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Monetary Policy and Equity Return: Evidence from the US Markets

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ABSTRACT: *This paper investigates the relationship between interest rate changes and equity returns during crisis periods following the "dot com" bubble burst (1999-2001) and the Lehman Brothers collapse (2008). Several relevant macroeconomic variables have been considered for forecasting – using a time series model, a vector autoregressive model and impulse response functions, including variance decomposition of fluctuations in equity prices. The data are from the Federal Reserve data sets, 1999 to 2016.The results indicate a significant change in the nature of the stock market response to monetary policy action in August 2007. The monetary policy makers failed to boost the stock market during the crisis periods.*

KEYWORDS: *Monetary Policy, Shock, Equity Return, Vector Autoregressive, and Impulse Responses.*

Introduction

Monetary policy objectives include macroeconomic variables such as real GDP growth, inflation and interest rates. When central banks change monetary policy, they affect macroeconomic variables indirectly. Stock prices are highly sensitive to economic news and are closely monitored. In this study, I have examined the impact of anticipated and unanticipated monetary policy actions taken by the Federal Reserve Bank on US equity returns. I define the unanticipated impact of monetary policy as the change in the three-month London Interbank Offered Rate (LIBOR). Futures contracts reflect market expectations at a given time. If the central bank undertakes a policy shift that the market expects, there should be no subsequent change in futures contracts. If, on the other hand, a change arises subsequent to a central bank policy change, that suggests an unexpected shift. While LIBOR is a London-based instrument, international financial markets are sufficiently integrated, that it has an indirect impact on short term interest rates in the US market. In summary, the prices of futures contracts on short term interest rates are a common measure used by the central bank; they help central bankers to forecast expectation and see the difference between futures rates and realized rates for monetary policy decisions.

The time period considered is from January 1999 to December 2016. A time series model has been estimated to forecast equity returns; a vector autoregressive model (VAR) has been estimated to forecast macroeconomic variables and show the relationships among them; finally, impulse responses have been estimated to measure the effect when a positive one standard deviation shock is given to specific variables. The purpose of the study is to investigate the relationship between monetary policy action and equity returns (S&P 500 index). The study has investigated the structural break in the relationship between interest rate changes and equity returns during the crisis periods. The results indicate a significant change in the nature of the stock market response to monetary policy shifts since August 2007. The paper also describes the stock market data, calculation of the monetary policy shock, empirical models and results.

Review of the Literature

Extensive research has been conducted to show the relationship between monetary policy and stock returns. Monetary economists are concerned with whether an unexpected change in monetary policy, reflected in the change in the three-month sterling LIBOR futures contract, has any effect on stock prices (Gregoriou et al 2009). On the other hand, financial economists are concerned with whether equity is a hedge against inflation. Bernanke and Gertler (2001) considered stock price "bubble" shocks and they found that an aggressive inflation-targeting rule stabilizes output and inflation when asset prices are volatile. Thorbeke (1997) applied a vector autoregression (VAR) model to examine the effects of monetary policy shocks on stock returns. Bernanke and Kuttner (2005) pointed out that the link between monetary policy changes and stock returns should account for anticipated policy actions. Estimating the response of equity prices to monetary

policy actions is not easy, as the market is unlikely to respond to policy actions that have already been anticipated, and distinguishing between expected and unexpected policy actions is essential for discerning their effects (Bernanke and Kuttner, 2003).

The relationship between monetary policy and stock returns has been measured in a variety of ways. VAR models examine the effect of monetary policy on stock returns; impulse response functions and variance decompositions from a VAR reveal statistically significant relationships between monetary policy and stock returns, with either a positive shock to the fed funds rate or negative shock to stock returns.

Distinguishing between expected and unexpected policy actions is essential. A simple way to do this is the methodology proposed by Kuttner (2001), which used Fed funds futures data to construct a measure of "surprise" rate changes. Bernanke and Kuttner (2005) used Kuttner's (2001) futures methodology to decompose the federal funds rate changes into expected and unexpected monetary policy shocks and found that an unanticipated monetary policy had a negative impact on the US stock market.

Data, Methodology and Choice Variables

The sample period covers 1999:Q1 to 2016:Q4. Data are collected from the Fred and Yahoo Finance. The equity returns data include S&P 500 index returns. I have measured equity returns by taking daily closing stock prices. This study examines a five-variable VAR that includes world oil prices, real GDP, the inflation rate, a measure of monetary policy estimated by the first difference of the fed funds rate and real stock returns. The software Stata and Eviews have been used to analyze data in time series models, VAR model, IRFs and variance decomposition.

Modeling Strategy

The equity returns are measured as the first difference of the natural log of the daily closing prices of the S&P 500 Index. Following Kuttner (2001), I have used data from the Fed funds rate in order to derive the monetary policy shock. The proxy for the unanticipated effect of a monetary policy shock, Δi_t^u, is the change in successive quarterly dollar LIBOR (London Interbank Offered Rate) futures contracts:

$\Delta it^u = LIBOR_t - LIBOR_{t-1}$

I have measured the expected change in interest rates, Δi_t^e, as the actual change in the three-month Fed funds rate minus the surprise:

$\Delta i_t^e = \Delta i_t - \Delta i_t^u$

The change in equity return is estimated as the first difference of the natural log of the quarterly closing price of the S&P 500 index:

Y_t (spindex_return) = 100*(lnspindext – $lnspindex_{t-1}$)

To examine the interactions among all economic variables and equity prices, the VAR is estimated using equity returns, interest rate (fed funds rate), inflation rate, real GDP, and oil prices. The impulse response functions and variance decompositions have been estimated from a vector autoregression that incorporates statistically significant relationships between monetary policy and stock returns. Based on

the estimated VAR, we can illustrate the projected impact of a one standard deviation positive shock to the fed funds rate or a negative one standard deviation shock to stock returns.

Time Series Models

The initial empirical investigation regresses S&P 500 returns on expected and unexpected interest rate changes.

Model 1

$$Y_t = \alpha + \beta^e \Delta i_t^e + \beta^u \Delta i_t^u + e_t$$

Where, α is the constant term/intercept

β^e is the parameter associated with expected monetary policy

β^u is the parameter associated with unexpected monetary policy

Δi_t^e is the parameter associated with expected interest rate change

Δi_t^u is the parameter associated with unexpected interest rate change

e_t is the parameter associated with error term

The OLS result in Table 1 indicates that the estimated stock market response to both the expected and unexpected components of monetary policy changes are statistically sig-

Table 1: Regression Output from Model 1, 2 and 3

	Model 1: Regression	Model 2: Regression	Model 3: Regression
Constant	1.167 (0.132)	1.785 (0.001)	
Δiexpect	8.704 (0.006)	2.318 (0.540)	-3.998 (0.541)
Δiunexpect	6.527 (0.001)	4.660 (0.013)	3.028 (0.134)
dummylehman		-11.980 (0.012)	-14.594 (0.000)
Dummy99_01		-6.520 (0.041)	-6.608 (0.020)
interactΔi expected			0.038 (0.100)
interactΔi unexpected			0.005 (0.059)
Observations	71	71	71
R2	0.187	0.294	0.430
R2 adjusted	0.163	0.251	0.378

nificant, but the adjusted R^2 statistic is small. This first specification has serial autocorrelation and heteroscedasticity problems. It does not adequately model the period that has large negative returns in the stock market, in 2002 (following the 'dot-com' bubble burst) and 2008 (right after the collapse of Lehman Brothers). I have re-specified in model 2, by including two dummy variables:

Model 2

$$Y = \alpha + \gamma_t \, DLehman_t + \gamma D2002_t + \beta^e \, \Delta i_t + \beta^u \, \Delta i_t + e_t$$

Where,

γ_t is the parameter associated with $DLehman_t$

γ_t is the parameter associated with $D2002_t$

[plus variables included in Model 1]

DLehman is equal to 1 during October-November 2008 and one period before and after; 0 otherwise. D2002 is equal to 1 in August 2002 and 0 otherwise. In table-2, the adjusted R^2 value (0.25) is larger than in model 1. Residuals are now free from heteroscedasticity and serial autocorrelation. The unexpected monetary policy variable is statistically significant, as are the two dummy variables, but the expected monetary policy variable is not significant.

I have considered the credit crisis on August 2007 onwards to 2009, where the equity market declined in valuation and interest rates declined too. Therefore, there is positive correlation between the stock return and interest rate changes. I wanted to know the change in this period due to expected and unexpected monetary policy changes. To do that, I have interacted the variables with crisis as dummy variable.

Model 3

$$Y = \alpha + \gamma_t \, DLehman_t + \gamma_t \, D2002_t + (\beta^e + \delta_t \, Dcrisis) \, \Delta i_t^e + (\beta^u + \delta_t \, Dcrisis) \, \Delta i_t^u + e_t$$

Where, α is the constant term/intercept

γ_t is the parameter associated with DLehmant

γ_t is the parameter associated with $D2002_t$

δ_t is the parameter associated with Dcrisist

Dcrisis is 1 from August 2007 to 2016; 0 earlier

β^e is the parameter associated with expected monetary policy

β^u is the parameter associated with unexpected monetary policy

Δi_t^e is the variable associated with expected interest rate change

Δi_t^u is the variable associated with unexpected interest rate change

e_t is the error term

In the above model, I have generated dummy variable Dcrisis equal to 1 from August 2007 onwards and 0 otherwise. This allows for a lagged effect of the Lehman collapse, post 2007.

Table 3 shows that the adjusted R^2 statistic has improved to 0.38, which tells us the fitness of the model improves on model 2. The unexpected monetary policy shock is positively associated with the stock returns but statistically is not significant. The expected monetary policy is negatively associated with the stock returns and statistically is not significant. The

two crisis variables are negatively associated with the stock returns and are highly significant. However, the dot com bubble burst and Lehman Brothers lagged dummy variables are related positively with the stock returns and are marginally significant at 0.1; the unexpected coefficient is significant at 0.1. This tells us that the stock market has not improved due to monetary policy changes following the post-2007 financial crisis, which means monetary policy makers have failed to boost up the stock market.

Estimation and Empirical Results

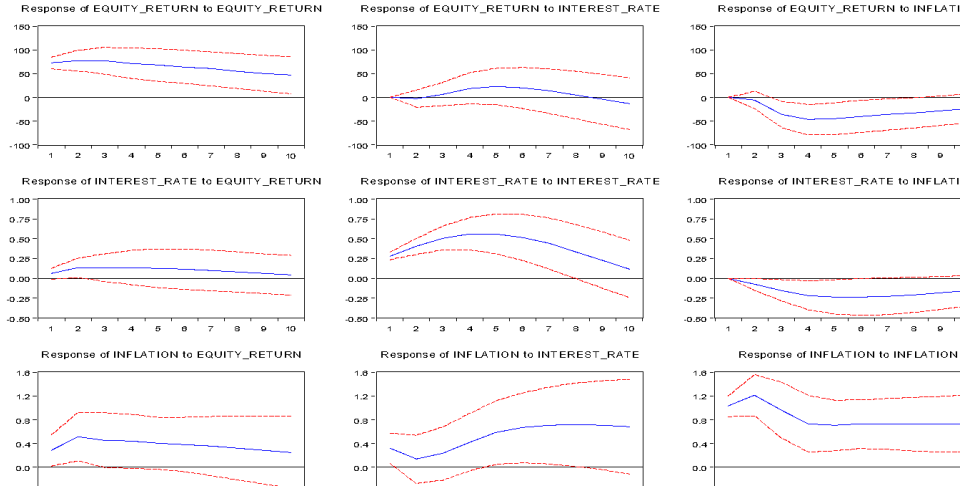
In this section, I have examined the monetary policy variable, stock returns, inflation rate, real GDP growth and oil prices. I run the impulse responses of stock returns to a positive one-standard-deviation shock to fed funds rate and variance decomposition analyzes forecast error to determine the monetary policy shock to the variance of stock returns.

The VAR and Impulse Response Functions (IRFs)

The model to run the VAR using the data describes above with an appropriate lag selection and IRFs includes real GDP, inflation, interest rate (fed funds rate), stock returns (S&P 500) and oil price (world) because it may influence monetary policy and, when oil price increases often indicates a pressure for future inflation. The Cholesky ordering for the model is: equity returns, real GDP, oil price, inflation, and interest rate (fed funds rate). While running VAR, the number of lag selection has been chosen based on the Akaika Information Criterion (AIC). An unrestricted VAR has been estimated, as the variables are not co-integrated. I have selected three lags based on AIC and for ordering the variables.

The responses of equity returns to various shocks from the macroeconomic variables are shown in Figure 1, which is a reduced form of impulses estimated from the VAR. The equity return has been affected by the interest rate shock in the short, medium and long run. This means when monetary policy tightens, the equity return decreases and vice-versa. An inflation shock causes significant fluctuations in equity returns. The equity returns are below the baseline and negative throughout the timeline and at the beginning, equity returns declines from the base line and then it follows steady but negative below the baseline. The shock from equity return leads to a marginal change in the equity prices in the medium and long run. The above findings suggest that the impact of interest rate shocks on equity return is significant and may be an interest to the central bank to respond to equity return indirectly. Impulse response results shows that the equity return is sensitive to monetary policy changes provide a strong evidence for developing monetary policy to control equity price movement.

Figure 1: Impulse responses to Cholesky one S.D. shocks



Variance Decomposition

The results of variance decomposition in equity prices caused by various macroeconomic variables shocks are presented in Table 2.

Table 2: Variance decomposition of fluctuation caused in equity prices

Variance Decomposition of EQUITY_RETURN:

Period	S.E.	EQUITY_R...	INTEREST...	INFLATION	REAL_GDP	OIL_PRICE
1	74.12717	100.0000	0.000000	0.000000	0.000000	0.000000
2	108.0964	99.18248	0.000441	0.116017	0.685449	0.015618
3	135.1226	94.97611	0.973728	3.522950	0.438710	0.088504
4	161.4368	86.83285	4.030953	7.046249	0.324924	1.765026
5	183.7827	80.61857	6.654573	9.115144	0.394281	3.217434
6	200.6254	77.30518	8.165051	10.16704	0.664442	3.698293
7	213.0478	76.09897	8.535741	10.63019	0.946068	3.789030
8	222.3179	76.20979	8.213844	10.68034	1.141487	3.754543
9	229.5230	76.92353	7.719362	10.47094	1.247605	3.638555
10	235.3831	77.63296	7.427275	10.14081	1.303130	3.495828

The interest rate tends to have a medium to long run impact on stock prices because there was no large variation in the first quarter but there was in the second and third quarters. The variance decomposition analysis of fluctuation in inflation reveals that equity prices are influenced in the short and medium term. Real GDP shocks influence the equity returns in the long run, and oil prices have a little impact on equity return in the short run.

Conclusion

This study investigates the impact of anticipated and unanticipated monetary policy of Federal Reserve monetary policy on US S&P 500 stock returns. The monetary policy shock is generated from the change in the three-month dollars LIBOR futures contract for a sample period from January 1999 to December 2016. Using time-series model, I have shown that both the expected and unexpected monetary policy changes affect significantly stock returns. The result shows an important change in the stock market reaction to monetary policy changes since 2007. This means that monetary policy makers failed to boost up the stock market valuations during the crisis period. The interaction between monetary policy shocks and stock returns has been shown with VAR analysis and Impulse Response Functions (IRFs). It is evident from the analysis that monetary policy variables affect equity returns during the crisis period and monetary policy actions have impacts on other macroeconomic variables in the short and medium run.

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