The Relationship among Stock Prices, Inflation and Money Supply in the United States

Radim GOTTWALD

Abstract

Many researchers have investigated the relationship among stock prices, inflation and money supply in order to find some dependence. The aim of the paper is to assess this relationship in the United States over the period from 2005 to 2014. The dependence of inflation on S&P 500 Index, the dependence of monetary aggregate M1 on S&P 500 Index and the dependence of monetary aggregate M1 on inflation are examined. Author uses linear regression analysis in order to examine the degree of the dependence between variables. The delays when the coefficient of determination is the highest and when it is the lowest are found for each of the three dependences. Results show that the use of linear regression model is the most suitable when the reaction of monetary aggregate M1 on change in inflation is delayed. Understanding the empirical relationship between stock prices and monetary variables such as inflation and money supply can be very useful for academics, investment professional and monetary policy makers, usually central banks.

Key words

Stock valuation, stock prices, inflation rate, money supply, regression analysis

JEL Classification

E44, E51, G15

Introduction

The author focuses on stock prices, inflation and money supply in this paper. The relationship among these variables is one of topical interesting economic topics, examined also by many researchers. The economy of each country is influenced by the development of the money supply and inflation. A number of researchers have investigated the relationship among these variables in order to find some dependence or causality. Several methods can be used to investigate it. Regression analysis is considered to be one of such methods.
The aim of the paper, detailly described in the Chapter “Methodology”, consists in the assessment of the relationship among stock prices, inflation and money supply in chosen country during chosen time period. This paper follows in some similarly focused empirical studies, which are quoted in the paper. Stocks are very sensitive to information which influence the stock market, in general. The volatility in stock markets picks up during some periods. Such a volatility poses a risk in economy of many countries. The more the volatility is, the more intensive the economic decline is. Thus, the gross domestic product should decrease, too.

The remainder of this paper is structured as follows. Chapter „Literary Survey“ describes the relationship among stock prices, inflation and money supply in general. An effort of many researchers to investigate such relationship is clear from the chapter. The choice of used country, stock market index, monetary aggregate and analysed time period are specified in the Chapter „Methodology“. Author presents there the way how the relationship is investigated. Regression analysis is implemented in the Chapter „Results“. The contribution of the paper is emphasized in the Chapter „Discussion“. Author presents, what another potential area for research can be used in the future. Chapter „Conclusion“ summarizes important and interesting findings related to this paper.

**Literary Survey**

Money supply is monetary policy tool used by monetary authorities. Monetary aggregate M1 is important policy instrument. Monetary authorities in each economy control this variable. Monetary authorities also affect the money supply through their monetary policy actions such as selling and buying government securities, changing reserve requirements, or changing the interest rate at which the monetary authority provides reserves to financial intermediaries.

At first, the relationship among stock prices, inflation and money supply can be interpreted in general. Inflation can either positively or negatively impact stocks, depending on the government’s monetary policy and the ability to hedge. An expansionary monetary policy by way of increasing money supply by the monetary authorities would, all things being equal, lead to a profound impact on stock prices in the stock market. Stock prices does not increase immediately after money supply increase but later. This delay in months could be caused by
the liquidity effect or transmission mechanism. A number of macroeconomic factors influence stock prices, in general. However, the money supply is considered to be an important factor. Inflation and money supply have a positive relationship among themselves. On the other hand, they have a dual effect on stock returns. At first, increase in money supply will increase inflation, which will again increase expected rate of return. The use of high expected rate of return will decrease value of the firm and will result in lower share prices. At second, increase in inflation and money supply increases future cash flow of the firm, which in turn, increases expected dividend, and will increase stock prices.

Investigation of the relationship among stock prices, inflation and money supply has been at the centre of attention of many researchers. United States stock market and economy are in this sense often analysed. Hsing (2011) examines the effects of several macroeconomic variables on the stock market in the United States and South Africa over the period from 1980 to 2010. He finds that South Africa’s stock market index is positively influenced by the ratio of the money supply to GDP and the United States stock market index and negatively affected by the domestic real interest rate and the domestic inflation rate. The impact of the monetary policy instruments on stock market returns in the United States and Malaysia over the period from 1999 to 2007 is investigated by Albaity (2011). He examines the volatilities of interest rates and inflation rate. He finds that monetary aggregates M1, M3 and inflation rate are significant in influencing stock index volatility in Malaysia, while monetary aggregates M2, M3 and inflation rate affected stock index in the United States. His study also aims at the use of stock market indices as a hedge against inflation. Shiblee (2009) shows the impact of inflation and money supply on stock prices in the United States stock market over the period from 1994 to 2007. He also presents that stock price is influenced by several factors like inflation and money supply and he shows the different effects of inflation and money supply on stock price of industrial sector. It is clear that these two independent variables have different effects. The strongest variable effect was money supply. It has a strong positive influence at most companies in the sample. Rahman and Mustafa (2008) show the short-run and long-run dynamic effects of broad money supply (M2) on the United States stock market represented by the S&P 500 index over the period from 1974 to 2006. Their results do not reveal any converging long-run causal flows. However, short-run interactive feedback relationships exist. Negative monetary shocks initially depress the United States stock market.
Nigeria is chosen as the appropriate country, too. Akani (2013), focusing on stock market in Nigeria over the period from 1985 to 2011, investigates the nature of relationship between macroeconomic aggregates proxies by inflation rates and money supply while stock index All Share Index standing as a proxy for aggregated stock prices. His results show that changes in inflation rates and money exert a significant impact on aggregated stock within the period. Positive long-run relationship exists between money supply and aggregated stock prices, while negative long-run relationship exists between inflation rates and All Share Index. He also finds bi-directional causality between money supply and aggregated stock prices and undirectional causality running from inflation to aggregated stock prices. Ogbulu and Uruakpa (2011) investigate the link between monetary policy and stock prices in the Nigerian capital market over the period from 1986 to 2011. They try to find the direction of causality between monetary policy variables and asset prices. Their results show that there is one co-integrating long run dynamic relationship between stock prices and the set of broad money supply and inflation. Broad money supply has a positive and significant impact on stock prices. The causality from stock prices to broad money supply is undirectional.

Some researchers focus on the Indian stock market and economy. Patel (2012) investigates the effect of several macroeconomic determinants including inflation and money supply on the performance of the Indian stock market over the period from 1991 to 2011. He finds that inflation and money supply are major factors affecting Indian stock market. Similarly, Naik and Padhi (2012) investigate the effect of determinants in stock market of India over the period from 1994 to 2011. Specifically, they find what relationship is between money supply and Indian stock market index BSE Sensex. Their results show that it is a long-run equilibrium relationship. The stock prices positively relate to the money supply but negatively relate to inflation. There is unidirectional causality from money supply to stock price, stock price to inflation are found.

**Methodology**

The aim of the paper is to assess the relationship among stock prices, inflation and money supply in the United States over the period from 2005 to 2014. Successively, the dependence of inflation on stock prices, the dependence of money supply on stock prices and the dependence of money supply on inflation are examined. Stock index Standard & Poor’s 500
(hereafter S&P 500), inflation in the United States and monetary aggregate M1 in the United States are used.

World Federation of Exchanges (2014) reports that US stock market belongs among the world’s most important stock markets according to market capitalization. Jílek (2009) reports that 70% of all trades with stocks is realized in the United States. The S&P 500 index is major indicator of the US stock market and the M1 is important monetary aggregate of money supply. This aggregate includes physical cash and coin, demand deposits and traveler’s checks of non-bank issuers. Based on these facts, just US stock market, S&P index and monetary aggregate M1 were chosen.

Author reports descriptive statistics of used variables. Various statistical indicators are calculated. Author compares coefficients of determination. Linear regression analysis is used in order to examine the degree of the dependence between variables.

Following linear regression equation is examined:

\[ \text{INFLATION} = \beta_0 + \beta_1 \cdot \text{INDEX} + r \]

whereas \( \text{INFLATION} \) is inflation rate, \( \beta_0 \) and \( \beta_1 \) are regression coefficients, \( \text{INDEX} \) is S&P 500 Index and \( r \) is residual of the model.

So, the dependence of inflation on S&P 500 Index, the dependence of monetary aggregate M1 on S&P 500 Index and the dependence of monetary aggregate M1 on inflation are examined. Coefficients, standard deviations, t-statistics and p-values related always to constant or variable are found. Coefficients of determination are again compared. Author examines in what cases data fit a linear regression model.

One variable need not respond to changes in other variable immediately. It means that a certain time delay in months must be within calculations taken into account. Thus, implementation time delay is supposed. Corresponded coefficients of determination are calculated regarding delay in various numbers of months. The delays when the coefficient of determination is the highest and when it is the lowest are found for each of the three dependences. Author examines when the use of linear regression model is the most suitable.
Data are collected on monthly basis. Closing prices of S&P 500 Index are obtained from Yahoo Finance (2015). Inflation rates, exactly harmonised indexes of consumer prices and monetary aggregate M1 values are obtained from OECD (2015).

Results

Table 1 reports descriptive statistics of the S&P 500 Index, inflation and monetary aggregate M1 over the period from 2005 to 2014.

Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th>Statistical indicator</th>
<th>S&amp;P 500 Index</th>
<th>Inflation</th>
<th>Monetary aggregate M1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean value</td>
<td>1360.4</td>
<td>99.707</td>
<td>107.05</td>
</tr>
<tr>
<td>Median</td>
<td>1316.5</td>
<td>100.00</td>
<td>97.150</td>
</tr>
<tr>
<td>Minimum</td>
<td>735.09</td>
<td>86.700</td>
<td>77.900</td>
</tr>
<tr>
<td>Maximum</td>
<td>2067.6</td>
<td>109.80</td>
<td>166.80</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>286.98</td>
<td>6.6016</td>
<td>29.647</td>
</tr>
<tr>
<td>Coefficient of variation</td>
<td>0.21095</td>
<td>0.066209</td>
<td>0.27694</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.58886</td>
<td>-0.18142</td>
<td>0.64588</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>0.19576</td>
<td>-1.1600</td>
<td>-1.0453</td>
</tr>
<tr>
<td>Linear trendline equation</td>
<td>y=0.151x-4727</td>
<td>y=0.183x+88.45</td>
<td>y=0.796x+58.07</td>
</tr>
<tr>
<td>Coefficient of determination</td>
<td>0.323</td>
<td>0.960</td>
<td>0.902</td>
</tr>
</tbody>
</table>

Source: Yahoo Finance (2015), OECD (2015) and own calculations

The trend of each used variable is mostly increasing, which partially confirms positive linear coefficient in linear trendline equation. Coefficients of determination of inflation and monetary aggregate M1 are rather high and substantially higher than coefficient of determination of S&P 500 Index. Thus, linear trendline equations in cases of inflation and monetary aggregate M1 really accurately describe actual development of variables.
Following dependences are now examined: the dependence of inflation on S&P 500 Index, the dependence of monetary aggregate M1 on S&P 500 Index and the dependence of monetary aggregate M1 on inflation.

Table 2 shows results of linear regression analysis of used variables.

Table 2: Results of Linear Regression Analysis

<table>
<thead>
<tr>
<th>Statistical indicator</th>
<th>S&amp;P 500 Index</th>
<th>S&amp;P 500 Index</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inflation</td>
<td>Monetary aggregate</td>
<td>Monetary aggregate</td>
</tr>
<tr>
<td>Coefficient (constant)</td>
<td>82.3414</td>
<td>9.77623</td>
<td>-300.991</td>
</tr>
<tr>
<td>Coefficient (variable)</td>
<td>0.0127656</td>
<td>0.0715053</td>
<td>4.09239</td>
</tr>
<tr>
<td>Standard deviation (constant)</td>
<td>2.42837</td>
<td>9.46151</td>
<td>16.8699</td>
</tr>
<tr>
<td>Standard deviation (variable)</td>
<td>0.00174694</td>
<td>0.00680651</td>
<td>0.168828</td>
</tr>
<tr>
<td>t-statistic (constant)</td>
<td>33.91</td>
<td>1.033</td>
<td>-17.84</td>
</tr>
<tr>
<td>t-statistic (variable)</td>
<td>7.307</td>
<td>10.51</td>
<td>24.24</td>
</tr>
<tr>
<td>p-value (constant)</td>
<td>2.57e-063</td>
<td>0.3036</td>
<td>1.49e-035</td>
</tr>
<tr>
<td>p-value (variable)</td>
<td>3.29e-011</td>
<td>1.06e-018</td>
<td>4.63e-048</td>
</tr>
<tr>
<td>Coefficient of determination</td>
<td>0.307952</td>
<td>0.479086</td>
<td>0.830408</td>
</tr>
</tbody>
</table>

Source: Yahoo Finance (2015), OECD (2015) and own calculations

The coefficient of determination is the highest in the case of the dependence of monetary aggregate M1 on inflation. In this case, regression line well fits the data. The model explains 83 % variability in monetary aggregate M1. Linear dependence between monetary aggregate M1 and inflation is strong. Coefficient (variable) is positive, so the dependence is direct. This dependence is statistically significant because of low p-value (constant) and p-value (variable). Coefficients of determination in the cases of other two examined dependences are low.
In summary, the highest dependence is found in the case of the dependence of monetary aggregate M1 on inflation.

Dependent variable can react to change in independent variable later. Table 3 reports coefficients of determination when various delays in months are supposed.

Table 3: Coefficients of Determination

<table>
<thead>
<tr>
<th>Delay in months</th>
<th>S&amp;P 500 Index - Inflation</th>
<th>S&amp;P 500 Index – Monetary aggregate M1</th>
<th>Inflation – Monetary aggregate M1</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>0.283902</td>
<td>0.507555</td>
<td>0.827585</td>
</tr>
<tr>
<td>-2</td>
<td>0.292516</td>
<td>0.497267</td>
<td>0.828035</td>
</tr>
<tr>
<td>-1</td>
<td>0.302570</td>
<td>0.488306</td>
<td>0.828214</td>
</tr>
<tr>
<td>0</td>
<td>0.307952</td>
<td>0.479086</td>
<td>0.830408</td>
</tr>
<tr>
<td>+1</td>
<td>0.303891</td>
<td>0.454215</td>
<td>0.838316</td>
</tr>
<tr>
<td>+2</td>
<td>0.294116</td>
<td>0.428285</td>
<td>0.845815</td>
</tr>
<tr>
<td>+3</td>
<td>0.279359</td>
<td>0.404169</td>
<td>0.854786</td>
</tr>
</tbody>
</table>

Source: Yahoo Finance (2015), OECD (2015) and own calculations

For example, delay „-3 months“ means that values of S&P 500 Index in some data are used together with the values of inflation in data 3 months sooner.

As for the dependence of inflation on S&P 500 Index, the highest coefficient of determination is found within no delay. On the contrary, the lowest one is found within delay +3 months. Inflation should theoretically react to change in S&P 500 Index immediately and vice versa.

Regarding the dependence of monetary aggregate M1 on S&P 500 Index, the highest coefficient of determination is found within delay -3 months while the lowest one within delay +3 months. It is clear that the longer delay is, the lower coefficient of determination is. S&P 500 Index should theoretically react to change in monetary aggregate M1 many months later.

Finally, as for the dependence of monetary aggregate M1 on inflation, the highest coefficient of determination is found within delay +3 months. On the other hand, the lowest one is found within delay -3 months. It is clear that the longer delay is, the higher coefficient of
determination is. Monetary aggregate M1 should theoretically react to change in inflation many months later.

Based on the highest coefficients of determination comparison in all three dependences, data best fit a linear regression model in such a situation when monetary aggregate M1 reacts to change in inflation later. S&P 500 Index reacts to change in monetary aggregate M1 later.

Discussion

Understanding the empirical relationship between stock prices and monetary variables such as inflation and money supply can be useful for academics, investment professionals including portfolio managers, financial hedgers and asset allocators as well as monetary policy makers, usually central banks. They should be knowledgeable of these relationship in order to influence economy. The findings of this paper extends the existing literature by providing some meaningful insight to the policy makers.

The findings of this paper have also some important policy implications for the formulation of monetary policy. Appropriate changes in money supply should be made that will guide the operations in the stock market as well as other macroeconomic variables in view of the found relationship between stock prices and money supply. The monetary authorities should give enough indication to the market on its plan for the change in the money supply, because the anticipated changes matter more than unanticipated changes. The more people anticipate changes in the money supply, the stronger the effect of changes is translated into real economic activity.

Monetary authorities should try to control inflation and money supply through Repo and Reverse Repo rates in accordance with results of this paper. Macroeconomic policies are expected to affect the stock market. Autonomous regulatory bodies should have greater impact on the stock market through the money supply channel. They should influence stock market growth by targeting M1, as this is a better predictor of stock prices in the future, rather than inflation. This paper therefore recommends that monetary authorities should always design and implement appropriate monetary policy mix that gives more prominence to money supply than inflation as instruments of monetary policy in view of the observed nexus between stock prices and monetary policy. Such monetary policy should be responsive to the needs of the stock market as well as providing the needed impulse to drive the market towards
optimal growth. The government, in formulating monetary policy, should take into consideration the fact that the stock market responds more favorably to an increase in money supply. It should boost the stock market.

Monetary authority policies, through the use of various monetary variables, should influence investment decisions of investors and, consequently, the overall state of the economy. The monetary authorities also need to monitor the developments in the world financial market such as movements in major world stock markets. Investors to stocks should pay close attention to the developments in the monetary policy. Investors who actively invest in the stock market should take macroeconomic variables like inflation and money supply into consideration. All these activities can contribute to efficient working and development of the stock market. It will enhance the contribution of the stock market to the economic growth of the country’s economy. Adequate policies should be put in place to enhance the stability of stock market so that it can contribute its role towards the overall growth of the economy.

The contribution of the paper is clear. The knowledge of the relationship among stock prices, inflation and money supply is beneficial when future development of the economy is predicted. Results of the paper indicate whether investors should take account of money supply development within investment decisions.

Investors can decide based on historical data of money supply or on prediction of development money supply to the future or on announcements of central banks about future increase of money supply, as it is usual in the United States. Prediction models are usually reliable only if no unexpected situation with high impact on the market will happen. In author’s opinion, the results will be used rather by such investors who invest in long-term horizon than by speculators preferring short-term investment horizon. It does not too matter whether they are retail or institutional investors because the consequences of investment decision will be similar for these investors. Results mentioned in the paper can be also considered to be helpful to monetary policy makers.

There are several ways in which research in this economic field can continue. Other macroeconomic variables, countries, time periods and statistical methods could be used. Researchers could examine whether the impact of monetary supply on stock prices is rather constant or volatile in time. Some researchers state that gradual decrease of intensity of positive relationship between stock prices and money supply can be seen in a number of
European stock markets. So, other stock markets could be examined in this sense. Interesting question could be discussed. Specifically, what effects are connected with actual stock prices trends and quantitative easing? Possible existence of causal relationship among stock prices, inflation and money supply could be examined by means of difficult econometric methods. The impact of world money supply on world stock market could be analysed. Another question remains, whether changes in stock prices are caused by money supply or rather psychological factors within investment decisions of investors. Some other factors which influence S&P 500 Index, inflation and monetary aggregate M1 could be analysed. For example, the minimum value of S&P 500 Index is measured in November 2008, probably because of world economic crisis.

**Conclusion**

The causal relationship between money supply and stock prices should exist according to economic theory. The empirical relationship among stock prices, inflation and money supply has been a subject of enduring interest to academics, policy makers and investment professionals. The paper was focused on assessing this relationship in the United States over the period from 2005 to 2014. Linear regression analysis was used in order to examine the degree of the dependence between variables. Author presented descriptive statistics of all used variables. The coefficient of determination was the highest in the case of the dependence of monetary aggregate M1 on inflation. Linear regression model explained 83% variability in monetary aggregate M1. Results showed that data best fitted a linear regression model in such a situation when monetary aggregate M1 reacted to change in inflation later. S&P 500 Index reacted to change in monetary aggregate M1 later. Certain time delay in months was also within calculations taken into account.

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Contact:
Ing. Mgr. Radim Gottwald
Department of Finance
Faculty of Business and Economics
Mendel University in Brno
Zemědělská 1
613 00 Brno
Czech Republic
email: radim.gottwald@mendelu.cz