meaning that the empirical evidence for the influences of macroeconomic variables is not completely one sided. Pearce and Roley (1985) did not receive significant results regarding announcements of unemployment rates. Likewise, Chen, Roll and Ross (1986) found only low explanatory power of real macroeconomic variables. Studies conducted by Roley and Troll (1983) and Pearce and Roley (1985) found no significant inflationary effect on stock prices nor on the U.S. Treasury bill Yields. Thus, our first set of hypotheses are the following:

H_{1A}: The macroeconomic variable of PMI will have a positive effect on the S&P 500 index
H_{1B}: The macroeconomic variable of CPI will have a negative effect on the S&P 500 index
H_{1C}: The macroeconomic variable of Unemployment will have a negative effect on the S&P 500 index

Arnes (2014) and the IMF working paper by Li and Hu (1998) are the main reports of interest. Arnes (2014) analyses the influence of macroeconomic indicators on the Istanbul Stock Exchange and uses various macroeconomic variables such as lending rates and consumer price index. Similarly, in their IMF working paper, Li and Hu (1998) investigated the responsiveness of different U.S. stock markets to macroeconomic news. They do this by studying the reaction of the Dow Jones Industrial, S&P 500, Russell 1000 and Russell 2000 Index together with an extensive list of macroeconomic announcements such as money supply, inflation and employment. Furthermore, they test for different effects from the state variables during periods of upturn and downturn.

However, the research in the two studies does not come to the same conclusions. Li and Hu (1998) establish that there is a significance in the macroeconomic announcement variables, however they found that the results vary between different segments of the market and between different sized companies. In the thesis by Arnes (2014), it is concluded that most of the macroeconomic variables tested are not significant. This is in line with some similar studies made previously, for instance Roley and Troll (1983), mentioned above. This indicates that her chosen variables do not have an effect on the Istanbul Stock Exchange.

Li and Hu (1998) comments about previous research within the subject of impact of economic announcements on stock markets by mentioning that previous work within this subject might have had a hard time proving the significance of macroeconomic announcements by not matching the regressions with the right variables, since running a standard regression that treats different states of the economy symmetrically would bias the response coefficients towards zero. Therefore, our second hypothesis is as follows

H_2: The three macroeconomic variables will have a more negative effect on the S&P 500 index during times of financial distress.

2.2. Efficient Market and Random Walk Hypothesis

The Efficient Market Hypothesis (EMH) and the Random Walk Hypothesis are the two most used financial theories throughout the previous literature. EMH is directly related to the research subject of the influence of macroeconomic variables on stock prices by the fact that

the goal of the subject is to analyse how new information influences stock prices. The theory concludes that a market is efficient if all available information is completely reflected in the stock prices. Hence, stock prices should always quickly react to newly available information.

The Efficient Market Hypothesis and the Random Walk Hypothesis are two theories that have had an impact on the financial world since the mid-1960s. Eugene Fama is a well-known advocate for these theories as he has published several documentations about the hypotheses. Throughout his paper Fama (1970) discusses three types of efficiency tests and they are categorised as *weak form*, *semi-strong* and *strong form*. The *weak form* considers a historical perspective and is interested in historical stock prices. Furthermore, it is tightly linked to the Random Walk Hypothesis.

Fama (1965) explains in his paper that the Random Walk Hypothesis implies that future stock prices cannot be predicted based on historical movements or trends and that the movement of stocks is unpredictable. Price changes are independent in individual stocks. Thus, the prices are said to move by a random walk.

The focus in the *semi-strong form* is the ability and the speed of stock prices to efficiently adjust based on publicly available information. It states that publicly available information is reflected in the current stock prices and is examined through information generating events. Finally, *strong form* asserts that all available information, both private and publicly available information, is reflected in the stock prices. Additionally, strong form claims that investors cannot predict future returns. If the *strong form* of efficiency holds, then this indicates that investors are not able to outperform the market by trading public information. If they outperform the market, it indicates that they have monopolistic access to some private information (Fama, 1970). Worth mentioning is that the information from the *strong form* of efficiency does not match with our hypothesis that new information from macroeconomic indicators would influence stock index prices. The *strong form* means that the stock prices would have already taken the information into consideration and therefore would not change.

3. DATA, METHOD & MODEL

3.1. Sample Selection

The following variables; CPI, PMI, unemployment and closing price of S&P 500, are downloaded from the Bloomberg software. Bloomberg has provided the estimated values and the latest values for the macroeconomic indicators and the index closing prices for our chosen stock indices. All values are based on historical data from a 21 year period starting from January 2000 to December 2021. Thus, there is a possibility to analyse the influence of the macroeconomic indicators during financial stability and during a financial crisis when there is financial disturbance. All forecasted values of CPI, PMI and unemployment are calculated as a median from several different economists predicting the value. The economists are chosen by Bloomberg by default.

CPI, PMI and unemployment values from the United States are the macroeconomic indicators of interest and the S&P 500 is the index that is to be analysed. Due to the fact that this thesis is heavily influenced by Arnes (2014) and Li and Hu's IMF working paper (1998) regarding the influence of economic announcements on the stock market we have chosen similar variables. Both papers use CPI as an indicator for the inflation influence. Additionally, the IMF working paper uses variables measuring economic activity and unemployment. Thus, we replicate that choice by using the PMI measurement to replicate the economic activity and the U.S. unemployment rate as the measurement for unemployment. Each variable contains a large amount of observations which is also an important factor to take into consideration when trying to have a well performed study.

Furthermore, in order to receive a well developed understanding of the influence on the stock market from macroeconomic announcements it is relevant to analyse a broad spectrum of macroeconomic indicators. Therefore, the selection of employment statistics, economic activity and inflation have been chosen.

Only winsorized values have been used in the regressions in order to not receive results influenced by extreme outliers. Significance tests have been conducted on 1%, 5% and 10% levels. The survey values of the macroeconomic indicators function as the weighted predicted

outcome of the next macroeconomic announcement made by different economists in the United States. Thus in our method we have used the percentage difference between the predicted outcome and the real outcome. All CPI and unemployment values are in percentages by default, hence a simple difference using subtraction was used in order to calculate the percentage difference between forecasted and latest values in each of the variables. As for the PMI and S&P 500 variables, they are not percentages in default. Thus the following formula was used to calculate the difference between the survey values and latest values as a percentage for the PMI and S&P 500 variables:

$$X_t - S_t = \ Percentage\ difference\ in\ CPI\ and\ Unemployment$$

Where X = latest values, and S = Survey values

$$(X_t - S_t)/S_t \ = \ Percentage\ difference\ in\ PMI$$

Where X = latest values, and S = Survey values

$$(X_t - X_{t-1})/X_{t-1} \ = \ Percentage\ difference\ in\ S\&P\ 500$$

Where X = latest values

3.2. Model for Hypothesis Testing

3.2.1. Model 1

To test the first hypothesis (without the time splitting dummy variable), we estimate the following regression model:

$$SPX_Diff_\%_t = \beta_0 + \beta_1 PMI_t + \beta_2 CPI_t + \beta_3 UNEM_t + \varepsilon_t$$

The dependent variable, *SPX_Diff_%,* presents the change in the percentage difference of the stock price return on the S&P 500 index from the market close of the last business day of month *t-1* to the last business day of month *t*. β_0 is the constant term and the ε presents the error term. The different betas represent the coefficient of each macroeconomic indicator and are values describing the amount each indicator influences the *SPX_Diff_%* variable.

3.2.2. Model 2

To test the second hypothesis (with the time splitting dummy variable), we estimate the following regression model:

$$SPX_Diff_\%_t = \beta_0 + \beta_1 PMI_t + \beta_2 CPI_t + \beta_3 UNEM_t + \beta_4\, t_Split\ x\ PMI_t + \beta_5\, t_Split\ x\ CPI_t + \beta_6\, t_Split\ x\ UNEM_t + \beta_j\, t_Split + \varepsilon_t$$

The dependent variable, *SPX_Diff_%,* presents the change in the percentage difference of the stock price return on the S&P 500 index from the market close of the last business day of month *t-1* to the last business day of month *t*. β_0 is the constant term and the ε presents the error term. The different betas represent the coefficient of each macroeconomic indicator and are values describing the amount each indicator influences the *SPX_Diff_%* variable. In contrast to model 1, the second model also uses the t_Split dummy variable and interaction variables. This is to measure the effect of the macroeconomic indicators in periods with financial distress on the $SPX_Diff_\%$ variable.

3.3. Variable Explanations

Table 1: Variable description

Variable	Description	Unit	Source
SPX Diff %	The difference between closing price of the index S&P 500 between two following months	Percentage	Bloomberg
PMI Survey Diff %	The difference between PMI survey values and actual values in a month	Percentage	Bloomberg
CPI Survey Diff %	The difference between CPI survey values and actual values in a month	Percentage	Bloomberg
UNEM Survey Diff %	The difference between Unemployment survey values and actual values in a month	Percentage	Bloomberg
t_Split	Crisis dummy. Values of 0 represent the the part of the survey sample during economic growth and values of 1 represent the part of the survey sample during an economic downturn	Dummy	

Table 1 contains all variables used in the tests and provides information about them.

3.3.1. Purchasing Managers' Index

The *Purchasing Managers' Index*, PMI, is an economic indicator that consists of surveys within certain business sectors. These surveys are then put together into a single numeric result that will indicate the economic health by asking purchasing managers at 300 firms different questions.

The most common survey items are:

- New orders
- Factory output
- Employment
- Suppliers' delivery time
- Inventories

The most common answers include:

- Improvement
- No change
- Deterioration (Harris, 1991)

In this thesis, the surveys originate from one of the most common surveyors, the *Institute for Supply Management* (*ISM*).

To get the numeric result wanted from these questionnaires, it is necessary to measure changes from multiple indicators, thus the PMI is a diffusion index. This type of index is useful when trying to spot economic turning points. The formula for calculating the PMI assigns weights to each common element and then multiplies them by 1 for improvement, 0.5 for no change, and 0 for deterioration.

PMI = (P1*1) + (P2*0.5) + (P3*0)
P1 = Percentage of answers reporting improvement
P2 = Percentage of answers reporting no change
P3 = Percentage of answers reporting deterioration

A result above 50 suggests improvement. A result below 50 suggests deterioration. The surveys are also divided into the manufacturing and services sectors since manufacturing is export-dependent, and services are more sensitive to the domestic economy. (Kuepper, 2022)

Because the PMI is widely seen as an accurate and timely indicator for correctly forecasting the change in economic trends (IHS Markit, 2022)[1], it will be closely related to the study this

[1] lHS Markit is part of the S&P Global and just as ISM Manufacturing compiles survey data for the Purchasing Managers' Index. They conduct the study in the same way and thus, IHS Markit is an alternate option to ISM Manufacturing's data.

thesis is conducting. The interpretation of the variable “Survey Median PMI” would be the median expected value of the PMI from the purchasing managers *predictions* about future change at the different firms.

3.3.2. Consumer Price Index

The *Consumer Price Index* is one of the most common measurements of inflation and deflation. It is also commonly compared to the *Producer Price Index* which ultimately tells what the price paid by the consumers are compared to the prices producers pay for inputs. The CPI is a measurement that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food, and medical care. This is done by taking price changes for each item in the predetermined basket of goods and averaging them. The CPI is then used to assess price changes associated with the cost of living. Essentially, the index attempts to quantify the aggregate price level in an economy and thus measure the purchasing power of a country's unit of currency.

The formula to calculate CPI for a single item:

CPI = (Cost of Market Basket in Base Year / Cost of Market Basket in Given Year) × 100

The basket of goods are regularly broken down into eight major groups, which are:

- Housing
- Clothing
- Transportation
- Education and communication
- Recreation
- Medical care
- Food and beverages
- Other goods and services

(Fernando, 2022)

Something to acknowledge is that the basket may vary over time, since consumer behaviour also changes over time. What was popular in the 1950s might not be as popular today, thus the prices of the products in the basket change dramatically due to demand. There is therefore a need to review and update these baskets to better reflect the consumption, but this comes at

the cost of comparing different baskets (Government of the United Kingdom, 2022). Thus when looking at the CPI in this thesis, it should logically be an useful explanatory variable.

3.3.3. Unemployment

Unemployment is a good indicator for economic health and refers to the amount of people who are actively searching for employment but can not find a job. There are different kinds of unemployment such as frictional, cyclical, structural, or institutional. This doesn't include people who leave the workforce for other reasons, such as retirement, higher education, and disability. In this thesis however, the unemployment rate is used as a single variable since it is the most common measurement of unemployment and thus the different types of unemployment are not specified.

The formula for unemployment rate:

(The number of unemployed people / Total number in the labour force) × 100

The unemployment rate is published by the U.S. Bureau of Labor Statistics and is a key economic indicator because it signals the ability (or inability) of workers to readily obtain gainful work to contribute to the productive output of the economy. More unemployed workers will lead to less total economic production than if it was the opposite. A low unemployment rate will likely mean that the economy is producing near its full capacity, maximising output, driving wage growth, and raising living standards over time. Although, extremely low unemployment could also be a cautionary sign of an overheating economy, inflationary pressures, and tight conditions for businesses in need of additional workers. On the other hand, when we look at an economy with high unemployment it means that it has a lower output without a proportional decline in the need for basic consumption. High, persistent unemployment can signal serious distress in an economy and even lead to social and political upheaval (Hayes, 2022). When considering this, unemployment is an evident explanatory variable for this thesis as well.

3.3.4. S&P 500

The S&P 500 is an abbreviation for *Standard and Poor's 500* and is an American index that tracks 500 publicly traded companies. It is one of the most commonly used indices and many

investors consider it to be the best measurement of American stock market performance. The index launched on a small scale in 1923, tracking 90 companies and later on expanding to 500 in 1957. Contrary to the Dow Jones Average index the S&P 500 is computed by a weighted average of the stocks that make up the index. Thus the stocks that have a greater market value will also have a greater impact on the index valuation. (Britannica, 2019)

The 500 companies that are listed represent the American industry and there are often additions and deletions of companies within the index to better reflect the market and its current trends. Important to consider is that holding companies and real-estate stocks are not eligible for the list. (Britannica, 2019)

3.4. Descriptive Statistics for the Original Sample

Table 2 presents descriptive statistics for the variables used in the regression analysis. Each economic indicator has negative means. PMI has a mean of -0.0021 and unemployment has a mean of -0.0076. CPI has a mean of -0.0176, hence it is more negative than both PMI and unemployment means. Both CPI and unemployment have medians of zero and PMI has a negative median of -0.0073. It is noted that the S&P 500 variable has a positive mean and median of 0.0058 and 0.0107 respectively. Furthermore, the CPI variable has a standard deviation of 0.1805, hence it is the highest standard deviation of all macroeconomic indicators. The standard deviation of the PMI and unemployment variable is 0.0357 and 0.0295 respectively. The S&P 500 variable has a standard deviation of 0.0422. When comparing the descriptive statistics to Li and Hu (1998), we can see that the results differ slightly for the variables CPI and unemployment. The PMI is not used in the working paper and thus no comparison can be made. However, the CPI has a mean of -0.0030, a standard deviation of 0.1561 and a median of 0. The unemployment has a mean of -0.0546, a standard deviation of 0.1880 and a median of -0.1. The reason for the differences is that Li and Hu (1998) uses fewer observations for all variables as well as the study being conducted during a different time period.

Table 2: Summarising statistics for the Original Sample

Variable	N	Mean	Std. dev.	Min	25%	Median	75%	Max
SPX Diff %	263	0.0058	0.0422	-0.1100	-0.0175	0.0107	0.0315	0.1077
PMI Survey Diff %	263	-0.0021	0.0357	-0.0807	-0.0251	-0.0073	0.0173	0.1034
CPI Survey Diff %	226	-0.0176	0.1805	-1.0000	-0.0500	0.0000	0.0500	0.4444
UNEM Survey Diff %	263	-0.0076	0.0295	-0.1200	-0.0222	0.0000	0.0112	0.0652

Table 2 displays summarising statistics about each economic indicator and the S&P 500 index within the sample. Note, the CPI variable has only 226 observations whilst the other variables have 263. The column "25%" represents the 25th percentile and the column "75%" represents the 75th percentile. The summarising statistics are based on each variable's winsorized values at 1% and 99% distribution levels.

3.5. Correlations for the Original Sample

Table 3 presents the correlations between the variables used in the regression analysis. In general terms, it is problematic when a correlation between variables is above 80-85%. *Table 3* indicates that this is not the case which indicates that all variables can be used in the following regression without any problem in terms of correlation. The only significant correlation is the one between the S&P 500 variable and the unemployment variable. This correlation is negative and rather small with the coefficient of -0.1265. PMI and CPI are positively correlated with the S&P 500 variable but are however insignificant. Worth noting is that the CPI variable is rather close to being significant. The PMI variable is far from significant with its p-value of 0.9735. CPI and unemployment are negatively and positively correlated to PMI respectively. Finally, the unemployment variable is positively correlated with both the CPI variable.

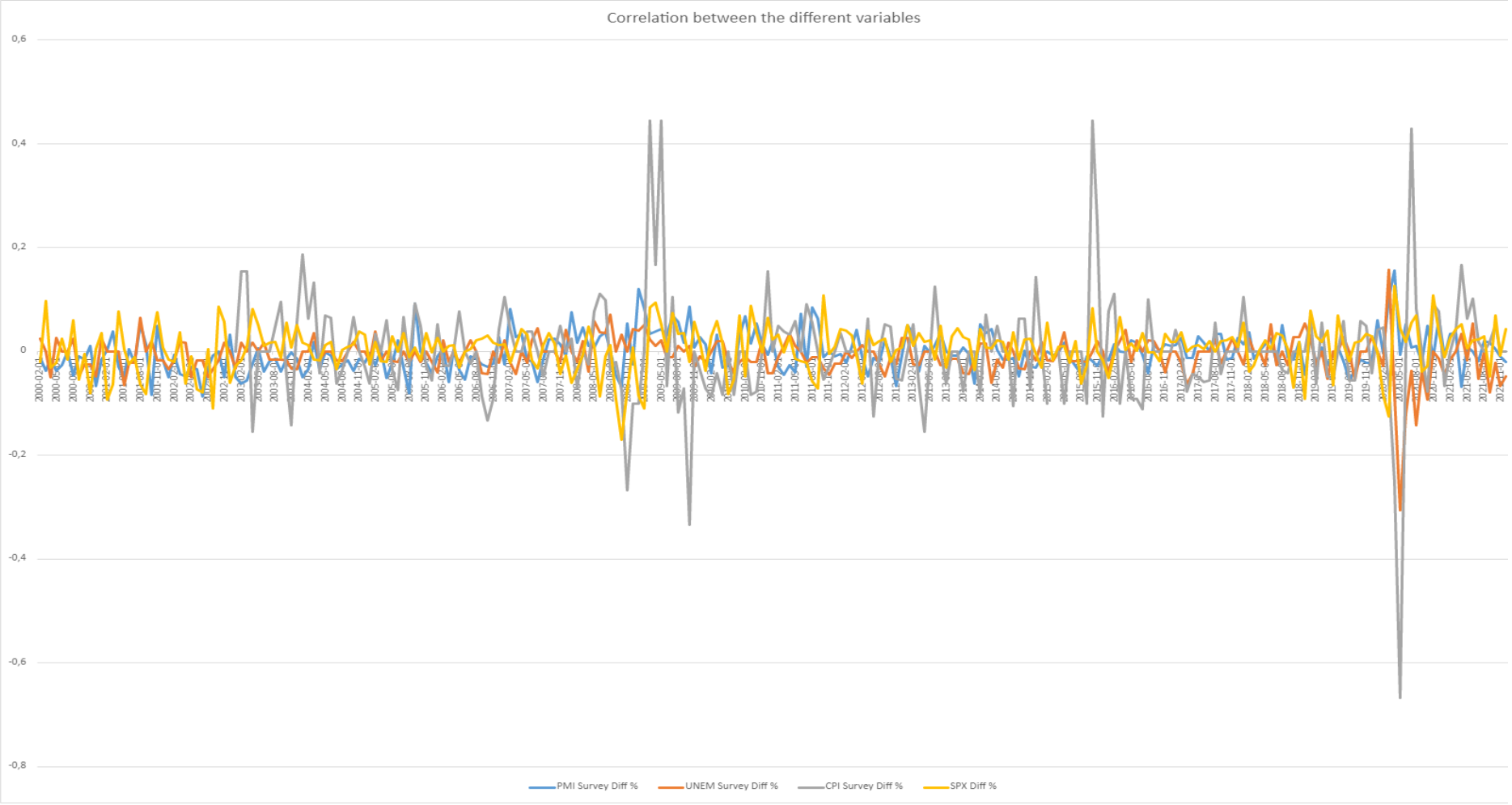
Table 3: Correlations for the original sample

	SPX Diff %	PMI Survey Diff %	CPI Survey Diff %	UNEM Survey Diff %
SPX Diff %				
PMI Survey Diff %	0.0021			
	(0.9735)			
CPI Survey Diff %	0.1179*	-0.0930		
	(0.0770)	(0.1636)		
UNEM Survey Diff %	-0.1265**	0.0377	0.0267	
	(0.0404)	(0.5428)	(0.6900)	

Table 3 contains a correlation test with the S&P 500 index, PMI, CPI and unemployment variables within the original sample. All values within each parenthesis present the P-value for the corresponding variable. * indicates statistical significance at the 10% level, ** indicates statistical significance at the 5% level and *** indicates statistical significance at the 1% level. Thus, the correlation between S&P 500 variable and the unemployment variable is the only significant correlation. Note that all values are based on the winsorized values of the variables of interest. The extreme values are winsorized at the 1% and 99% percent distribution levels.

Line chart 1 (see below) previews four different correlation graphs, one for the S&P 500 variable and one graph for each of the macroeconomic indicators. The main purpose of the line chart is to illustrate how the macroeconomic indicators correlate with the S&P 500 (yellow line). The graph facilitates the process of analysing the movements of the different variables throughout the period 2000 to 2021. When analysing the movements, it is possible to determine that the correlations have changed during the different years and that most of the outliers emerge during periods of financial distress. The CPI is the variable that fluctuates the most but can be seen to move the same way as the S&P 500 in most cases. Also when looking at the unemployment the opposite seems to be true, meaning the S&P 500 and the unemployment variable moves conversely to each other. These two variables compared to the S&P 500 are also the only significant correlations with the CPI at the 10% level and the unemployment at the 5% level. When looking at the PMI however, there seems to be periods with strong correlation and other periods with a lagged correlation where the S&P 500 rises and falls at a slightly later time than the PMI. Additionally, at some other periods there seems to be no correlations between the two at all. A possible explanation for the differences between the periods is that the correlation between PMI and S&P 500 is insignificant.

Line Chart 1: Overview of the Correlation between the different macroeconomic indicators together with the S&P 500 index



This line chart provides all the monthly percentage differences of the PMI, CPI and unemployment, together with the S&P 500 index. All extreme values are winsorized at 1% and 99% percent distribution levels. The reason for the CPI outliers seeming large even after the winsorization process is because of the latest values being very small or equal to zero in some months, creating an illusion of a very big difference when put in percentage form.

3.6. Time-split Variable

Dummy variables can be used in time-series regressions to capture regional or subgroup differences (Hardy, 1993) and as Li and Hu (1998) mentions in the IMF working paper, running standard regressions that treats different states of the economy symmetrically would bias the response coefficients towards zero. Thus to see if there is a significant difference between the PMI-, CPI- and unemployment variable during growth in the economy and downturn in the economy a dummy variable was created.

The dummy variable is used in this thesis in order to further analyse the stock market reaction to different macroeconomic announcements during periods of financial distress and financial stabilisation. By studying the daily return on the S&P 500, different turning points in the index were determined (see *Line chart 2*) where downturn was set to the value 1 and growth was set to the value 0.

Line Chart 2: Overview of the S&P 500 during the last 22 years

Daily last price data of the S&P 500 that has been collected from Bloomberg .

The three different periods of economic decline chosen for the dummy were the dot-com bubble, the 2008 financial crisis and the Covid-19 crisis. The estimation for when these different crises had an effect on the data sample of the S&P 500, giving the dummy variable a value of 1, were set to:

Table 4: Economic downturn estimates

Dot-com bubble	2008 financial crisis	Covid-19 crisis
30/4/2000 - 28/2/2003	31/10/2007 - 31/3/2009	28/2/2018 - 31/3/2020

Based on **estimated** turning points in the economy from our sample of data, therefore these are not exact turning points.

Thus the remaining sample of observation dates will make the dummy variable take a value of 0.

3.7. T-test for the Sample with the Dummy Variable

In order to decide whether there is a significant difference between the two different samples of economic growth and economic downturn we conduct a T-test to compare the values of each sample.

Table 5 presents the T-test for the sample with the dummy variable. The p-values for the PMI and CPI are larger than the significance level and therefore each t-test is insignificant. The null hypothesis indicates that the difference between the means is equal to zero. In this case it is not possible to reject the null hypothesis. The t-test for the unemployment variable is the only significant variable with a p-value of 0.0017, meaning it is significant at the 1% level and there is evidence for different means within the crisis sample and non crisis sample being different.

Table 5: T-test for the dummy variable

	Non crisis				Crisis				t-test	
Variable	N	Mean	Std. err.	Std. dev.	N	Mean	Std. err.	Std. dev.	Mean difference	p-value
PMI	184	-0.0013	0.0024	0.0331	79	-0.0039	0.0045	0.0397	0.0027	0.5735
CPI	181	-0.0130	0.0124	0.1665	45	-0.0359	0.0342	0.2298	0.0228	0.4485
Unemployment	184	-0.0113	0.0021	0.0279	79	0.0010	0.0035	0.0315	-0.0124***	0.0017

Table 5 contains a T-test for all values of the macroeconomic indicators split between periods of financial distress and financial stabilisation. In total there are three T-tests, for the PMI, CPI and unemployment. The results of the tests for the different periods are presented under the headlines “Non crisis” and “Crisis”. The “T-test” headline presents the mean differences between each economic indicator in the “non crisis sample” and the “crisis sample” respectively as well as the p-values. Note, the CPI variable contains less observations than the other variables in both samples. All values are based on the winsorized values of each economic indicator. * indicates statistical significance at the 10% level, ** indicates statistical significance at the 5% level and *** indicates statistical significance at the 1% level. The extreme values are winsorized at the 1% and 99% percent distribution levels.

4. EMPIRICAL RESULTS

4.1. OLS-Regressions for the Original Sample

Table 6 presents the results of the multiple OLS-regressions made with the data sample without the dummy variable. Thus only the dependent variable *SPX Diff %* and the independent variables of PMI, CPI and unemployment are used throughout the regressions. There are four OLS-regressions conducted with this sample and the results are the following:

Table 6: Regressions for the original sample

Variable	Predicted sign	(1)	(2)	(3)	(4)
PMI Survey Diff %	+	0.0025			0.0601
		(0.980)			(0.536)
CPI Survey Diff %	-		0.0253		0.0273
			(0.154)		(0.124)
UNEM Survey Diff %	-			-0.1809*	-0.2132**
				(0.056)	(0.031)
R^2		0.0000	0.0139	0.0160	0.0432
N		263	226	263	226

Table 6 displays all OLS-regressions containing winsorized values of all macroeconomic indicators and the S&P 500 variable. The extreme values are winsorized at the 1% and 99% percent distribution levels. The S&P 500 index is the dependent variable and the macroeconomic indicators are independent variables. Column "Predicted sign" displays our expected signs of each coefficient. For instance, for the CPI variable we predict a negative sign. Column (1) presents the first OLS-regression using only the PMI variable as an independent variable. Column (2) displays the second OLS-regression only using the CPI variable as an independent variable and column (3) presents the OLS-regression containing only the unemployment variable as the independent variable. Lastly, column (4) shows the OLS-regression using all macroeconomic indicators as independent variables simultaneously. R^2 row displays all R square values for each OLS-regression and the N row shows the number of observations used in each OLS-regression. Values presented in

parentheses indicate the corresponding p-value of the variable's coefficient. * indicates statistical significance at the 10% level, ** indicates statistical significance at the 5% level and *** indicates statistical significance at the 1% level. Note, all tests are conducted with robust standard errors. All coefficients are presented in values of percent.

When examining regression (1) using only the PMI variable as the independent variable results in a positive coefficient of 0.0025 percent. The interpretation of regressions with only values of percentages is that with one percent increase in the independent variable the dependent variable increases or decreases by the coefficient of the independent variable (Freund, et al, 2006). This indicates that a one percent increase in the PMI variable increases the S&P 500 variable with 0.0025 percent. On the other hand, the PMI variable is insignificant due to the large p-value. Hence, it is not possible to reject the null hypothesis that the PMI does not have an effect on the S&P 500 index. Therefore, no conclusions can be drawn using only the PMI variable in the OLS regression. In order to be significant the p-value needs to be lower than the significance level of 0.05.

When inspecting regression (2) using only the CPI variable as the independent variable, the results show a positive coefficient of 0.0253 percent indicating that one percent change in the CPI increases the S&P 500 by 0.0253 percent. The CPI variable is similar to the PMI when looking at the p-value, since the coefficient of CPI is also insignificant. A significant coefficient would indicate that if the price of a basket of goods increases by one percent and thus cost of living rises then the return on the S&P 500 index increases with approximately 0.0253 percent. This is not the case in our results so for regression (2) we cannot reject the null hypothesis that the CPI does not have an effect on the S&P 500 index.

For regression (3), the unemployment variable has a coefficient of -0.1809. This indicates that when the unemployment rate increases with one percent then the return on S&P 500 decreases with 0.1809 percent. Furthermore, the unemployment variable follows the PMI, and CPI variables in terms of insignificance at the 5% level, but is significant at the 10% level with its p-value of 0.056. This signifies that there is some evidence for a rising unemployment rate having a negative effect on the S&P 500. This indicates that if the unemployment rate in the United States rises with one percent then the return on the S&P 500 index decreases with approximately 0.1809 percent.

When examining the results from regression (4) using all macroeconomic indicators simultaneously as independent variables it is noted that the p-values substantially decrease. The PMI and CPI variables are still insignificant. There is a notable difference in the Unemployment variable between regression (3) and (4). In regression (4), the p-value of the Unemployment variable is 0.031. Thus, the Unemployment variable has a significant coefficient of -0.2132 at the 5% significance level. This indicates that the unemployment rate has a significant negative effect on the S&P 500 index in regression (4) as well as regression (3). In general terms, all coefficients of the macroeconomic indicators have been altered in a small amount to have a larger coefficient when tested simultaneously but they still have the same signs. Also when comparing the significance of the different regressions we can see that with more variables the p-value improves, proving that regression (1), (2) and (3) suffer from certain omitted-variable bias.

4.2. OLS-regressions for the Sample with the Dummy Variable

When the dummy variable has been added it is possible to study the difference between macroeconomic variables' effect on the market during crisis and non crisis periods of time. *Table 7* presents all regressions for the sample with the Dummy variable, thus including the macroeconomic variables, the dummy variable and interaction variables between the macroeconomic variables and the dummy variable.

Table 7: Regressions for the Sample with the Dummy Variable

Variable	Predicted sign	(1)	(2)	(3)	(4)
PMI Survey Diff %	+	0.1124			0.1254
		(0.240)			(0.190)
tPMI Survey Diff %	-	-0.3228*			-0.1111
		(0.090)			(0.651)
CPI Survey Diff %	-		0.0084		0.0106
			(0.619)		(0.527)
tCPI Survey Diff %	-		0.0442		0.0361
			(0.265)		(0.414)
UNEM Survey Diff %	-			-0.0429	-0.0328
				(0.657)	(0.733)
tUNEM Survey Diff %	-			-0.1609	-0.3197
				(0.420)	(0.226)
t_Split	-	-0.0294***	-0.0240***	-0.0278***	-0.0210***
		(0.000)	(0.002)	(0.000)	(0.006)
R^2		0.1130	0.0911	0.1033	0.1157
N		263	226	263	226

Table 7 displays all OLS-regressions containing winsorized values of all macroeconomic indicators and the S&P 500 variable. The extreme values are winsorized at the 1% and 99% percent distribution levels. The S&P 500 index is the dependent variable and the macroeconomic indicators as well as the corresponding interaction variable are independent variables. Interaction variables are products of each economic indicator and the crisis dummy variable. Column "Predicted sign" displays our expected signs of each coefficient. For instance, for the unemployment variable we predict a negative sign. Column (1) presents the first OLS-regression using only the PMI variable and its interaction variable as independent variables. Column (2) displays the second OLS-regression using only the CPI variable and its interaction variable as independent variables and column (3) presents the OLS-regression containing only the unemployment variable and its interaction variable as independent variables. Lastly, column (4) shows the OLS-regression using all macroeconomic indicators and their corresponding interaction variable as independent variables simultaneously. R^2 row displays all R square values for each OLS-regression and the N row shows the number of observations used in each OLS-regression. Values presented in parentheses indicate the corresponding p-value of the variable's coefficient. * indicates statistical significance at the 10% level, ** indicates statistical significance at the 5% level and *** indicates statistical significance at the 1% level. Note, all tests are conducted with robust standard errors. All coefficients are presented in values of percent.

When looking at the regression in *Table 7*, the only significant variable at the 5% level or lower, is the dummy variable. If we analyse the different interaction variables, their coefficients are all negative except the CPI. If these observations were significant it would make it possible to anticipate that during a contraction in the economy, the S&P 500 was less positively influenced by a rise in the PMI, more positively influenced by a rise in the CPI and even more negatively influenced by a rise in unemployment. These types of regressions can be hard to interpret but one interpretation would be that the original variable is the effect on the dependent variable when the dummy variable is equal to zero and then the interaction variable will be the effect on the dependent variable when the time split variable is equal to one (Huntington-Klein, 2022). Meaning that in our case when looking at regression (1), the interaction variable *tPMI Survey Diff %*, which is significant at the 10% level, would be the added effect on the *SPX Diff %* when the t_Split variable is equal to one. Thus the coefficient of the PMI during a crisis would be equal to: 0.1124 + (-0.3228) = -0.2104. Although, this is just one example and the *PMI Survey Diff %* is still insignificant in this regression and thus no conclusion can be drawn based on this information.

5. DISCUSSION

Looking at the PMI, there should generally be an expectation of a positive coefficient since a positive shock on the market indicates more market activity (Kuepper, 2022). It is a surprise that it was not possible to find a significant result within the regressions, although this could be caused by the lack of observations for the sample. Another reason for the PMI being insignificant could be explained by the fact that the PMI is an index for industrial production and does not consider other types of companies, meaning that the S&P 500 includes some companies that the PMI does not acknowledge (Arnes, 2014).

The unemployment is the only variable that is found significant in *table 6*. The results are negative and in line with our hypothesis where we estimated that the unemployment variable would have a negative effect on the S&P 500 index. Additionally a result indicating that unemployment has a significant effect on stock prices is in consensus with Hardouvelis (1987). However, no significant correlation between the CPI and unemployment was found. This is surprising because high rates of unemployment are usually a signal of economic distress and extremely low rates of unemployment are usually a signal of an overheated economy (Hayes, 2022). One could think of these stages as turning points where unemployment might be rising at the same time as stock prices or the other way around. Unemployment expectations are usually correlated with interest rate expectations because if there is a positive shock on unemployment (an increase of unemployed workers) then interest rates would be expected to fall which increases stock prices. The bottom line is that stock prices usually rise when bad news of unemployment has been published due to the fact that the economy usually is in an expansion (Boyd, et al. 2005). In this thesis however, the significant result of a negative relation between the unemployment and the S&P 500 is still reliable since the percentage differences in the CPI and unemployment does not show a correlation in the observed sample. The theories presented by Hayes (2022) and Boyd, et al. (2005) are therefore only useful and interesting in the discussion of the correlations, but it is not applicable in the discussion about the results.

Related to Arnes (2014), the CPI variable is insignificant and supposedly would have a positive effect on the S&P 500 index in our thesis. However, this result is contradictory to the significant results generated by Jaffe and Mandelker (1976), Fama & Schwert (1977) and

Nelson (1977). As mentioned above, their studies generated results of negative correlations between stock prices and inflation rates. Although, if we were to interpret the positive coefficient as mentioned above, it would indicate that if the purchasing power of individuals decreases then the return on the S&P 500 index increases. This should not be plausible because CPI is the most commonly used measurement of inflation and according to Li and Hu (1998) a positive surprise in inflation would result in lowered stock prices. For instance, with announcements of higher inflation the investors may adjust their savings or expect a higher inflation rate. This would result in an increase in interest rates and therefore lower stock prices.

Another hypothesised reason for the insignificance within the sample can be observed when studying the raw data from Bloomberg, because there seems to be a tendency to negative bias. For example in the PMI, the survey participants will not speculate too much and would rather have a slightly more pessimistic view about the future. This will then result in bigger percentage differences during the largest fluctuations in an expanding economy.

When it comes to the time split regressions there are further insignificance complications. This is in line with the previous assumption that there are too few observations since the survey sample is split into two different samples. Also, when looking at the t-test conducted in *table 5* there also is a worrying insignificance since the expected results would be that there is a difference between all variables during economic growth and economic downturn. The reason for this insignificance could be that the exact periods of growth and downturn are not specific enough. Since we are using seven different periods of time that are individually continuous (counting both periods of growth and downturn), there will be some growth during our periods of economic downturn and contrariwise for our periods of economic growth. This relates to what was mentioned by Li and Hu (1998), which is presented earlier in this thesis. “[...] running a standard regression that treats different states of the economy symmetrically would bias the response coefficients towards zero.”

Furthermore when analysing the regressions with the dummy variable in *table 7* there is no significant variable except the dummy variable, thus no conclusions can be drawn except for that there is evidence for a downturn in the economy related to when the dummy variable is equal to one, just as predicted. The PMI and unemployment also return the predicted negative sign, however the CPI does not. Comparing the results to Li and Hu (1998) they found

significant results for the CPI and unemployment during a downturn in the economy, indicating that both had negative effects on the S&P 500. Unfortunately, no earlier literature has tested for the PMI's effect on the market during an economic downturn and hence we cannot find any evidence to compare our results to for this variable.

6. CONCLUSIONS

The purpose of this thesis was to analyse if announcements of macroeconomic indicators have a significant influence on the S&P 500 index. The macroeconomic indicators of interest were PMI, CPI and unemployment rates and their influence was investigated throughout multiple OLS-regressions. A crisis dummy was also considered in the OLS regression in order to further investigate the effects of the macroeconomic indicators.

The results are partly in consensus with previous literature in the sense that some variables are significant and others are insignificant. In general terms, there is a problem with insignificance within the results and thus it is hard to draw conclusions from the result provided. However, by looking at the different regressions one can draw hypothesised conclusions that the S&P 500 is moving a certain way as a result of an one percent increase in the variable studied. For example we can see that the unemployment is significant at the 5% level in *table 6*, test *(4)* with a coefficient of -0.2132, thus indicating that an increase in the unemployment could be assumed to have an negative impact on the S&P 500. PMI and CPI could be presumed to have a positive effect as well since both *table 6* and *table 7* provide the positive coefficients, however something to consider is that there is no significant result of these variables and no real evidence for this.

These conclusions are just hypotheticals, it is not possible to say for sure what the effect from the different variables are more than guessing that the PMI and CPI has an increasing effect, while unemployment has a decreasing effect. Therefore we cannot validate our hypotheses H_{1A} or H_{1B} even though the sign for H_{1A} is the expected result and the sign for H_{1B} is not. However, there is evidence for hypothesis H_{1C} to be true.

Because the regressions with the dummy variable also provide insignificant results we can not say how the variables affect the S&P 500 during different economic situations. However, as mentioned in the results, the interaction variable for the PMI is significant at the 10% level. This means there is some evidence that the effect of a one percent increase in the PMI during a crisis would lead to a -0.3228 percent lower increase/decrease in the S&P 500 than if there was no crisis. The reason it is not possible to decide whether there is an increase or a decrease is because of the insignificant value of the PMI. Furthermore when looking at the

dummy variable itself there is evidence for a downturn in the economy during our estimated crisis periods in *table 4,* thus showing the estimates are correct to a large extent. To put this in relation to hypothesis H_2 there is almost no evidence for this to be true. The only significant result is the interaction variable for the PMI, which is showing the expected result. The other variables also show the expected result but as mentioned earlier, the problem lies within the insignificance.

7. FURTHER STUDIES

The method used in this thesis is rather simple with common OLS-regressions using robust standard errors and winsorized values. Further research can follow our methodology and hopefully develop it by using more macroeconomic variables and more advanced regressions. For instance, further research can conduct an event study using data from all the firms within the S&P 500 to see if there are any abnormal returns generated from the shock of macroeconomic announcements. For example it would be interesting to see if the PMI would have an increased abnormal return on producing companies since these are the only firms participating in the surveys, or if the abnormal returns are spread out across all firms within the S&P 500.

Further studies should also work more around dealing with the significance problem by including more variables in the work to prevent omitted variable bias as well as try to perfect the time splitting variable to see if there is a better explanation for the different variables during an expanding versus contracting economy. Hopefully the continued research could also find survey data further back than the year 2000, to increase the reliability in their results.

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