Sensitivity Of Stock Prices To Money Supply Dynamics

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Abstract

Financial theory models typically relate stock prices with inflationary shocks that emanates from an expansionary monetary policy. Literature generally supports the causality relationship between money supply and stock prices due to price volatilities in the real interest rate. This paper attempts to determine causality between money supply and stock prices using monthly share prices and money supply quantities from 2011- 2013. The results of the study support the recent evidence against the positive affiliation between money supply and stock prices. The study uses the Johansen cointegration test and the Vector Error Correction Models (VECM) models for testing causality relationship between money supply and stock prices. While the expectation was that there should exist a statistically significant positive affiliation between money supply and stock prices, results of the tests reject this ideal. However, the results are plausible when interest rate factors are included in the analysis. It is concluded that money supply shocks provide robust changes in the stock prices.

Keywords: stock prices; money supply; causality.

Introduction

According to Valcarcel (2012), theoretical Finance models generally associate a positive short run response in stock prices with an inflationary shock resulting from monetary policy expansion. Through the Gordon Growth model, theoretical finance shows that stock prices are positively associated with current and expected growth rules of dividend returns. The relationship however, between money supply and stock prices has been controversial. Early studies conducted by Sprinkel (1971), Homa & Jaffee (1971) showed that money supply leads stock prices. While the extant literature supports this relationship, it has been proved that historical movements in stock prices can also be attributed to new information either about future real dividends or about the prospects of the real interest rates used to discount the dividends (Grossman & Shiller, 1980). A study conducted by Choudhry (1996) has shown that stock prices play a significant role in the determination of stationary real long run M1 and M2 demand functions. The study used the cointegration tests and error correction modeling techniques. Bilson et al (2001) intended to address macroeconomic variable power over stock price returns in emerging markets. The study reported only moderate evidence to support this contention (Bilson, et al, 2001). However, Rapach (2001) used structural vector autoregression to measure contributions of macro shocks to real stock fluctuations. It was then reported from the study that money supply shocks bring about a short run plunge in the stock prices which is evidenced by standard present-value equity valuation models. Browne & Cronin (2010), using cointegration VAR framework and US data, has proven the equilibrium relationships between money, commodity prices and consumer prices hence implicating a causal relationship. Evidence for the positive affiliation was further presented by Hafer (1986) who reported that unanticipated money stock changes do affect stock prices.

While the above mentioned studies support the positive relationship, recent studies dispute this established financial ideal. Alatiqi & Fazel (2008) for instance reported the absence of a causal relationship from money supply on stock prices which may be attributed to uncertainties over whether interest rates may fluctuate due to money supply instabilities. Gupta & Modise (2013), using monthly data from 1990-2010 reported that macroeconomic and financial variables do not seem to contain much information in predicting South African stock returns in a linear predictive regression framework.

This paper attempts to contributes to the controversial literature by examining monthly data from 2011-2013 of Botswana Diamond share prices (BoD). The rest of the paper is as follows. Next is the literature review which will then end with a synthesis of the reviewed studies. Following this will be the research hypotheses, data description, as well as the methodology. From there the study presents hypotheses test results which will be followed by a discussion of the results and finally a conclusion of the study.

Literature Review

Previous studies have attempted to link money supply and stock prices in different economies. Choudhry (1996) aimed to investigate the relationship between stock prices and the long run money demand functions in Canada and the US for the period 1955-1989. The study further intended to determine whether there exists a stationary long run relationship between money demand and real stock prices. Cradle to the study, was to determine the size and direction of the effect of stock prices on the demand for money. Choudhry (1996) applied the Johansen method of cointegration and errors correction modeling techniques. The study used the money demand function that relates stock prices and money supply as $(M/P)^d = f(y,i,sp)$. Effectively, cointegration tests results showed that stock prices play a significant role in the determination of stationary long run real M1 and M2 demand function in both countries. It was further demonstrated that the direction and magnitude of the role of stock prices depends on the definition of money supply and geographical location. From the presentation of the findings, error correction results provide evidence of causality between the real stock prices and the determinants of money demand. Another study conducted by Bilson e.al (2001) attempted to address the question of whether local macroeconomic variables have explanatory power over stock returns in emerging markets. The objective was fulfilled with evidence supporting commonality in the factors that drive return variation across emerging markets. While the results are plausible, the implications to an investor are also positive since the evidence shows that diversification is enhanced when allocation of funds is spread across.

Whereas the above mentioned studies focused on normal conditions, Rapach (2001) took a different direction by linking macro shocks to real stock price volatilities. The study aimed to measure the contributions of macro shocks to real stock price volatilities using the structural Vector Autoregression models (VAR). Rapach (2001) reported that the impulse response to an expansionary money shock is found when the price level responses are very low. However Rapach (2001) reported that money supply shock also brings about a short run increase in real stock prices which is easily explained by the standard present value equity valuation model. The study further reported that money supply shock lowers the interest rates and raises the real stock prices in a short run framework. However, Rapach (2001) flagged that the stock prices change relatively little post the shock effect. Schmidt (2001) attempted to link money supply and prices using a market equilibrium approach. The study used the Johansen maximum like-hood approach and the results reported that a change in money supply exogeneity alters the level of the endogenous money variable which produces volatilities in the level of price level and interest rate variables. From the study, it was concluded that money is weakly endogenous with respect to both demand and supply functions. Valcarcel (2012) attempted to determine the adjustment of stock prices to inflation disturbances. From financial economics, money supply growth is often associated with rising inflation. However, the study concluded that there exists a negative relationship between inflation and stock prices. The evidence surfaced using VAR models and trivariate benchmark specifications. In another study conducted by Boyle and Young (1999) the aim of the study

was to examine the effects of monetary policy using utility functions. The study concluded that by altering the supply of money in response to real conditions, monetary adjustments affect both the average level and the volatility of future real equity dividends. Consistently, Shiller (1988) argued that changes in stock prices reflect changes in investor expectations about future values of certain economic variables that affect directly the pricing of the stocks in consequence.

While literature generally supports the positive affiliation between stock prices and money supply, Rangan & Modise (2013) suggest otherwise. Using the diffusion index approach and monthly data from 1990- 2010, the results report that macroeconomic and financial variables do not seem to contain much information in predicting South African stock returns in a linear predictable regression framework. Alatiqi & Fazel (2008) reported that the causal relationship from money supply to interest rates and from interest rates to stock prices results in no significant long term causal relation from money supply and stock prices.

In summary, literature generally favors the positive impact of money supply on the stock prices drawing from the studies of Choudhry (1996), Rapach (2001), Schmidt (2001), and Browne & Cronin (2010). The extant literature is controversial as there is still evidence against this relationship. This paper attempts to contribute to the literature by using econometric techniques to determine the relationship in Botswana scenario.

Research Hypothesis

From the literature review there is substantial evidence in support of the positive affiliation between money supply and stock prices as indicated by Choudhry (1996), Rapach (2001), Schmidt (2001), and Browne & Cronin (2010). While literature supports that an increase in money supply leads to stock price increase, evidence provided by Rangan & Modise (2013) invalidates the return-money supply relationship. From the discussed literature, it is hypothesised that:

H1 Money supply moves positively with stock prices

H2 Money supply leads stock prices **Data**

This study uses monthly data from 2011:1- 2013:12 to determine the relationship between stock prices and money supply. The historical Botswana Diamonds share prices (BoD) was obtained from Yahoo Finance and money supply quantities were obtained from the Botswana Financial statistics which are monthly central bank publications as reported by the Bank of Botswana Research Department. Following, Barro (1990) money supply was defined as the hand to hand currency in circulation which also assists in the determination of liquidity effects.

Methodology

Following Barro (1990), money supply will be defined as:

$$MS = C_x|\eta_t| + M_x|\eta_t| \qquad (1)$$

Where:

MS = money supply

$C_x|\eta_t|$= coins in circulation conditional upon monetary policy effects at the time "t"

$M_x|\eta_t|$ = paper money in circulation conditional upon monetary policy effects at the time "t"

The return on the asset will be defined in terms of N-local factors and K-global factors (Bilson, et al 2001). The asset return model applied is:

$$R_{it} = \alpha_1 + \sum_{i=1}^{N} \beta_{im} F_{mt}^{W} + \sum_{j=1}^{K} \gamma_{it} F_{ijt}^{L} + \varepsilon_{it} \qquad (2)$$

Cointegration Analysis

Hypothesis 1 stipulated that money supply moves positively with the stock prices. The Johansen cointegration test was selected as it has high statistical power to test the long run co-movement of the variables. Following Schmidt (2001), the Johansen cointegration test is suitable for proper estimation used to simultaneously estimate more than one cointegrating relations. While the Dickey Fuller test could have been applied also, it has been reported that the power of the Johansen cointegration test is higher than that of the Dickey Fuller test (Lee & Tse, 1996). Classical cointegration test have been developed such as Engle & Granger (1987), Phillips (1991), but the preferred option is the Johansen cointegration test. Following Johansen (1988) the cointegration model applied is:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i-1}^{p-1} \Gamma_i \Delta y_{t-1} + B x_t + \varepsilon_t \quad (3)$$

The coefficient matrix was defined as

$$\Pi = \sum_{i-1}^{p} A_i - I \quad (4)$$

And

$$\Gamma_i = -\sum_{j-i+1}^{p} A_j \quad (5)$$

Following Schmidt (2001) the variable Δy_t will represent a ρ-element vector of observations on all variables in the system at the time *"t"* while $\Gamma_i \Delta y_{t-1}$ will account for variations in stationarity in relation to the past history of variables. The coefficient matrix Π will consist of the cointegrating relations. In the computation of the cointegrating equations the trace test was computed as:

$$LR_{tr}(r|k) = -T\sum_{i=r+1}^{k} \log\left(1-\lambda_i\right) \qquad (6)$$

And the maximum-eigen value test was defined as:

$$LR_{max}(r|r+1) = -T\log\left(1-\lambda_{r+1}\right) \qquad (7)$$

$$= -T\sum_{i=r+1}^{k} \log\left(1-\lambda_i\right) - \left(LR_{tr}(r+1|k)\right) \qquad (8)$$

$$= LR_{tr}(r|k) - LR_{tr}(r+1|k) \qquad (9)$$

Causality Analysis

Hypothesis 2 posited that money supply leads stock prices. The Granger causality test points to a state of priority between the variables (Incekara et.al, 2012). According to Dufour et.al (2006) the original definition of the Granger Causality refers to the predictability of variable x_t where it is an integer from its own past. The Vector Error Correction Model is used for Granger Causality following (Engle & Granger, 1987). The error correction models formed for money supply(MS) and stock prices (P_t) are:

$$\Delta MS = \alpha_1 + \sum_{i=1}^{m} \beta_{1t} \Delta I_{t-i} + \sum_{i=1}^{n} \delta_{1t} \Delta MS_{t-i} + \sum_{i=1}^{r} \varphi_{1i} ECM_{r,t-1} + \varepsilon_{1t} \quad (10)$$

$$\Delta P_t = \alpha_2 + \sum_{i=1}^{m} \beta_{2t} \Delta I_{t-i} + \sum_{i=1}^{n} \delta_{2t} \Delta MS_{t-i} + \sum_{i=1}^{r} \varphi_{2i} ECM_{r,t-1} + \varepsilon_{2t}$$

Hypothesis Test Results

Cointegration Test Results

Hypothesis 1 postulated that there exists a positive affiliation between money supply and nominal interest rates. For the period 2011:1- 2011:12 the trace test results indicated ρ-values of 0.07 and 0.85 which were both greater than the critical level of 0.05 so the hypothesis was rejected. The 2012:1-2012:12 period also reported ρ-values of 0.15 and 0.38 which were both greater than the

critical level of 0.05 thus indicative of no cointegration between the variables. The last data set of 2013:1-2013:12 trace test also reported ρ-values of 0.11 and 0.09 reporting no cointegration between the variables. Table 1 shows the results of the trace test.

Table 1: Trace Test Results[3]

Hypothesized No. of Coint. Vectors	Eigenvalue	Trace Statistic	Critical Value[1]	ρ-values[2]
2011:1- 2011:12				
0	0.80	14.50	15.50	0.07
1	0	0.03	3.84	0.85
2012:1- 2012:12				
0	0.67	12.10	15.50	0.15
1	0.07	0.74	3.84	0.38
2013:1- 2013:12				
0	0.68	13.16	15.50	0.11
1	0.28	3.0	3.84	0.09

[1]*critical level of 0.05*
[2]*based on the MacKinnon-Haug-Michelis (1999) ρ-values*
[3]*as computed by EViews 7*

The maximum-eigen value test reported ρ-values of 0.05 and 0.85. A ρ-value of 0.05 and 0.85 reports no cointegration at critical level of 0.05. The 2012:1- 2012:12 data represents ρ-values of 0.14 and 0.39 which are both greater than the critical level of 0.05 thus indicative of no cointegration of the variables. Similarly, the 2013:1-2013:12 data set reports ρ-values of 0.20 and 0.09 which are greater than the critical level of 0.05 thus indicative of no cointegration. Table 2 shows the results of the maximum-eigen value test. In general, the cointegration tests suggest no long run comovement of the variables.

Table 2: Maximum Eigenvalue Test Results[3]

Hypothesized No. of Coint. Vectors	Eigenvalue	Max-Eigen Statistic	Critical Value[1]	ρ-values[2]
		2011:1- 2011:12		
0	0.80	14.50	14.30	0.05
1	0	0.03	3.84	0.85
		2012:1- 2012:12		
0	0.68	11.37	14.30	0.14
1	0.07	0.74	3.84	0.39
		2013:1- 2013:12		
0	0.68	10.20	14.30	0.20
1	0.28	2.96	3.84	0.09

[1]*critical level of 0.05*
[2]*based on the MacKinnon-Haug-Michelis (1999) ρ-values*
[3]*as computed by EViews 7*

Causality Test Results

Hypothesis 2 posited that money supply leads stock prices. For the 2011:1-2011:12 data the ρ-values reported were 0.38 and 0.11 which were both greater than the critical level of 0.05 therefore the causality was rejected. Similarly for the 2012 data set the causality between money supply and stock prices was rejected. The 2013 monthly data also rejected the hypothesis with ρ-values of 0.47 and 0.44 greater than the critical level of 0.05. Table 3 shows the results of the Granger Causality test. Reverse causality also did not hold in all the instances.

Table 3: Pairwise Granger Causality Test Results

Causality Under Evaluation	Observations	F-Statistic	ρ-values
	2011:1- 2011:12		
$MS \rightarrow P_t$	9	1.24	0.38
$P_t \rightarrow MS$	9	5.50	0.07
	2012:1- 2012:12		
$MS \rightarrow P_t$	10	1.15	0.38
$P_t \rightarrow MS$	10	0.47	0.65
	2013:1- 2013:12		
$MS \rightarrow P_t$	9	0.89	0.47
$P_t \rightarrow MS$	9	0.98	0.44

Discussion

Hypothesis 1 postulated that there is co-movement between money supply and stock prices. The results of the trace test and maximum-eigen value test shows that there is no long run comovement and causality between money supply and stock prices from the examination. While the expectation was that money supply should lead stock prices, the results are plausible. However Choudhry (1996) reported that stock prices were equally as important as they play a significant role in the determination of stationary long run real M1 and M2 money supply implicating causality relationship. While the results have shown that there is no statistically positive relationship, Bilson et.al (2001) affirms this deviation. Bilson et.al (2001) attempted to link macroeconomic variables with stock returns and the results only reported moderate evidence of the explanatory power over stock returns. It is then plausible that given the limited predictive power of the macroeconomic variables over stock prices, therefore there is a possibility of no positive affiliation and causality at all. The lack of a positive relationship is better explained by Rapach (2001) who associated real stock prices with money supply shocks. Evidence reported that money supply shock brings about a short run increase in real stock prices which is derived from the standard present value equity valuation model. According to Rapach (2001) the logic is that money supply shock lowers the interest rate and therefore escalates stock prices. This study did not consider money supply shocks, so it is credible to anticipate the lack of statistically significant positive relationship between money supply and stock prices.

Hypothesis 2 reported that money supply leads stock prices. The results of the hypothesis report that there is no causality between money supply and stock price. The reverse causality was also rejected. While literature generally stipulates that money supply leads stock prices (Sprinkel, 1971; Keran, 1971; Homa & Jaffe, 1971), the results of the tests are not far-fetched. Drawing from the dismissal of cointegration reported above, it follows subsequently that there should exist

statistically insignificant causality relationship. This study is further supported by Rangan & Modise (2013) who reported that macroeconomic and financial variables do not seem to contain much information in predicting South African stock returns. Further evidence provided by Hafer (1986) shows that unanticipated money supply stock changes holds high probability of affecting stock prices implicating causality relationship. Alatiqi & Fazel (2008) have reported that the absence of a causal relationship from money to stock prices may be partly due to uncertainty over whether interest rates will fall as result of an increase in money stock.

Conclusion

This study attempted to link money supply with stock prices. In general, literature supports the positive association between money supply and stock prices. The summation of the literature supports that money supply shock attributes strongly to stock price volatilities. The results of the study reveal that there exists statistically no positive relationship between money supply and stock prices. While the expectation was to see evidence in support of this relation, the extant literature explains better this relation in terms of the earlier mentioned positive shocks. For these reasons it is stipulated that further research should be carried out in this area, using varying methodological approaches such as quantile cointegration or the King & Watson (1997) methodology. This paper therefore supports the positive relationship between money supply and prices in terms of monetary shocks.

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