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Stock Market Returns under the Influence of Monetary Policy in the United State

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Abstract: In response to the phenomenon of overheated inflation after the Covid-19 pandemic, the Federal Reserve began to continuously carry out substantial interest rate increases, which has also caused financial markets to suffer heavy losses for a time. Consequently, the emphasis of this study lies in how monetary policy such as the effective federal funds rate and quantitative easing affect the monthly return of S&P 500 index. This paper collects monthly data between July 2004 and June 2023. This paper finds that the impact of effective federal funds rate on the stock market returns is insignificant. The fourth round of quantitative easing significantly affected the stock market returns, that with the quantitative easing the stock market rerurns increase by 2.786 percent. The inflation has a significant and consistent influence on stock market returns, which decreases by 0.4% for every 1% increase in the CPI index. Therefore, the volume of quantitative easing and the pace of asset purchases significantly affect stock market returns.

Keywords: stock market return, monetary policy instrument, quantitative easing, inflation

1. Introduction

In January 2020, the Covid-19 pandemic outbreak took place. In March of the same year the Federal Reserve initiated a monetary policy mix of zero interest and quantitative easing. Unlike the previous quantitative easing context, the pandemic was exogenous. For quick fix to US consumption, the US government made massive cash handouts to the population. This has led inflation in the U.S. in recent years reaching an all-time high since the early 1980s, which has undoubtedly caused a decline in savings and capital accumulation across society [1]. In order to fight the high inflation to maintain social stability, the Federal Reserve announced to raise the federal funds rate starting in March 2022. During this period, the rate hike has been expanding. In April 2023, the inversion of the federal funds rate with the inflation rate occurred. This increases the risk of stagflation happening in the US economy in 2023-2030 [2].

This paper focuses on the correlation between monetary policy and stock market returns to enable investors to react quickly to future monetary policy announcements and thus avoid exposure to large system risks. In the study effective federal funds rate and quantitative easing were selected as the variables responding to conventional and unconventional monetary policy. This study chooses the S&P 500 index as a measure of stock market returns. Some studies have shown that the impact of the Fed's monetary policies on the financial market does not disappear over time, although there has been some quantitative easing that has not had a significant impact on financial markets [3,4]. Thus, the

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quantitative easing variables are added to the model gradually when using the model for regression. The regression results find that monetary policies significantly affect the returns in the stock market. The results, therefore, enable investors to have a better interpretation of future monetary policy releases.

2. Methodology and Data

The analysis of this study will be focused on the S&P 500 index monthly return which is influenced by the two major monetary policy tools: effective federal funds rate (EFFR) and quantitative easing (QE). As one of the decisive indicators for the Federal Reserve in determining whether to use the monetary policy instruments, the consumer price index (CPI) has some impact on monetary policy and the stock market. This study adopts regression analysis on time-series data, where the S&P 500 index's monthly return serves as the dependent variable. The independent variables are added in turn for linear regression, and there are two main models in the regression analysis. The financial market tends to react very quickly to economic data and policies in the market, so lags were not considered in this study [5].

In the first model, only the effects of macroeconomic data and conventional monetary policy on stock market returns are considered. For unconventional monetary policies, the analysis focuses on quantitative easing (QE). The time frame selected for the study contains a total of four times quantitative easing conducted by the Federal Reserve. Stock market returns and unconventional monetary policy's relationship is analyzed by adding quantitative easing to the regression model on a case-by-case basis.

To examine the effect of CPI and conventional monetary instrument on stock return, the following regression model uses the data of *SP, CPI*, and *EFFR* from July 2004 to June 2023:

$$\mathrm{SP_t} = \beta_0 + \beta_1 \mathrm{CPI_t} + \beta_2 \mathrm{EFFR_t} + \varepsilon_t \tag{1}$$

where subscript *t* denotes month t, respectively, and ε_t is the error term. The *SP* is the growth rate of S&P 500 index in every month. The *CPI* is the consumer price index of every month. The *EFFR* is the effective federal funds rate. Note that, in the regression model, β_1 measures the impact of current month CPI data on stock market returns, β_2 measures the effect of the Federal Reserve's announcement of the effective federal funds rate.

To improve model 1, model 2 introduces unconventional monetary policy as additional explanatory variables to the model and forms a new multiple linear regression. Being the primary tool for unconventional monetary policy, quantitative easing is used as the variable in this model [6]. In the regression analysis, four quantitative easing policies are included into the model as dummy variables, QE1, QE2, QE3, and QE4, as shown below:

$$\mathrm{SP_t} = \gamma_0 + \gamma_1 \mathrm{CPI_t} + \gamma_2 \mathrm{EFFR_t} + \gamma_3 \mathrm{QE1} + \gamma_4 \mathrm{QE2} + \gamma_5 \mathrm{QE3} + \gamma_6 \mathrm{QE4} + \eta_t \tag{2}$$

where QEs are dummy variable that equals one when it has an impact on the current month and zero for not. The determination of whether quantitative easing had an impact on financial markets was based on the timing of the Fed's statements and the announcements of their end. In the process of model regression, the impact of each quantitative easing on the model is examined through stepwise multiple regression model [7].

This study proposes the following hypotheses about how the macroeconomic data and monetary policy instruments influence the stock market returns.

H1: Macroeconomic data and monetary policy instruments are significantly influence the stock market returns

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H1a: Conventional monertary policy instruments are significantly influence the stock market returns

H1b: Unconventional monetary policy instruments are significantly influence the stock market returns

The formulation of the hypothesis is dependent on the relevant research literature mentioned in the Introduction section.

The data were collected between July 2004 and June 2023. The data range chosen for the conventional monetary policy which the Federal Reserve used begins in June 2004 and during that period the Federal Reserve also uses the unconventional monetary policy such as quantitative easing (QE). The data on stock prices are from Yahoo Finance, while data for CPI is from U.S. Bureau of Labor Statistics and for EFFR is from the St. Louis Fed FRED economic data.

3. Results

3.1. Descriptive Statistics

All of the variables' descriptive statistics are included in model 1 are shown in Table 1 below. All the variables in the descriptive statistics are ratio data and monthly. The QE variables are dummy variables, so descriptive statistics are not required for them.

Table 1: The descriptive statistics of variables.

Variable	Obs.	Mean	Std. Dev.	Min	Max
SP	228	0.717	4.328	-16.942	12.684
CPI	228	2.561	1.988	-2.100	9.100
EFFR	228	1.409	1.710	0.050	5.260

3.2. Validation of Assumptions

It was previously thought that this study might use multiple linear regression analysis because the dependent variables contain quantitative data. When using the multiple linear regression analysis, there are seven assumptions that should be held [8].

First, the sample size needs to be five to ten times as many independent variables as there are. The number of the observations for the model is 228 with six independent variables. The assumption holds. Also, there should exist a linear relationship between continuous independent and dependent variables. The assumption is held by plotting scatterplots and two-way linear prediction plots with confidence intervals. Considering that the QE1, QE2, QE3, and QE4 are dummy variables, it is only necessary to plot the remaining independent variables.

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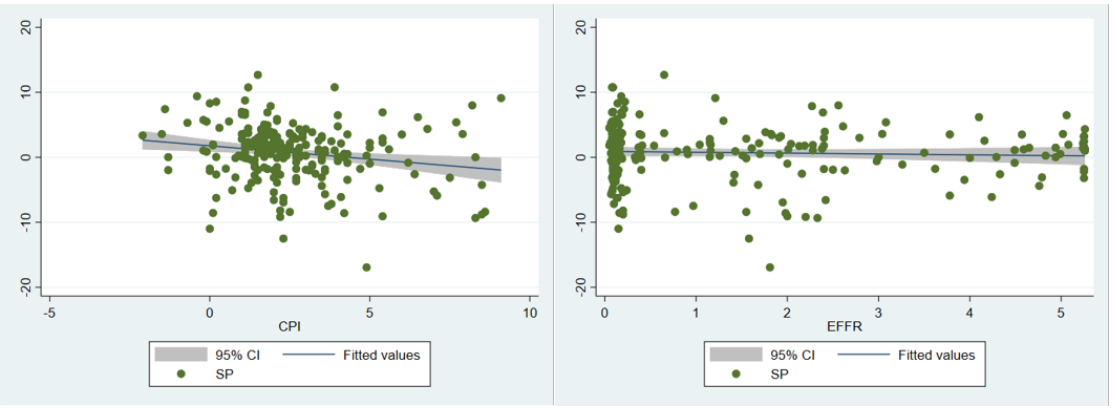

Figure 1: The scatterplot and two-way linear prediction plots with confidence intervals.

As can be seen in Figure1, "CPI" , "EFFR" and the dependent variable "SP" have linear relationships. The data satisfy the assumption. Then it needs to be judged the independence between observations. The selected data in the regression analysis are in the time-series data format. Regression analysis and autocorrelation tests can be performed directly.

The Durbin Watson statistic is used to test the autocorrelation . In this study, the observations are independent of one another and meet the assumption, according to the DW value of 2.108, which is near to 2.

Furthermore, to evaluate whether a strong influence point is an outlier for the dependent variable, Cook's distance is utilized. When D is less than 0.5, it is typically not regarded as an outlier, and when D is larger than 0.5, it is seen as an outlier. In this test the maximum of the Cook's distance is 0.103 in the selected data, which is lower than 0.5. Suggesting that there are no significant outliers, the selected data fulfills the assumption.

After that, to satisfy the multicollinearity judgment, it is necessary to calculate the variance inflation factor (VIF) and tolerance ($\frac{1}{VIF}$). The results show that all the independent variables have VIF less than 10 and $\frac{1}{VIF}$ greater than 0.1, suggesting that there is no serious covariance problem among the independent variables.

When doing the normality test of residuals, it is failed to test the normality of residuals by Kernel density estimate and Shapiro-Wilk test. Since the sample size is large enough (number of observations greater than 100), the central limit theorem was chosen to prove the normality of the residual term [9]. It follows the normal distribution, where the standard deviation is equal to 4.176 and the mean is zero. The sample size is already known is 228. The last step is to do the variance chi-square tests.

The distribution of the residuals of the predicted values and values of each variable was relatively uniform and did not show any particular form of distribution in Figure 2. This suggests that the residuals had a flush of variance, and the data of the present study fulfilled the assumption.

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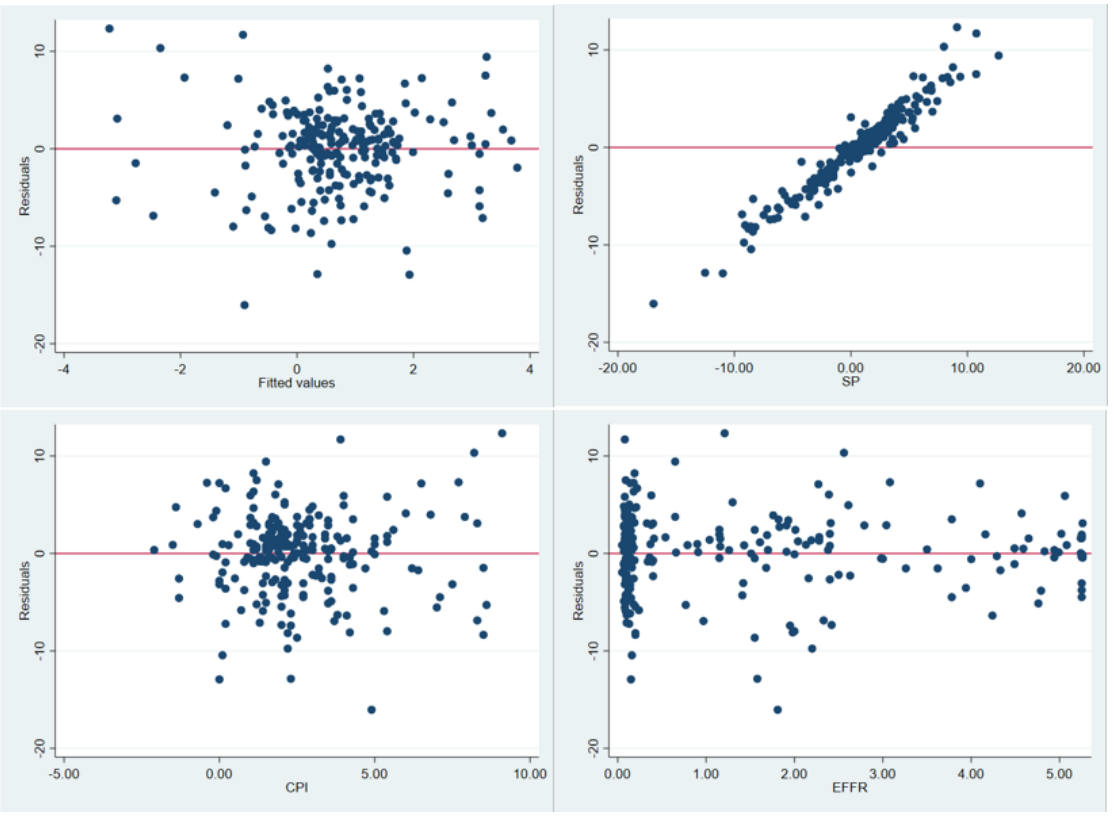

Figure 2: Residual Plots of fitted values, SP, CPI, and EFFR.

3.3. Regression Result

Table 2 below shows the regression results. The data in five columns are the result of running five different regressions based on model 1 with the variables added one by one. Column 1 corresponded the model 1, and column 2 to 5 added QE dummies into the model one by one. Column 5 corresponded the model 2.

The results from the regression model 1 show that stock market returns are negatively related to inflation, positively related to conventional monetary policy, and there exist many other factors that influence the returns of the stock market. The p value for this regression model is 0.092, which is less than 0.1, so the confidence level reaches more than 90 percent.

By examing the regression results, it was found that by adding these variables, the CPI's coefficient is robust and statistically significant at ten percent and around -0.4. Only in column 5 which corresponded the model 2, it goes around -0.5 by the influence of QE4. The independent variables "EFFR", "QE1", "QE2", and "QE3" are not statistically significant in the model. A discussion of the context of the fourth round of quantitative erasing is followed. The Federal Reserve initiated a $700 billion quantitative easing program through asset purchases in March 2020 to bolster the U.S.'s struggling liquidity as a result of the Covid-19 pandemic. Compared to the previous three rounds of quantitative easing, this time assets were purchased in higher volumes and at the fastest pace. This has led to the QE4 in the model 2 is also statistically significant and it affects the CPI to a certain extent.

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Table 2: Regression results (Dep. Var: Monthly Returns of S&P500 Index).

	(1) SP	(2) SP	(3) SP	(4) SP	(5) SP
CPI	-0.418*	-0.410*	-0.411*	-0.398*	-0.508*
	(0.202)	(0.207)	(0.208)	(0.210)	(0.229)
EFFR	0.029	0.032	0.041	0.070	0.309
	(0.141)	(0.141)	(0.145)	(0.158)	(0.185)
QE1		0.199	0.228	0.372	0.853
		(1.403)	(1.408)	(1.443)	(1.444)
QE2			0.489	0.607	1.336
			(0.980)	(1.017)	(1.037)
QE3				0.553	1.205
				(0.661)	(0.697)
QE4					2.786*
					(1.152)
No. of Obs.	228	228	228	228	228
Adj-R^2	0.027	0.023	0.019	0.016	0.044

3.4. Discussion

In this study, the multiple linear regression model was applied to perform the analysis to examine the influence of macroeconomic information and monetary policy tools on stock market returns in the US between July 2004 and June 2023. The conventional monetary policy instrument does not significantly impact the monthly stock market returns, but the fourth quantitative easing in unconventional monetary policy and CPI have significant impacts on stock market returns, which inline with part of the previously proposed hypotheses H1b.

In future research, one can focus on observing and comparing the volume and duration of each quantitative easing and whether there is a lag in the impact cycle or other affect. Along with adding the rate of change of it as an independent variable in place of the effective federal funds rate [10]. Some research suggests that both inflation and financial markets are shocked by the monetary policy series, and it most effects on maturities in the mid-term structure [11].

4. Conclusion

The findings from the study are that CPI has been acting as a stable and significant independent variable affecting the stock market returns. The dependent variable is not significantly affected by the effective federal funds rate, mainly because of its possible lagged correlation with the CPI. The first three rounds of quantitative easing were caused by systemic risks built into the financial system. Compared to the first three rounds of quantitative easing, the fourth quantitative easing after the pandemic has a significant impact on stock market returns, which is mainly analyzed as the emergence of the pandemic is an externality for the financial markets. Although the CPI and the fourth round of quantitative easing turned out to be significant in the results of the study, they are far from sufficient to explain the complexity of stock market returns.

This paper lays the groundwork for the extent to which monetary policy has an impact on the stock market, which could be useful in future studies of the financial markets or stock returns in various sectors. In future studies for the stock market returns' regression, more parameters need to be added to the model. The data can be attempted to be regressed using nonlinear models. Regarding research

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on traditional monetary policy and the financial market, it is more appropriate to regress the data by adjusting it for time or using its rate of change monthly as a variable.

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