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Analyzing the Effect of Change in Money Supply on Stock Prices

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Abstract

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 will 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.

Keywords

stock market

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I. Introduction[1]

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, investments 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 to be 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 will analyze this delicate yet crucial relationship between monetary policy and the stock market.

Specifically, I will 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 will 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.

There are competing theories on how money supply affects stock market prices. The competing theories examined here are the ones developed by the real activity theorists and by Peter Sellin (2001). Sellin (2001) argues that the money supply will affect stock prices only if the change in money supply alters expectations about future monetary policy. He argues that a positive money supply shock will lead people to anticipate tightening monetary policy in the future. The subsequent increase in bidding for bonds 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

1 *Biniv Maskay is a senior economics major and business administration minor from Kathmandu, Nepal. He wrote "Analyzing the Effect of Change in Money Supply on the Stock Prices" for his senior project class.*

decline. As a result, stock prices decline. Furthermore, Sellin (2001) argues economic activities decline as a result of increases in interest rates, which further depresses stock prices.

The real activity economists, on the other hand, argue that a positive money supply shock will lead to an increase in stock prices. They argue that a change in the money supply provides information on money demand, which is caused by future output expectations. If the money supply increases, it means that money demand is increasing, which, in effect, signals an increase in economic activity. Higher economic activity implies higher cash flows, which causes stock prices to rise (Sellin, 2001).

Ben Bernanke and Kenneth Kuttner (2005) argue that the price of a stock is a function of its monetary value and the perceived risk in holding the stock. A stock is attractive if the monetary value it bears is high. On the other hand, a stock is unattractive if the perceived risk is high. The authors argue that the money supply affects the stock market through its effect on both the monetary value and the perceived risk. Money supply affects the monetary value of a stock through its effect on the interest rate. The authors believe that tightening 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 value of the stock as argued by the real activity theorists (Bernanke and Kuttner, 2005).

The authors argue that tightening of the money supply would increase the risk premium that would be needed to compensate the investor for holding the risky assets. They believe that tightening the money supply symbolizes a slowing down of economic activity, which reduces the potential of firms to make a profit. Investors would be bearing more risk in such a situation and, hence, demand more risk premium. The risk premium makes the stock unattractive, which would lower the price of the stock (Bernanke and Kuttner, 2005).

It is possible that both Sellin (2001) and the real activity theorists are correct in determining stock market prices through changes in money supply, and it is also possible that stock prices change in a particular direction because the prediction of one theory dominates the prediction of the other. I will analyze which theory dominates the other, or in other words, what direction stock prices take as the money supply changes.

Not only does money supply matter, but the extent to which changes in money supply are anticipated versus unanticipated could influence stock prices. A significant amount of research has been done to analyze the different impacts caused by anticipated and unanticipated changes in money supply on the stock market, but the results achieved by those studies have varied. 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 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 stock prices too (Corrado and Jordan, 2005).

Eric Sorensen (1982) studies the impact of money on stock prices with special attention to anticipated and unanticipated changes in money supply. Sorensen's (1982) 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, in which money supply is regressed against previous money supplies, the unemployment rate, and real federal government expenditure. In the second stage, the stock index is regressed upon anticipated money growth using estimates from the regression for 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 the unanticipated component. Sorensen (1982) finds that unanticipated changes in money supply have a larger impact on the stock market than anticipated changes, supporting the efficient market hypothesis.

Bernanke and Kuttner (2005) analyze the anticipated and unanticipated components of monetary policy by looking at the impact of changes in the federal funds rate on equity prices. Observations used in the model are the days in which federal funds rates were changed corresponding to 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. A vector autoregression model is used 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).

Fazal Husain and Tariq Mahmood (1999) study the relationship between monetary expansion and stock returns in Pakistan. M1 and M2 are used as dependent variables and stock indices of six sectors are used as independent variables. An Augemented Dickery Fuller test is used to find a relationship between money supply and both short and long run changes in stock market prices (Husain and Mahmood, 1999). The study finds that money supply causes changes in stock prices not only in the long run, but also in the short run, predicting that the stock market is not efficient with respect to the money supply, or in other words, finding that the efficient market hypothesis does not persist (Husain and Mahmood, 1999).

As the stock market reacts differently to anticipated and unanticipated changes in money supply as shown by these past studies, I will also dichotomize the money supply into anticipated and unanticipated components, and analyze these variables' relationships with the stock prices.

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

1. Whether or not there is a relationship between money supply and stock prices. If there is, what is the direction of the relationship? Do stock prices behave as Sellin (2001) argues or as the real activity theorists argue?
2. Is there a difference in the relationship between anticipated and unanticipated changes in money supply with stock market prices? Does the efficient market hypothesis persist?

III. Empirical Model

A two-stage regression model will be used in this study. 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, the unemployment rate, and real federal government expenditure. Specifically, my first stage model is as follows:

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

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

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

M2 is defined as an aggregate of currency, demand deposits, other checkable deposits, travelers' check outstanding, saving deposits and money market deposit accounts, 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 (1982) and Husian and Mahmood (1999).

DM_t is defined as the change in the money supply in quarter t from the money supply in the same quarter of the previous year. In other words, DM_t is defined as the difference in quarterly money supply year over year.

The difference between this model and Barro's model is that Barro uses log differences in quarterly money supply year over year while I use linear differences 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.

The data for M2, unemployment rates, and real federal government expenditure are obtained from Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis website. Quarterly data from the 1st quarter of 1959 to the 2nd quarter of 2006 are used in the study. Monthly data of M2 and unemployment rates are averaged to produce quarterly data.

The second stage is divided into two components. In the first one, the actual money supply is regressed upon the S&P 500 index to measure the change in stock prices caused by a change in the money supply. The result of this section allows us to see if the stock prices behave as Sellin (2001) argues or as the real activity theorists argue. The data for S&P 500 index are obtained from Yahoo Finance website.

Mathematically, the empirical model is, Model 1:

S&P500 = a1 + a2*Actual change in money supply + a2*Consumer confidence
+ a3*GDP + a4*unemployment rate (2)

Several control variables are added to the model in addition to the actual change in the money supply variable. One of them is consumer confidence. Consumer confidence has a huge influence over 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 increase, 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 from the University of Michigan are used and are obtained through FRED. Monthly data on consumer confidence are averaged over three months to produce quarterly data.

The other control variable added in the model is nominal GDP. Most industries are procyclical in nature, meaning that the firms in the industry do well as the economy does well and vice versa. If GDP is high, the stock prices generally tend to be high as companies are doing better than otherwise. So, GDP is an important determinant of 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 up the demand and subsequently prices of 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 in which companies can operate. So, a negative relation is expected between stock prices and unemployment rates. The data for unemployment rates are obtained from FRED.

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

Mathematically representing the relationship

between actual, anticipated and unanticipated changes in money supply,
Unanticipated Change in money supply = DM_t – DM_t*,
where DM_t is actual change in money supply and

Table 1: Result of 1st Stage, Dependent variable = Change in Money Supply (M2)

Variables	Coefficient	t-Statistics	Sig.
Constant	-34.172	-1.169	0.244
DM_lag1	0.840	7.492	0.000
DM_lag2	-0.235	-1.910	0.058
DM_lag3	-0.257	-2.124	0.035
DM_lag4	0.539	2.901	0.004
DM_lag5	-0.294	-1.400	0.163
DM_lag6	0.112	0.974	0.331
UN_lag1	90.152	0.880	0.380
UN_lag2	-115.041	-0.632	0.528
UN_lag3	12.682	0.123	0.902
FEDV	11.000	1.448	0.149
R Square	0.977		
N	178		

DM_t* is the predicted money supply from equation 1.

The unanticipated change in 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. 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:

S&P500 = b1+ b2 *anticipated change + b3* unanticipated positive + b4*unanticipated negative + b5* consumer confidence + b6*GDP + b7*unemployment (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 for each variable in model 1.

IV. Results

The results of the 1st stage regression are provided in table 1.

Using the results presented in Table 1, anticipated and unanticipated changes in the money supply are computed. Table 2 provides descriptive statistics of the results obtained for predicted and residual money supply change, the dependent variable, and other control independent variables.

The results for Model 1 are presented in Table 3. The actual changes in money supply are regressed against the 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, as the coefficient for the actual change in M2 is positive. These results support the real activity theorists' argument that an increase in money supply increases stock prices and vice versa.

The results for the control variables are also consistent with the argument made in Section III. The result shows that consumer confidence and GDP are positively related with stock prices and the unemployment rate is negatively related with stock prices as previously argued.

Also note that all the variables are significant to the 0.01 percent level. The R squared is .964, meaning that 96.4% of the variance in stock prices are explained by the model, which is very good.

In order to conceptualize the results, I conducted some simulations connecting descriptive statistics in Table 2 and the results in Table 3. The results shows that when money supply increases by $ 142.3 billion (average change in quarterly money supply, year over year), the S&P 500 index increases by 83.67 points, about 5.94% of current index.

The results for Model 2 are provided in Table 4. This model is different from Model 1

in that it has separate explanatory variables for anticipated and unanticipated changes in money supply.

Table 2: Descriptive Statistics

Variables	N	Mean	Standard Deviation
S&P 500	188	374.261	410.693
Actual change in M2	188	$142.3b	109.502
Anticipated Change in M2	182	$142.251b	106.962
Unanticipated Positive	182	$7.762b	14.083
Unanticipated Negative	182	$-7.762b	15.1768
Consumer Confidence	113	88.1317	12.121
Unemployment rate	188	5.8840	1.435
GDP	188	$2037.155b	1966.792

The results in Table 4 show that both anticipated and unanticipated changes in the money supply are positively related with stock prices. This again proves that the real activity theorists are correct in assuming a direct relationship between money supply and stock prices.

The most important conclusion that can be drawn from the result of Model 2 is that anticipated changes in money supply matter more than unanticipated change. As argued in Section II, the proponents of the Efficient Market Hypothesis argue that anticipated change in 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 changes in the money supply matter too. The result in Table 4 shows that anticipated changes in money supply matter more than unanticipated changes as both unanticipated components are insignificant at 0.1 percent level whereas the anticipated change is highly significant at the 0.01 percent level. So, the results support the critics of the Efficient Market Hypothesis and signify that anticipated change in money supply matters too. The result is consistent with the results found by Hussain and Mahmod (1999).

The results for the control variables are consistent here too with the arguments made in earlier sections. The results show that consumer confidence and GDP are positively related with stock prices and the unemployment rate is negatively related with stock prices.

The results suggest that when the money supply changes by $142.25 billion (average change in anticipated money supply) and this change is anticipated, the S&P 500 index increases by 83.5 points, about 5.93% of the current index. Similarly, when the money supply increases by $7.762 billion (average change in unanticipated money supply) and this change is unanticipated, the S&P 500 index increases by 2.95 points, about 0.21% of the current index. Similarly, when the money supply decreases by $7.762 billion (average change in unanticipated money supply) and this change is unanticipated, the S&P 500 index decreases by 6.59 points, about 0.47% of the current index.

VI. Conclusion

The results of this study suggest that the theory of real activity theorists dominates Sellin's (2001) theory. The results support the view of the real activity hypothesis that a positive money supply shock increases stock prices and vice versa. The results also support the opponents of Efficient Market Hypothesis that anticipated changes in the money supply matter more than unanticipated changes in the money supply in determining stock prices.

Table 3: Model 1, Dependent variable = S&P 500 index

Variables	Coefficient	Sig.
Constant	-82.578	.58
	(-.556)	
Actual change in M2	0.588	.000
	(4.123)	
Consumer Confidence	4.095	.001
	(3.526)	
GDP	0.157	.000
	(16.928)	
Unemployment rate	-50.244	.000
	(-4.466)	
R Squared	.964	
N	113	

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 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 for changing the money supply. Since anticipated changes matter more than unanticipated changes, the more the people can anticipate changes in the money supply correctly, the greater the effect of changes in the money supply are 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 (1982) 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.

One way to improve on the empirical model would be to use monthly or even weekly data instead of quarterly data. As stock market prices are fairly quick in adjusting to changes in information, using a smaller time frame would be more effective in capturing the behavior of the stock prices.

The other method that would more effectively and accurately assess anticipated and unanticipated changes in the money supply would be to replicate Bernanke and Kuttner's (2005) model (discussed in Section II) using money supply rather than the federal funds 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 that the one presented by the model in this study.

Using the S&P 500 index as a dependent variable itself could also be a limitation of the model. Even though the S&P 500 is the 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 is only comprised of 500 large capitalized (bigger than $5 billion in market value) companies. Therefore, this study ineffectively leaves out the performance of other companies that are not included in S&P500. Studies in the future could consider a more comprehensive index that includes middle and small capitalized companies, rather than just the S&P 500 index, to effectively capture the effect of the money supply on stock prices.

Table 4: Model 2, Dependent Variable = S&P 500 index

Variables	Coefficient	Sig.
Constant	-88.341	.559
	(-.586)	
Anticipated change in M2	.587	.000
	(3.851)	
Unanticipated Positive	0.381	.635
	(0.476)	
Unanticipated Negative	0.850	.241
	(1.18)	
Consumer Confidence	4.102	.000
	(3.501)	
GDP	0.158	.000
	(15.747)	
Unemployment rate	-49.274	.001
	(-4.237)	
R Squared	.964	
N	113	

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