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**Analyzing the Relationship between
Change in Money Supply and Stock Market Prices**

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This paper examines the relationship between change in the money supply and the level of stock prices. This paper also dichotomizes change in the money supply into anticipated and unanticipated change and analyzes each of their relationships with stock market prices. Competing theories exist on how change in the money supply affects stock prices. The real activity theorists argue that change in the money supply and stock prices are positively related, where as the Keynesian economists argue otherwise. This study finds a positive relationship between change in the money supply and stock prices, agreeing with the real activity theorists. Economists also debate on the relationship of anticipated and unanticipated change in money supply with the stock market prices. The proponents of the Efficient Market hypothesis (EMH) argue that anticipated change in money supply would not have a significant impact on stock prices and only unanticipated change in the money supply would matter, whereas the opponents of EMH argue that anticipated change in money would matter too in determining the stock prices. This paper finds that anticipated change in money supply matter more than unanticipated change, failing to find efficiency in the stock market.

I. Introduction

Billions of dollars worth of shares are traded in the stock market on a daily basis. Many people depend on the stock market as their primary source of income while others have their retirement funds tied to the stock market. The importance of “good” performance of the stock market is obvious. History has shown that a downturn in stock prices can cause major disturbances in the lives of many. Also, the strength of a stock market can have a major effect on the economy through its influence on real activities such as consumption, investment, etc.

Monetary policy is one of the most effective tools that a central bank has at its disposal. In fact, many economists consider monetary policy as the most important macroeconomic policy. The central bank uses monetary policy frequently to cause a desired level of change in real activities. These frequent changes in monetary policy are believed to have a significant effect on the stock market. It is important to analyze the relationship between the most effective economic policy, namely monetary policy, and one important determinant of the economy, the stock market. In this study, I analyze this delicate yet crucial relationship between monetary policy and the stock market.

Specifically, I look at the relationship between the money supply and stock market prices. Money supply is one of the components of monetary policy that the Federal Reserve uses. Changes in money supply can be either anticipated or unanticipated by the people. It is believed that anticipated and unanticipated changes in the money supply affect the stock market differently. Taking this point into consideration, I differentiate the anticipated and unanticipated components of changes in the money supply and analyze how each affects stock market prices.

In Section II, the theoretical framework is discussed along with the relevant literature on the topic. Next, in Section III, the variables and data set utilized in this study are described and the empirical model is developed. Results are presented and discussed in Section IV. The paper concludes with Section V, in which suggestions for further studies are pointed out and policy implications are considered.

II. Theory and Review of Literature

The price of a stock is determined by the present value of the future cash flows. The present value of the future cash flows is calculated by discounting the future cash flows at a discount rate. Money supply has a significant relationship with the discount rate and hence with the present value of cash flows.

Sellin (2001) lays out competing theories on how the money supply affects the stock market prices. The competing theories to be examined here are the ones developed by the Keynesian economists and the real activity theorists. Keynesian economists argue that there is a negative relationship between stock prices and money supply whereas real activity theorists argue that the relationship between the two variables is positive (Sellin, 2001).

The Keynesian economists argue that change in the money supply will affect the stock prices only if the change in the money supply alters expectations about future monetary policy. According to them, a positive money supply shock will lead people to anticipate tightening monetary policy in the future. They bid for funds in anticipation of tightening of money supply in the future, which will drive up the current rate of interest. As the interest rate goes up, the discount rates go up as well and the present value of

future earnings falls. Stock prices consequently decline. Furthermore, they argue that economic activities decline as a result of increase in interest rates, which further depresses stock prices (Sellin, 2001).

The real activity economists believe that change in money supply, assuming accommodating monetary policy, provides information on money demand. In other words, they argue that increase in money supply means that money demand is increasing in anticipation of increase in economic activity. Higher economic activity implies higher expected profitability, which causes stock prices to rise. Hence, the real activity theorists argue that there is a positive relationship between money supply and stock prices (Sellin, 2001).

Sellin also discusses the risk premium hypothesis proposed by Cornell. Cornell argues that money is held as opposed to alternate assets for precautionary motives and money demand is directly proportional to risk and risk aversion. An unexpected money supply increase indicates higher money demand given an accommodating monetary policy. Higher money demand suggests increase in risk. As a result, investors demand higher risk premium for holding stocks making them less attractive, which causes equity prices to fall (Sellin, 2001).

Bernanke and Kuttner (2005) combine the real activity and risk premium hypotheses and argue that the price of a stock is a function of the present value of future returns and the perceived risk in holding the stock. The authors believe that there is a positive relationship between the money supply and stock prices, agreeing with the real activity hypothesis but disagreeing with Cornell's risk premium hypothesis. A stock is attractive if the potential of high returns is high. On the other hand, a stock is unattractive

if the perceived risk of holding it is high. The authors argue that the money supply affects the stock market through its effect on both present value of future returns and the perceived risk. Money supply affects the present value of future returns through its effect on the interest rate. The authors believe that a tightening of the money supply raises the real interest rate. An increase in the interest rate would in turn raise the discount rate, which would decrease the present value of future returns, which in turn decreases the price of a stock (Bernanke and Kuttner, 2005).

Unlike Cornell's risk hypothesis, Bernanke and Kuttner argue money supply changes and the risk premium vary inversely. Tightening of the money supply would increase the risk premium that would be needed to compensate the investor for holding the risky assets because it symbolizes a slowing down of economic activity, which reduces the potential of the firms to make a profit. Investors would be bearing more risk in such a situation and hence demand more risk premium for holding stocks. The risk premium makes the stock unattractive which would lower the price of the stock (Bernanke and Kuttner, 2005).

It is possible that both the Keynesians and the real activity theorists are correct in their predictions about the effect of the changes in the money supply on stock market prices but the two opposite effects offset each other. I will analyze which theory dominates the other, or in other words, what direction the stock prices take as the money supply changes.

Another debate regarding money supply and stock prices is that stock prices are believed to react differently to the anticipated and unanticipated component of the money supply. Sellin, in his review article, discusses works of Cornell, Pearce and Roley, Hafer

and Hardouvelis concerning the issue, and points out varied results obtained by these studies (2001). The economists involved in this debate disagree on the extent to which the market is efficient. The proponents of the efficient market hypothesis hold that all available information is already embedded in the price of a stock. Hence, they argue that anticipated changes in money supply would not affect the stock prices and only the unanticipated component of a change in money supply would affect the stock market prices. The opponents of the efficient market hypothesis, on the other hand, contend that all available information is not embedded in the prices and hence, the anticipated changes in money would affect the stock prices too (Corrado and Jordan, 2005).

Sorensen studies the impact of money on stock prices with special attention to anticipated and unanticipated changes in money supply. Sorensen's study is particularly important for my study because my empirical model follows his empirical model very closely. He uses a two-stage regression model in his analysis. In the first stage, he replicates Barro's model of money supply where money supply is regressed against previous money supplies, unemployment rate and real federal government expenditure. In the second stage, the stock index is regressed upon anticipated money growth using estimates of the regression of the first stage. Residuals of the first stage equation are used as the unanticipated component, which is regressed upon a stock index to figure out the effect of unanticipated component. Sorensen finds that unanticipated changes in the money supply have a larger impact on the stock market than anticipated changes, supporting the efficient market hypothesis (Sorensen, 1982).

Bernanke and Kuttner also analyze the anticipated and unanticipated components of the monetary policy but they looked at the impact of announced and unannounced

changes in the federal funds rate on equity prices rather than anticipated and unanticipated changes in money supply. Observations used in the model are the days in which federal funds rates were changed corresponding to the Federal Open Market Committee (FOMC) meetings. This way, they are easily able to identify the anticipated and unanticipated components by looking at the discrepancies between FOMC reports and the actual change in rates. They use a vector autoregression model on 131 observations from June 1989 to December 2001, excluding September 2001. The authors find a higher reaction by the stock market to unannounced changes in the federal funds rate, again supporting the efficient market hypothesis (Bernanke and Kuttner, 2005).

Unlike previous studies discussed, Husain and Mahmood fails to find evidence efficiency in the market. Husain and Mahmood studies the relationship between monetary expansion and stock returns in Pakistan. M1 and M2 are used as dependent variables and stock indices of six sectors were used as independent variables. An Augmented Dickey Fuller test is used to find a relationship between the money supply and both short run and long run changes in stock market prices (Husain and Mahmood, 1999). The study finds that change in money supply causes changes in stock prices in both short and long run, suggesting that the stock market is not efficient with respect to money supply changes, or in other words, finding that the efficient market hypothesis does not persist (Husain and Mahmood, 1999).

This study will also dichotomize the money supply into anticipated and unanticipated components, and analyze their relationship with the stock prices. This study expands on previous work by adding several control variables, which are discussed in section III. This study is different from Bernanke and Kuttner's study because the

dependent variable is the money supply rather than the federal fund rate. This study is also different from Husain and Mahmood's study because it analyzes U.S. stock market prices as opposed to Pakistan's stock market prices.

In sum, following from the theory and review of literature, this paper seeks to study the following:

1. Is there a relationship between change in money supply and level of stock prices? If there is, what is the direction of the relationship? Do the stock prices behave as the Keynesian economists argue or as the real activity theorists argue?
2. Do stock market prices react differently to anticipated and unanticipated changes in the money supply? Does the efficient market hypothesis persist?

III. Empirical Model

1. Effect of change in the money supply on stock market prices

This section is divided into two parts. In the first part, I test for the relationship between change in money supply and change in stock prices. The actual change in money supply is regressed upon the S&P 500 index to carry out the test. All money variables and the S&P 500 index are in real terms consistent with Laopodis's (2006) study. The results of this section allow us to see if the stock prices behave as the Keynesians argue or as the real activity theorists argue.

I use M2 for the money supply variable. M2 is defined as an aggregate of currency, demand deposits, other checkable deposits, travelers' check outstanding, saving deposits and money market deposit account, small time deposits and retail purchase of money market mutual fund (Fisher, 2001). The use of M2 in the model is consistent with the variable used by Sorensen, and Husain and Mahmood in their studies. The data for

the money supply (M2) are obtained from Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis website, <<http://research.stlouisfed.org/fred2>>.

Monthly data of M2 are averaged out to produce quarterly data.

The data for S&P 500 index are obtained from Yahoo Finance website, <<http://finance.yahoo.com>>. Quarterly data are used in the study from 1st quarter of 1959 to 2nd quarter of 2006.

Mathematically, the empirical model is,

Model 1:

$$\begin{aligned} \text{S\&P500} = & a_1 + a_2 * \text{Actual change in money supply} + a_3 * \text{Consumer confidence} \\ & + a_4 * \text{GDP} + a_5 * \text{unemployment rate} \end{aligned} \quad (1)$$

I add several control variables in the model in addition to actual change in the money supply variable. Consumer confidence is a very important influence in the stock market. When consumer sentiments rise, people tend to be less risk averse. Hence, they are willing to hold more of their assets in the form of equities, which are considered riskier investments than holding assets in cash or other fixed income securities such as bonds. As the demand for equities increases, so do their prices. People do exactly the opposite when confidence falls. So, a positive relation is expected between consumer confidence and stock market prices. The data for consumer confidence compiled by University of Michigan are used and obtained through FRED. Monthly data of consumer confidence are averaged over three months to produce quarterly data.

Another control variable added in the model is real GDP. Most industries are pro-cyclical in nature, meaning that the firms in the industry do well as the economy does well and vice versa. If the GDP is high, the stock prices generally tend to be high, as the

companies would be doing better than otherwise. So, GDP is an important determinant of the stock prices and should be included in the model. A positive relationship is expected between stock prices and GDP. The data for GDP are obtained from FRED.

The unemployment rate is also an important variable because it is a major factor that determines the demand for equity. When the unemployment rate is low, more people can afford to hold shares of the firms, which drives the demand and subsequently prices of the stocks. Also, the unemployment rate is a proxy for overall aggregate demand in the economy. When the unemployment rate is low, aggregate demand is high, which indicates a healthy environment for the companies to operate in. So, a negative relation is expected between stock prices and unemployment rates. The data for unemployment rates are obtained from FRED.

2. Effect of anticipated and unanticipated change in the money supply on stock market prices

A two-stage regression model is used in the second part of the section. In the first stage, Barro's money supply equation is closely followed as his model has received wide approval from economists in the field. The independent variables in the model are past money supply, unemployment rate and real federal government expenditure. Specifically, my first stage model is as follows:

$$DM_t = \alpha_0 + \alpha_1 * DM_{(t-1)} + \alpha_2 * DM_{(t-2)} + \alpha_3 * DM_{(t-3)} + \alpha_4 * DM_{(t-4)} + \alpha_5 * DM_{(t-5)} + \alpha_6 * DM_{(t-6)} \\ + \alpha_7 * UN_{(t-1)} + \alpha_8 * UN_{(t-2)} + \alpha_9 * UN_{(t-3)} + \alpha_{10} * FEDV_t \quad (2)$$

where

$$DM_t = M2_t - M2_{t-4},$$

$$UN_t = \log(\text{unemployment rate}_t / (1 - \text{unemployment rate}_t)),$$

$FEDV_t = \log(\text{real federal expenditure}_t) - \log(FED^*_t)$, and

$$\text{Log}(FED^*_t) = 0.2(\log(FED_t)) + 0.8(\log(FED^*_{t-1})).$$

DM_t , here, is defined as a difference in change in money supply in quarter t from change in money supply in same quarter of previous year. In other words, DM_t is defined as a difference in quarterly money supply year over year. Unemployment rate is used to capture a countercyclical policy response in money supply. Increase in unemployment rate could lead the Fed to adopt easy monetary policy and thus increase money supply. Hence, a positive relation between unemployment rate and money supply is expected. Federal government expenditure is included to control for fiscal policy. Including federal government expenditure captures the activity of financing government expenditure through money creation. A positive relation between government expenditure and money supply is expected as well.

Barro calculates $\text{Log}(FED^*_t)$ using a adaptive expectations model. It is assumed that what will happen in future is based on what has happened in the past. Here, he obtains the log of expected federal government expenditure at time t is obtained through a weighted sum of the log of actual government expenditure at time t and the log of expected government expenditure at time $t-1$. He applies weights of 0.2 and 0.8 respectively.

The difference between my model and Barro's model is that Barro uses log differences in quarterly money supply year over year while I use linear difference in quarterly money supply year over year. One advantage of using my transformed Barro's model is that it makes the interpretation of the results easier.

In the second stage, the change in money supply predicted by Barro's 1st stage regression of the money supply is measured against the actual change in money supply obtained from FRED. The resulting difference between the actual change in money supply and the predicted change in money supply as predicted by 1st stage model is the unanticipated component of the money supply.

Mathematically, the relationship between actual, anticipated and unanticipated changes in money supply is as follows:

$$\text{Unanticipated change in money supply} = DM_t - DM_t^*,$$

where DM_t is actual change in money supply and,

DM_t^* is the predicted money supply from equation 2.

The unanticipated change in the money supply could be positive or negative. If the actual change is greater than the predicted change, the resulting difference is a positive unanticipated change in money supply. On the other hand, if the actual change is less than the change predicted by the model, the unanticipated change is negative. Differentiating positive and negative unanticipated money supply is crucial as it enables me to assess the impact of each variable on the stock prices. If I had only one variable, the unanticipated positive might offset the unanticipated negative giving me ambiguous results.

These anticipated and unanticipated changes in money supply are regressed upon the S&P 500 index to see if the efficient market hypothesis persists.

Mathematically, the second empirical model is,

Model 2:

$$\begin{aligned} \text{S\&P500} = & b_1 + b_2 * \text{anticipated change in M2} + b_3 * \text{unanticipated positive change in M2} \\ & + b_4 * \text{unanticipated negative change in M2} + b_5 * \text{consumer confidence} \\ & + b_6 * \text{GDP} + b_7 * \text{unemployment} \end{aligned} \quad (3)$$

The same control variables are added in model 2 as in model 1. The expected sign for each control variables in this model is the same as the expected sign in model 1. The result from this model should show us the direction of stock market price changes caused by positive and negative unanticipated change in money supply and also the difference in their impact.

IV. Results

1. Results of Model 1

Table 1 provides descriptive statistics of the actual change in money supply, real S&P 500 index, and other control variables.

Table 1: Descriptive Statistics

Variables	N	Mean	Standard Deviation
S&P 500	114	365.9573	215.2593
Actual change in M2	114	49.1119	76.8746
Consumer Confidence	114	88.083	12.121
Unemployment rate	114	6.1636%	1.1414
GDP	114	\$4629.955	945.9436

The result of Model 1 is presented in Table 2. The actual changes in money supply are regressed against the real S&P 500 index in this model.

Model 1 shows that there is a positive relationship between changes in the money supply and stock prices. The results support the real activity theorists' argument that an increase in the money supply increases stock prices and vice versa.

Table 2: Model 1, Dependent variable = S&P 500 index

Variables	Coefficient	Sig.
Constant	-152.266 (-1.121)	0.265
Actual change in M2	0.465 (3.712)	0.000
Consumer Confidence	.842 (.947)	0.346
Real GDP	0.146 (12.169)	0.000
Unemployment rate	-41.169 (-4.783)	0.000
R Squared	0.873	
N	114	

t-value in parenthesis

The results for the control variables are also consistent with the argument I made in section III. The results show that consumer confidence and GDP are positively related to the stock prices and the unemployment rate is negatively related to stock prices as argued.

Also note that change in money supply, real GDP, and unemployment rate are highly significant at a 0.01 level. Consumer confidence is insignificant variable at a 0.1 level. The R squared is .873, meaning that the model explains 87.3% of the variance in stock prices.

In order to conceptualize the results, I did some simulations connecting descriptive statistics in table 1 and the results in table 2. The results shows that when the

money supply increases by \$49.1119 billion (average change in quarterly money supply, year over year), the S&P 500 index increases by 22.83 points, about 1.61% of current index (as of March 30, 2007).

2. Results of Model 2

The result of the 1st stage regression of Model 2 is provided in Table 3.

Table 3: Result of 1st Stage Regression of Model 2

Variables	Coefficient	Sig.
Constant	4.448 (.260)	0.795
RDM_lag1	1.507 (21.898)	.000
RDM_lag2	-.714 (-6.158)	.000
RDM_lag3	.343 (2.936)	.004
RDM_lag4	-.718 (-6.158)	.000
RDM_lag5	.939 (7.920)	.000
RDM_lag6	-.463 (-6.552)	.000
UN_lag1	101.996 (1.175)	.242
UN_lag2	-24.682 (-.163)	.871
UN_lag3	-76.88 (-.888)	.376
RFEDV	59.656 (1.250)	.213
R Square	0.931	
N	178	

t-value in paranthesis

By using the results as presented in table 3, the anticipated and unanticipated change in money supply is computed. Table 4 provides descriptive statistics of the result obtained on predicted and residual money supply change.

Table 4: Descriptive Statistics

Variables	N	Mean	Standard Deviation
Anticipated Change in M2	114	48.4485	74.4839
Unanticipated Positive	114	8.8746	13.3071
Unanticipated Negative	114	-8.2113	12.6841

The results of Model 2 are presented in Table 5. The anticipated change, unanticipated positive change and unanticipated negative change in money supply are regressed against the real S&P 500 index in this model.

Table 5: Model 2, Dependent variable = S&P 500 index

Variables	Coefficient	Sig.
Constant	-149.88 (-1.090)	0.278
Anticipated change in M2	0.473 (3.612)	0.000
Unanticipated Positive	0.268 (0.411)	0.682
Unanticipated Negative	0.599 (0.884)	0.379
Consumer Confidence	0.8 (0.883)	0.029
GDP	0.147 (11.77)	0.000
Unemployment rate	-41.178 (-4.716)	0.000
R Squared	0.873	
N	114	

t-value in parenthesis

The most important conclusion that can be drawn from the result of model 2 is that anticipated changes in the money supply matter more than unanticipated change. As argued in section II, the proponents of the Efficient Market Hypothesis argue that anticipated change in the money supply does not matter in predicting stock prices and only unanticipated change does. The opponents of the Efficient Market Hypothesis, on the other hand, argue that anticipated change in the money supply matters too. The result

in table 4 shows that anticipated change in money supply matters more than unanticipated changes as both unanticipated components are not significant at a .1 level, whereas the anticipated change is highly significant at a .01 level. So, the results support critics of Efficient Market Hypothesis and signify that anticipated change in money supply matters too. The result is consistent with the results found by Hussain and Mahmud.

The results for control variables are consistent here too with the argument I make in earlier sections. The results show that consumer confidence and GDP are positively related to the stock prices and unemployment rate is negatively related with stock prices as argued. Also, as in Model 1, real GDP and unemployment rate are highly significant at a 0.01 level, whereas consumer confidence is not significant at 0.1 level.

The results suggest that when the anticipated money supply changes by \$48.4485 billion (average change in anticipated money supply), the S&P 500 index increases by 22.91 points, about 1.61% of current index. Similarly, when the unanticipated positive money supply increases by \$ 8.8746 billion (average change in unanticipated money supply), the S&P 500 index increases by 4.2 points, about 0.29% of current index. Similarly, when the unanticipated negative money supply increases by \$8.211 billion (average change in unanticipated money supply), the S&P 500 index increases by 4.92 points, about 0.35% of current index.

I also tried alternate ways in analyzing the relationship between anticipated and unanticipated change in money supply. I tested a model where I do not dichotomize the unanticipated money supply into unanticipated positive and unanticipated negative. The result for the model was similar to the one presented in this paper, where unanticipated

changes in money supply were found to have positive but insignificant effect on the stock prices.

I also considered a model where change in money supply greater than the sum of actual change and $\frac{1}{2}$ standard deviation of actual change is considered as unanticipated positive change in money supply and change in money supply less than the difference of actual change and $\frac{1}{2}$ standard deviation of actual change is considered as unanticipated negative change in money supply. The result for this model too was similar to the one presented in paper where anticipated change in money supply had positive and significant effect on the stock prices and both unanticipated positive and unanticipated negative changes in money supply had positive but insignificant effect on the stock prices.

VI. Conclusion

The results of this study suggest that the real activity hypothesis dominates Keynesian theory. The results support the view of the real activity hypothesis that a positive money supply shock would increase the stock prices and vice versa. The results also support the opponents of Efficient Market Hypothesis that anticipated change in money supply matter more than unanticipated changes in money supply in determining the stock prices.

Several policy implications can be drawn from this study. The government, in formulating monetary policy, must be aware of the fact that the stock market responds more favorably to an increase in the money supply. The government must also be conscious that the stock prices tend to increase when the government implements expansionary policy to increase GDP and decrease unemployment rates.

The other implication that is clear from the study is that the central bank should give enough indication to the market on its plans of changing money supply. As the anticipated changes matter more than the unanticipated changes, the more the people could anticipate change in money supply correctly, the better the effect of change in money supply would be translated into real activity.

The models presented in the study, however, are not free of drawbacks. Sorensen (1982) points out that using estimates and residuals from Barro's model to dichotomize anticipated and unanticipated component is arbitrary. As I follow Barro's model closely, my model could have this drawback too. However, Sorensen is quick to defend the model by arguing that there is no single model that all the participants of the stock market would be using (Sorensen, 1982).

One way of effectively and accurately assessing the anticipated and unanticipated change in the money supply would be to replicate Bernanke and Kuttner's model as discussed in section II but using money supply rather than federal fund rate. By measuring the money supply corresponding to the FOMC announcements, the difference between announced and the actual could be calculated resulting in the unanticipated component on the money supply, which would be far more accurate than the one presented by the model in this study.

Using S&P 500 index as a dependent variable itself could be a limitation of the model. Even though S&P 500 is a most widely used benchmark and some even consider the performance of S&P 500 as the performance of the market, it is important to note that the index only comprises of 500 large capitalized (bigger than \$5 billion in market value) companies. Therefore, this study ineffectively leaves out the performance of the other

companies that are not included in S&P500. Studies in the future could include more comprehensive indices along with S&P 500 index to capture the effect on stock prices of middle and small capitalized companies through change in money supply.

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