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CAUSAL RELATIONSHIP OF MONEY SUPPLY AND INFLATION: A STUDY OF BANGLADESH

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ABSTRACT

The major intendment of this study is to investigate the relation between money supply and inflation in Bangladesh using monthly data spanning from 2010.05 to 2017.12. By utilizing the cointegration and Vector Error Correction Modeling (VECM) techniques this study demonstrate that money supply does not affect the inflation in short-run and this is not true in vice-versa. In the long run, this study depicts a bi-directional causal relationship of money supply to inflation. Thus for short-run inflation in Bangladesh is not a financial incident somewhat it can boost the growth of the money supply but in the long-run inflation can significantly be influenced by the money supply. This study recommends that the monetary authority of Bangladesh can pursue the monetary policy considering the long run effect of the money supply.

Contribution/ Originality: This study contributes in the existing literature which has been able to verify that money supply is not a significant element that triggers up the price level in Bangladesh economy in the short-run, and this study also documents that in the long-run the effect of money supply is not neutral.

1. INTRODUCTION

In the economic history, Bangladesh economy has been facing severe price instability in various periods. Thus the price instability is one of the significant macroeconomic challenges for this economy. According to the fundamental concept of economics, inflation arises from the excess money supply and credits these leads to many economic problems. Excessive aggregate demand and pressure of production cost create demand pull and cost push inflation respectively (Amiri and Talbi, 2014; Kaouther and Besma, 2014). The inefficient system of production and disorganized allocation of goods and services are responsible for structural inflation. Although the percentage of inflation continuously varies over time, the overall economy has been affected by adversely or favorably. Policymakers try to control inflation within their limits. An empirical analysis is essential for monetary policy which specifies some course of action in defining the short-run and long-run connection of money supply to

inflation in Bangladesh. This study aims to investigate whether inflation in Bangladesh has been raised by monetary extension throughout May 2010 to December 2017 or money supply is related with the inflationary process.

This study is structuralized as follows. Segment 2 provides a short appraisal of the theoretical and empirical literature. Characteristics of data, model, and methods used in the econometric analysis represent in section 3. Section 4 shows the observed results and findings of the study. Finally, section 5 deals with conclusions that are found.

2. LITERATURE REVIEW

2.1. Theoretical Framework

The theoretical framework running by this study includes the monetarist view, Friedman's view, Keynesian view, and structuralist view.

2.1.1. Monetarist View

The monetarists focus on the function of money which is the grounds of demand-pull inflation. The quantity theory of money explores that inflation is nothing but the pecuniary incident which is emerged by the monetary expansion. The quantity theory of money recognizes that there prevails a one to one association between money supply and price level. The theory employs the familiar identity of Fisher's exchange equation.

Fisher's exchange equation demonstrates by the following equation.

$$MV=PY$$

Where, the M=Total dimensions of the money supply

V=Velocity of money

P=Price level

Y=True output level

By assuming that V and Y are exogenously determined, the price level varies with money supply proportionately, and the money supply doesn't affect the real output.

2.1.2. Friedman's View

Modern quantity theorists followed by Friedman said that "Inflation is forever and all over a monetary phenomenon that derives from fast growth in the amount of money than in total income.' He points out that change in the money supply will effort effectively throughout to be the main reasons for change in nominal income. He discusses output level will go first through monetary expansion if the nominal income of the public rises.

2.1.3. Keynsian View

The eminent economist John Maynard Keynes encountered the monetarist's view. Based on the short-term analysis he argues that the increase in aggregate demand boosts up demand-pull inflation. The main source of rapid inflation is the gap between aggregate demand and aggregate supply. According to Keynesian theory, prices are determined exogenously, or nonmonetary forces and output are to be variable which is resolute by the change in investment expenditure.

2.1.4. Structuralist View

The well-known economist's Myrdal and Straiten were generalized this theory as an explanation of inflation in the developing countries. They investigated that the existence of market imperfections and structural imbalances in some sectors of developing countries create the mismatch between demand and supply which raises inflation. As a result, fiscal and monetary actions can't solve this economic difficulty.

2.2. Review of Empirical Literature

Investigate the financial association among the monetary aggregates and inflation has constituted a significant concern in various economic literature all over the world. There we try to analyze some literature focusing on many economies in this regard.

By adopting cointegration and ECM approach on the annual time series of 1970 to 2016 a study of Amassoma et al. (2018) found no causality from money supply to inflation and vice versa in case of the Nigerian economy, and the researchers mentioned the recession as a possible reason of their result. Sasongko and Huruta (2018) used Granger causality model for the monthly data of 2007.01-2017.07 and found a unidirectional causality connection of money supply to the price level in Indonesia and the study recommended that the government should be cautious to control and managing the monetary policy as well as the fiscal policy.

Vtyurina and Alturki (2010) studied the short and long-term dynamism of and forecast inflation in Tajikistan. By utilizing ARMA and VECM, they originated that the overindulgence supply of broad money creates inflation in any period short or long. Blavy (2004) also developed an ECM to investigate the dynamics of inflation in Guinea covering the period 1992 to 2003. The paper brought into being the verification of the long-run connection of money supply to price level and also ensured that short-run dynamism has a long-run impact. Through analyzed the impulse response this study showed that any shock in the money stock could arise an escalating effect over two years and further stabilized a high rate. Likewise, Ghazali et al. (2009) used the Toda-Yamamoto causality test on the monthly data of 1974.01 to 2006.09 and found a uni-directional causality between monetary aggregates to the consumer price index.

Nguyen (2015) empirically estimated the impact of deficit financing and broad money (M2) contribution on inflation for the nine Asian economies by using pooled mean group (PMG) estimate and panel differ generalized method of moments (GMM) covering the period 1985 to 2015. The result indicated that M2 supply positively influence the inflation according to PMG estimation but both method support that fiscal deficit, public expense, and interest rate significantly determine the inflation rate for all nine economies. In the same vein, Diermeier and Goecke (2016) investigated the connection between money supply and inflation in various countries of the Euro Zone, despite the variation in time lag. By utilizing Granger causality and correlation analysis in VAR approach, they found disconnection between the growth of monetary aggregates and inflation, moreover, it turns a relatively new connection between the balance sheet size of the commercial bank and the inflation rate. By adopting Bayesian VAR approach based on the data from 1970 to 2006 another study about Euro Zone (Berger and Österholm, 2011) showed forecasting capacity of money supply growth for inflation considerably lower for the present period compare to the earlier 1970 or 1980s. In contrast to the above (Yousfat, 2015) inspected the relation of money supply growth to inflation in GCC countries by using annual time series of 1970to 2013. The result of the Johansen cointegration test of the study identified that long-run money supply growth had a momentous positive affiliation with the inflation rate.

Sabade (2014) checked the effectiveness of Fisher's exchange theory of money in the Indian economy. By analyzing the various monthly currency and inflation data covering the period 2010-2013, the paper postulated that inflation is not a result of the money supply. On the other side, the opposite effect found by Qayyum (2006); Mukhtar and Zakaria (2010) and Chaudhry et al. (2015) in the case of Pakistan economy. The investigation of the Qayyum (2006) revealed that excess growth of money supply has a noteworthy involvement in raising the price level and recommended a tight monetary policy for Pakistan. The studies of Mukhtar and Zakaria (2010) also confirmed the causal connection between money supply to inflation but not the budget deficit in Pakistan economy. By using the ARDL technique on the historical data of 1973 to 2013 (Chaudhry et al., 2015) originated that money supply is the prime reason for the inflation of Pakistan.

Ndungu and Durevall (1998) analyzed the behavior of price level for the period of 1974 to 1996 in Kenya and developed an error correction model in this purpose. They instituted that money supply and interest rate are the

short-run incidents of inflation where exchange rate, overseas price, and requisites of trade influenced inflation in the long-run. This study concluded that exchange rate is more proficient nominal anchor than the money supply. On the other hand, Kiganda (2014) found a significant positive connection between money supply and inflation in Kenya by using VECM approach, and Granger causality over the annual data of 1984 to 2012 and the paper suggested to pursue a tight monetary policy to control the persistent inflation of Kenya. Atrkar (2014) used cointegration and causality technique over the seasonal data of 1980-2010 in Iran and found the indication of the bidirectional relation between money supply and inflation. The above result also followed up by Mehrara and Sujoudi (2015) in the Iranian Economy. By using Bayesian econometric approach over the period 1959 to 2010, the study revealed that growth of monetary variables and energy prices should be declined to control the inflationary pressure in Iran.

By using OLS and error correction modeling techniques, Mbongo et al. (2014) found that money supply and exchange rate have a substantial collision on inflation of Tanzania. Through the VAR approach, they also mentioned that present inflation could be a significant cause for future inflation. Similarly, in Malawi, Simwaka et al. (2012) used the various econometric technique on the monthly data of 1995.01 to 2011.03 evaluated that growth of monetary aggregate drives the price level with lags of three or six months. The result of their study further buttressed that exchange rate adjustment plays a comparatively more vital role to boost up the cost-push inflation.

A small number of studies carried out to find out the affiliation between money supply and price level in case of Bangladesh and found various results which depend on the time, data frequency and the mechanism of the research. Much earlier, for instance, the study of Parikh and Starmer (1988) found a momentous unidirectional causality of prices to money for Bangladesh by using Granger causality on monthly data from 1973 to 1986. The study recommended that strict exogeneity of the money supply could not be accepted in Bangladesh. Almost in the similar time, another study carried out by Jones and Sattar (1988) used Wiener-Granger causality on the monthly data of 1974 to 1985 and found that money cause to price in Bangladesh for the short-run but not in the long term. Moreover, they found that money can enhance the growth of the output in the long run. By using Granger causality test Kamal (2016) also found a unidirectional causality of money supply to price level covering the period 1972 to 2013 where money supply granger causes the price level but not true vice-versa. Another study of Hossain (2011) also revealed the previous results by using Granger causality and ECM over the period 1975 to 2008, that a unidirectional causality exists broad money to inflation in Bangladesh in any period short or long.

Taslim (1982) analyzed the inflation process of Bangladesh and found that neither it followed the 'structuralist' view nor the 'monetarist' view. This result is in line with Chaudhry et al. (2015). By using the VAR approach on the quarterly data from 1974 to 1992, they found no clear-cut causal relation of money supply to inflation in the case of Bangladesh. Another research of Murshed et al. (2018) also found no causality between money supply to inflation either in the short-run or long-run in Bangladesh by using Granger causality and VECM approach on the annual data of 1980 to 2014. But the study found a short-run unidirectional causality from budget deficit to inflation.

However, the above analysis depicts that the affiliation of money supply and inflation is mixed. This study is an upgrading ended the presented literature as it investigates the short-run dynamism and long-run connection of money supply (broad and narrow) and inflation covering the monthly data of 2010.05 to 2017.12 in Bangladesh.

3. DATA AND METHODOLOGY

This study explores the causal correlation of narrow and broad money with inflation in Bangladesh. This quantitative research uses the monthly data of 2010.05 to 2017.12. The data are collected from Bangladesh Bank monthly economic trend. The secondary data titled consumer price index (CPI), narrow money (M1) and broad money (M2) are used to investigate the dynamics of inflation.

3.1. Model Formulation

In this study, the primary assumption is the consumer price index is the dependent variable, and narrow money and broad money are explanatory variables. The model can be expressed as:

$$CPI_t = f(M1, M2) \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(1)}$$

Where, CPI= Consumer price index, M1= narrow money and M2= broad money

In regression form the model can be written as:

$$CPI_t = \beta_0 + \beta_1 M1_t + \beta_2 M2_t + \varepsilon_t \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(2)}$$

Log model provides suitable coefficients of the elasticity for the dependent variable adjacent to explanatory variables. Moreover, for smoothing the data, we transformed the variable into logarithms. Therefore, equation (2) is transformed into:

$$LnCPI_t = \beta_0 + \beta_1 LnM1_t + \beta_2 LnM2_t + \varepsilon_t \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(3)}$$

Ln shows the natural log. Thus, LnCPI indicates natural log of CPI, LnM1 denotes natural log of M1 and LnM2 represents the natural log of M2. Here β represent the coefficients of the model, t denotes the time, and ε is the error term.

3.2. Methodology

This study implies the unit root test of ADF and PP, cointegration test, and vector error correction model to carry out the study purpose.

3.2.1. Unit Root Test

With the intention of checking the presence of the unit root, this study applies the Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979). The lag of the variable is included in this test under the assumption of the correlated error term. The model is expressed as:

$$\Delta LnCPI_t = \alpha_1 + \alpha_2 t + \delta LnCPI_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta LnCPI_{t-1} + \varepsilon_t \quad \dots\dots\dots\dots\dots\dots \text{(4)}$$

Where $\Delta LnCPI_{t-1} = (LnCPI_{t-1} - LnCPI_{t-2})$ t is a time trend, the number of lag of dependent variable is p and

ε_t is the error term.

The results of ADF further justified by Phillips and Perron (1988) test.

The hypothesis for the unit root test is

H_0= variables are non-stationary

H_1: variables are stationary

3.2.2. Cointegration Test

In this study, all the variables are integrated on the first difference which supporting the existence of cointegration among the variables. For investigating long-run cointegration, we relied on the Johansen-Juselius technique. Trace statistic and Maximum-Eigenvalue are the two known procedure to identify the vectors of the co-integrating. The hypotheses for trace statistics are-

H_0: At most r co-integrating vectors

H_1: r or more than r co-integrating vectors

The Trace statistic is given by-

$$\lambda_{trace} = -T \sum_{i=r+1}^{k} \ln(1 - \lambda_I) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Here λ_I is I^{th} number eigenvalue, and k is the number of separate series to be analyzed.

The hypotheses for Max-Eigen value statistics are-

H_0: Exactly **r** co-integrating vectors

H_1: more than r co-integrating vectors

And the Max-eigenvalue statistic is

$$\lambda_{max} = -T \ln(1 - \lambda_{r+1}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Here λ_{r+1} is the $(r+1)^{th}$ largest squared eigenvalue, and T is the sample size.

3.2.3. Vector Error Correction Model (VECM)

After finding long-run cointegration from Johansen cointegration test, it is permitted to run VECM. We applied VECM to find out the long-run and short-run causality among the variables included in this study. For policy implication, it is cooperative to scrutinize the causal direction of the time series. The equations used on VECM are:

$$\Delta LCPI_t = \alpha_1 + \sum_{i=1}^{k} \lambda_{1i} \Delta LCPI_{t-i} + \sum_{i=1}^{k} \delta_{1i} \Delta LM1_{t-i} + \sum_{i=1}^{k} \partial_{1i} \Delta LM2_{t-i} + \gamma_1 \varepsilon_{t-i} + \upsilon_{1t} \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$\Delta LM1_t = \alpha_2 + \sum_{i=1}^{k} \lambda_{2i} \Delta LM1_{t-i} + \sum_{i=1}^{k} \delta_{2i} \Delta LCPI_{t-i} + \sum_{i=1}^{k} \partial_{2i} \Delta LM2_{t-i} + \gamma_2 \varepsilon_{t-i} + \upsilon_{2t} \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

$$\Delta LM2_t = \alpha_3 + \sum_{i=1}^{k} \lambda_{3i} \Delta LM2_{t-i} + \sum_{i=1}^{k} \delta_{3i} \Delta LCPI_{t-i} + \sum_{i=1}^{k} \partial_{3i} \Delta LM1_{t-i} + \gamma_3 \varepsilon_{t-i} + \upsilon_{3t} \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where ε_{t-i} indicates to the error adjustment term which resulting from long-run cointegrating associations and represents the speed of adjustment towards long-run equilibrium.

4. EMPIRICAL RESULTS AND FINDING

4.1. Result of Stationary Test

To finding the order of integration of the time series, this paper had been applied ADF and PP tests. The fallout of the tests are depicted in Table 1.

Table-1. Test for Stationary

Variables	Test	At level	1st difference	Decision
LCPI	ADF	-3.329033 (0.0687)	-6.073638 (0.0000)	I (1)
	PP	-1.906920 (0.3278)	-5.708973 (0.0000)	
LM1	ADF	-2.528420 (0.3141)	-5.926234 (0.0000)	I (1)
	PP	-0.342623 (0.9132)	-15.80292 (0.0001)	
LM2	ADF	-1.795046 (0.6990)	-5.619976 (0.0001)	I (1)
	PP	-3.615820 (0.07209)	-13.17245 (0.0001)	

Source: Author's Calculation by using eviews 8.
Note: p-values are in ( )

The outcomes of unit root tests confirm that all the variables do not show the characteristics of stationary time series at the level as the p-values are higher than the 5% level of significance. Furthermore, the first-differenced unit

root test was applied, and the results show all the variables show the characteristics of stationary time series at first difference as the probability value is less than the level of significance (5%).

4.2. Lag Order Choice

To applying the cointegration test and develop the VECM lag order choosing is necessary.

Table-2. Lag Order Choice Benchmark

Lag	LogL	LR	FPE	AIC	SC	HQ
0	358.6210	NA	6.20e-08	-8.082296	-7.997841	-8.048271
1	839.9829	918.9636	1.35e-12	-18.81779	-18.47997	-18.68169
2	885.2637	83.3578*	5.92e-13*	-19.6423*	-19.0511*	-19.4041*
3	888.3698	5.506370	6.78e-13	-19.50841	-18.66386	-19.16816
4	891.2722	4.947116	7.82e-13	-19.36982	-18.27191	-18.92750

Source: Author's Calculation by using eviews 8.

Before Johansen cointegration test we select the perfect number of lag by Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ) lag length selection criteria. The appropriate lag for the study is two which is presented in Table 2.

4.3. Result of Johansen's Test for Cointegration

According to the result of stationary tests, all the variables LCPI, LM1, and LM2 are stationary at first difference in both ADF and PP method. That implies the variables are I(1) or integrated into order 1. As all series of this study are I(1), we proceed for Johansen cointegration test.

Table-3. Result of Johansen Cointegration Test

Hypothesized No. of CE(s)	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value
None*(r=0)	64.31378	29.79707	42.74343	21.13162
At most 1*(r≤1)	21.57034	15.49471	20.97410	14.26460
At most 2 (r≤2)	0.596239	3.841466	0.596239	3.841466

Source: Author's Calculation by using eviews 8.

Table 3 represents that there exist two co-integrating vectors in the Trace and Max-Eigen statistic. Because the Trace and Max-Eigen statistics values are more abundant than their critical values at 5% significance level (at the most one no. of cointegrating equations). That postulates that there exists long-run cointegration among narrow money, broad money and inflation.

4.4. Result of VECM

Table 4 presented the coefficient of amendment speed to long-run stability. The coefficient of ECT must be negative and momentous to shows the long-run relationship. The coefficient of ECT of the model, where the dependent variable is LCPI, is -0.319 which is negative and noteworthy at 5% level. This result portrayed that the long run causality from LM1 and LM2 to LCPI.

Table-4. Long run causality checking under VECM

Dependent Variable	ECT(coefficient)	Probability
D(LCPI)	-0.319049	0.0000
D(LM1)	-1.243235	0.0010
D(LM2)	-0.393865	0.0000

Source: Author's Calculation by using eviews 8.

The table further depicted long run casual relation from LM2 and LCPI to LM1. Because the coefficient of ECT in the model, when the dependent variable is LM1, is -1.24 which is negative and noteworthy too at 5% level.

The results also indicate that there present significant long-run causality of LCPI and LM1 to LM2. As the coefficient of ECT in the model, when the dependent variable is LM2, is -0.393 which is negative and the p-value is lower than 5% level. These clarify bidirectional long-run causality among CPI, M1, and M2. These findings are in line with the result of Kamal (2016).

Table-5. VEC Granger Causality/Block Exogeneity Wald Tests

		Chi-square (Wald test statistic)	P value
D(LM1) ⟶	D(LCPI)	0.264382	0.8762
D(LM2) ⟶	D(LCPI)	1.255417	0.5338
D(CPI) ⟶	D(LM1)	19.21100	0.0001**
D(CPI) ⟶	D(LM2)	25.25882	0.0000**

Source: Author's Calculation by using eviews 8.
Note: ** denotes momentous at 5% level.

To show the short-run causality under VECM, we applied block Exogeneity Wald tests. The outcomes of Wald tests are shown in Table 5. The fallouts illustrated that inflation causes narrow money and broad money in the short run. Narrow and broad money doesn't cause inflation, as the Wald test statistic 0.264 (in case of narrow money) and 1.255 (in fact of broad money) are insignificant at 5% significance level. Thus, in short, we cannot accept our previous assumption mention in the earlier section that inflation is a function of narrow and broad money. However, the statistic value in case of inflation causes M1 and M2 are significant at the 5% significance level. That suggests, there exist one-way causality consecutively from inflation to M1 and M2. Thus inflation has a reaction upshot on money supply and which stimulate self-sustaining inflation.

Table-6. Overall Long and Short Term Causality in the VECM Outline

	CPI ⟶ M1	M1 ⟶ CPI	CPI ⟶ M2	M2 ⟶ CPI
Long run	Yes	Yes	Yes	Yes
Short run	Yes	No	Yes	No

The causality framework obtained from VECM for both long-run and short-run are presented in Table 6. Table 6 advocates that there is bidirectional causality among CPI, M1, and M2 in the long run. But, in short- run, unidirectional causality follows from inflation to M1 and M2. Therefore Bangladesh economy does not support the 'monetarist' view of inflation. This result supports the previous study of Taslim (1982) and Chowdhury *et al.* (1995).

5. CONCLUSION

The study wishes to examine the association of money supply to inflation. Furthermore, it aims to find out the causality direction of the variables. In the study, all the time series are integrated in order (1), and there exist long-run cointegration among the variables that are revealed by the Johansen cointegration test. The study establishes that there present bidirectional causality of narrow and broad money to inflation in the long run. Besides, the unidirectional causal relation is originated from inflation to narrow and broad money for the short term. These findings imply that the money supply does not affect the price level in the short run, but in the long run money supply stimulates the inflation. Then the monetary policy of Bangladesh is not worked as an influential variable to control the inflation rate in the short run. So it is recommended that monetary authority can consider the long-run consequence of money supply to institute the monetary policy.

The study includes only narrow and broad money as the impetuses of inflation. Others determinants of the inflation are excluded due to unavailability of monthly data. Further studies may be carried out by including more

variables and more time-frequency of the data set to show more precise outcomes of the money supply on inflation in Bangladesh.

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