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Monetary Policy and Bank Lending: The Case of Bangladesh

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Abstract

This paper investigates the monetary policy shock to the private sector credit in Bangladesh during the period 2004-2013. After checking and correcting for data stationarity, the paper applies vector error correction model (VECM) and Johansen co-integration test to identify the long-term and short-term dynamic relationship between monetary policy and private sector credit. Results show that quarterly monetary policy shocks have a significant long-term impact on private sector credit. Moreover, all the variables such as credit to private sector, broad money (M2), interest rate, and credit to government jointly at their four respective lags affect private sector credit whereas interest rate and credit to government sector at their all individual lags, except lag 3 for credit to government, significantly influence private sector credit. The impulse response shows one-year time lag for monetary policy to have its effect on the economy.

Keywords: Bank Lending, Interest Rate, Money Supply, Crowding Out, Bangladesh

JEL Classification: E42, E52, E58

Paper Classification: Research Paper

Introduction

Monetary policy has multifaceted roles to play in an economy. During the time of economic depression, credit expansion through lowering interest rate can be warranted to stimulate private spending and investment whereas the reversal is essential to tame a possible bubble during the period of economic boom. Lack of timely monetary policy actions may result in destabilizing the economic and financial systems. Recent worldwide financial meltdown is believed to be triggered by huge influx of money resulting from expansionary monetary policy. Stiglitz (2012) argues that the subprime mortgage crisis was not inevitable; but monetary and regulatory authority led the economy to the crisis. Similarly, Posner (2009) contends that Fed intervened too much to keep the interest rate low even at a time when it came to know that a bubble was forming. Subsequently, Fed decided to raise the interest rate but it was too late to counteract the house-buying frenzy and excessive mortgage lending.

The current crisis is not an exception. History is replete with examples that show that most waves of financial crisis followed a wave of credit bubble (Kindleberger, 1996; Reinhart & Rogoff, 2009). In pursuit of explaining the great depression of 1929, Fisher (1933) forwarded a theory popularly known as 'debt-deflation theory of great depressions'. Fisher argues that in a general state of economy, equilibrium is disturbed if there is a huge influx of money which makes some sectors over indebted. Fisher`s approach was further elaborated by Minsky (1976, 2016) who introduces the concept of `fragility` in an attempt to clarify the problem of over use of debt during economic upswing. Minsky believes that financial fragility is systemic which starts initially with the spurt of one or more displacements including changes in interest rate. This initial displacement inflates price of some assets (real or financial) which in turn, leads to a possible bubble. Kindleberger (1996) sketches a comprehensive historical analysis of financial crisis and shows that there have been four significant waves of financial crisis since the early 1970s (Latin America in the early 1980s, Japan in the 1990s, Asian Financial Crisis in 1997; and the subprime meltdown in 2006-7). He shows that all these crisis were preceded by a rapid growth of loans from major international banks to government and government owned enterprises.

Moreover, monetary policy actions are required to recover an economy from its ailing stage. Researchers argue that any solution to counteract economic bubble or to neutralize an adverse effect in the post-bubble period should accompany the changes in monetary policy (Boivin et al., 2010; Mishkin, 2011). Thus, it is essential to know when to introduce contractionary and its counterpart, expansionary monetary policies as well as the transmission mechanism with which the policy actions can be communicated to the economy effectively. This is what makes monetary policy not only a dynamic policy tool but also a complex one (Bernanke, 1988).

While the impact of monetary policy on economic activities is well documented in the context of developed countries, debate on this issue, however, has not advanced well as far as developing economies are concerned. Page (2013) argues that the effect of government failure to adhere to a balanced monetary policy is more serious in developing countries because of the complexities of financial system through which the policy is implemented. Monetary policy in those economies focuses on how to implement the policy itself instead of considering the interplay between macroeconomic changes and financial sector sensitivity (Page, 2013). This statement echoes with the recent devastation of financial sector in Bangladesh. Dhaka Stock Exchange (DSE), the primary bourse of the country, experienced a historic crash in December 2010. General index of the bourse rose to 8,919 points at its peak but to sustain only for a few months. The index plummeted to 3,800 points in February 2011, a decline of more than 57 percent.

Economists and financial analysts have listed several proximate causes of the crash. Monetary policy has occupied the center of debate because the central banks raised the Cash Reserve Ratio (CRR) just a week prior to the crash. This policy move reduced the money supply in the economy. Financial institutions including banks, which were allowed to invest in capital market instruments, sold these instruments en masse to meet the new CRR requirement. It was thus, argued that the crisis was primarily triggered by the change of CRR. Amidst a huge public outcry, the central bank quickly counteracted by purchasing the Reverse Repo (a short term financial instrument) aiming to increase the short-term money supply in the market but with no effect. By the time the capital market rebounded to stability, the crisis has encrypted its scary marks on small and short-term investors who lost their faith not only on the financial market but also on regulators.

Although this situation urges researchers to focus more on the timing and transmission mechanism of monetary policy, the issue has not received adequate attention from the

contemporary scholarships in the context of Bangladesh. Very few studies can be recognized which have attempted to focus on monetary policy tools from various perspectives. For instance, (Nguyen et al., 2012) investigated the effect of monetary policy on inflation, and output growth. This study showed that inflation converges to long-run threshold faster if the prevailing inflation is above the threshold than if it is below the threshold. In contrast, Bhuiyan (2011) found that the inflation rate responds to monetary shock with a lag of more than one year and output responds with a lag of over half a year. Ahmed & Islam (2004) examined the effect of monetary policy on aggregate output and prices transmitted through bank lending and exchange rate channels. They, however, found evidence in favor of weak existence of bank lending and exchange rate channels of monetary policy. In contrast, Younus (2004) showed that monetary base, as a proxy of monetary policy, does not significantly affect deposits and credit. This finding implies the absence of money channel or credit channel in Bangladesh. She attributes the reason to the excess liquidity in the banking system. This may be true in the context of time the study has covered (1975-2000). At that time credit demand was mostly inelastic to the change in interest rate or money supply mainly due to directive policy lending mechanized through the nationalized commercial banks. This has paved the way for developing a default culture in Bangladesh (Younus also reports a substantial accumulation of non-performing loans in the banking system at that time). These features are no longer relevant. Competition in the banking sector has increased tremendously which can be attributed to the rise in the number of private banks (Miah & Sharmeen, 2015). Thanks to the increased competition, banks are now more vigilant than ever before in screening and monitoring their clients who are also sensitive to interest rate. In addition, excess liquidity argument mentioned in Younus (2004) is no longer a reality. Rather, higher call money rate reflects liquidity constraint in the banking system.

The above discussion implies that there still remains a research gap on the question as to how monetary policy affects private sector credit in Bangladesh. The current study is an attempt to fill this gap. It analyzes the relationship between monetary policy and private sector lending applying vector error correction model. The findings of the study can be useful for strategizing monetary policy of the country.

Monetary Policy Transmission Mechanisms

Monetary policy is one of the crucial tools which affect economic activities through its various transmission mechanisms. For instance, the traditional Keynesian view states that investment decision critically depends on the interaction between interest rate and marginal efficiency of capital. A lower rate of interest tends to tap borrowers towards investment so long as the prospective return on the investment remains unchanged. In contrast, a contractionary monetary policy leads to the rise of real interest rate which in turn, raises the cost of capital, causing a decline in investment which results in the fall of output and employment (Keynes, 1936; Mishkin, 1995). This view of monetary policy holds that money is exogenous and any change in reserves is accompanied by the corresponding change in supply of available money in the economy.

This conventional model which is also known as 'money version' of the monetary system considers financial system a market for money in which public's demand for money interacts with the supply of money (Belongia & Ireland, 2015; Bernanke, 1988). Since the central bank controls the supply of money, it reserves in theory, the capacity to set the interest rate. The level of market interest rate in turn, determines how much households and business decide to spend on new goods and service. People are considered in this model as having the following choices: how much of their portfolio to devote to money, with which they can make purchases, and how much to

devote to the other, less liquid assets, which presumably offer a higher yield (Bernanke, 1988). The higher the volume of expenditure people intend to make the greater is their demand for money. The higher the interest rates on alternative financial assets the less money they demand (Minsky, 1975). On the other side of the model, banks supply the money to those who need it and they do so in two ways: by making loans and by buying marketable securities. When a bank makes loan, it gives deposit it collects to creditworthy borrowers. Also, banks can go to the financial markets and buy treasury bills or other types of securities. In this model, banks are considered merely financial intermediaries that collect deposits and convert these deposits into credits. Thus, they have a special role to play in transmitting money by changing the liability side keeping the asset side unchanged (Kashyap & Stein, 1994).

Financial market is settled at a certain level of interest rate that equates the demand for money to its supply. If banks can create more deposit than the public wants to hold at current interest rate they can clear the excess supply either by selling more credit to the public or if banks prefer to hold more money-market securities, they can offer more prices for securities resulting in slicing the yield. In either way, banks' tendency to clear the excess supply of money creates a downward pressure on interest rate. Conversely, if banks can mobilize less deposit than the demand for credit, a rise in interest rate will clear the excess demand for funds. Also, money market securities which banks hold in their portfolio can be sold at lower price bidding up the yields on these instruments. Now, if the central bank wants to decrease the supply of money, it can decrease the reserves of commercial banks. This decline in reserves reduces banks capacity to provide credit to business and households. Since other macroeconomic variables remain unchanged, the credit constraint tends to bid up the market clearing interest rate. Financial market responds quickly to this change in money reserves whereas the market for goods and services adjusts only gradually (Bernanke, 1988). Ultimately, the higher interest rate depresses the spending. Consumers adjust their spending on durable goods including houses, cars and other such goods. This in turn, leads an economy to the contractionary mode. The reverse cycle is applied if the central bank wants to increase the spending.

In contrast to this traditional money view, the recent focus of monetary policy has shifted to another transmission mechanism known as the 'credit view' which works through the asset side of banks' balance sheet. In this view, monetary policy directly constrains banks' ability to disburse credit (Ciccarelli et al., 2015; Jiménez et al., 2012; Kashyap & Stein, 1995; Romer et al., 1990). The basic tenet of the credit view is to change the amount of lending of banks with effect through exogenous changes in external finance premium (Morris & Sellon, 1995). Premium is the difference between the cost of funds raised externally and the cost of funds collected internally. Premium is considered the result of friction prevailed in the market which can be attributed to asymmetry of information and transaction cost. The cost of obtaining information about a firm's condition as well as liquidation and bankruptcy cost are different for different firms which the market cannot easily estimate without establishing a long-term relation. This problem is more acute for small firms than the large firms because small firms have not yet been able to prove their creditworthiness like their large counterparts. Moreover, banks possess comparative advantage over other intermediaries in collecting and processing information as well as monitoring clients which facilitates them to make loan to smaller firms at a comparatively cheaper rate than the market. In this scenario, a change in loan supply tends to affect small firms because of their limited capacity to substitute bank loans with market securities. Consequently, changes in monetary policy that raise or lower the open market interest tend to change the external finance premium in the same directions. Bernanke & Gertler (1995) have identified two channels of credit system

transmission mechanism, the first is the balance sheet channel and the second is the bank lending channel.

The balance sheet channel emphasizes on the changes in borrower's balance sheet due to change in monetary policy. For instance, a tight monetary policy directly weakens borrower's balance sheet by increasing the commitment of cash flow to service the floating rate or short-term debt. An increase in cash outflow adversely affects firms' financial position. Moreover, higher interest rate will decrease the value of some marketable securities shown in the firm's balance sheet. The combined effect will be negative on firms' net worth. A decline in net worth means that borrowers have less available collateral to offer against a loan. For lenders, it increases the probability of adverse selection. In this circumstance, banks are likely to enforce tighter lending strategy which may lead to credit rationing (Stiglitz & Weiss, 1981).

Bernanke and Gertler (1995) moreover, show an indirect effect of monetary policy on banks' balance sheet. They argue that a tighter monetary policy can reduce the spending of customer on which a certain firm is based. This, in turn, leads to the decline of that firm's revenue. Assuming that the firm's fixed or quasi fixed cost cannot be adjusted in the short run, the declining revenue will be accompanied by an increase in financing gap which may result in erosion of firm's net worth and credit worthiness.

Besides the balance sheet channel, monetary policy can affect the premium of external financing by shifting the supply of banks credit. Consistent with the information asymmetry argument, some firms cannot switch lenders easily. Thus, an increase in supply of banks credit can effectively reduce the rate of external finance premium. It also enhances credit flow in the economy, and vice versa. Contrasting to the traditional money view model which transmits the effect of monetary policy by changing the composition of liability, particularly deposit, the credit channel works through the composition of banks' assets. A critical condition required for credit channel to function effectively is that banks cannot substitute the decline in deposit with money market securities or new equity issue.

Among all these available channels for monetary transmission, it cannot be generalized which transmission mechanism works better. Each system has its own friends and foes. Although there are two channels identified in the credit view, Bernanke and Gertler (1995) note "it is extremely difficult to carry out an empirical test that would conclusively separate the bank lending channel from the balance sheet channel". This leaves us practically two views- money and credit- to consider. Credit view to be effective requires certain conditions to be fulfilled. Financial market should be featured with various frictions so that borrowers cannot switch from banking system to alternative lenders. Or in other words, intermediated loans and open market bonds must not be perfect substitutes for borrowers. Similarly, lenders should not be able to replenish the shortage of reserves by borrowing from less reserve-intensive form of finance. Putting them in the context of developing countries like Bangladesh, it seems that credit channel should function comparatively better because asymmetry of information is pronounced along with high transaction cost. Majority of firms are small in size and depend largely on bank loan as external source of finance. Furthermore, substitution effect for lenders is not substantial because of underdeveloped bond markets. Bernanke and Gertler (1995) further state that credit channel as transmission mechanism is more functional in the presence of asymmetry of information and higher cost of contracting. In contrast, Romer et al. (1990) conclude that the traditional money view seems to have superior transmission power over more recent theories that emphasize on banks' lending activities. This provides with the evidence that the effectiveness of transmission mechanism is inconclusive which requires trial and error methods of experiment.

Data and Methodology

Data description

There is also a heated debate as to what actually represents the monetary policy shock. Perhaps, it is more logical to paraphrase the question: what monetary policy instrument better indicates policy tool? Scholars are of the view that the short term interest rate is a good indicator of monetary policy actions (Bernanke & Blinder, 1992; Estrella & Mishkin, 1997; Goodfriend & McCallum, 2007; Taylor, 1999). The logic in favor of this argument is that short term interest rate is unlikely to be biased by endogenous responses to the prevailing economic conditions (Bernanke and Blinder, 1992). In addition, central banks mostly prefer interest rate policy because the demand for currency and bank reserves can be met by open market operations (Goodfriend and McCallum, 2007). Evidence is also available which supports the effectiveness of monetary aggregate as policy instrument (Friedman & Schwartz, 1963; Nelson, 2003). The argument focusing on monetary aggregates notes that money supply contains important information which affects output and price. In line with this logic, we apply both short-term interest rate (I) and broad money supply (M2) as monetary policy shocks. M2 includes M1 (cash and checking deposits) and 'near money' which is mainly composed of savings deposits, money market securities, and other time deposits.

On the other side of the equation, the credit to private sector is considered a proxy for response to policy shocks. Our choice in this regard is constrained by the fact that the premium of external financing is hard to obtain due to underdeveloped market for certificate of deposits in Bangladesh. Moreover, high frequency data of bank balance sheet are not available because reporting is done in historical cost rather than market value. We have added one more variable, public sector borrowing from the local banking system, to check if there exist a 'crowding out' effect in the economy. Crowding out happens if government borrowing from the local banking sector displaces private borrowers and thereby, investment. Governments in developing countries are constrained by their capacity to collect revenues because of low level of income. Sometimes they borrow heavily from the local financial system to balance the deficit budget which is a long-standing tradition of Bangladesh. As a result, including this variable will provide us crucial information regarding the effect of public borrowing on private credit. Data for credit to private sector, credit to government, and money supply (M2) are collected from Monthly Economic Trends published by Bangladesh Bank (the central bank of Bangladesh) whereas data for interest rate has been collected from Major Economic Indicators also published by Bangladesh Bank. Quarterly data of these variables range from the second quarter of 2004 to the first quarter of 2013. The reasons of selecting 2004 as threshold year for our analysis are driven to two policy events: first, the introduction of managed floating exchange rate system; and second, the introduction of market-based monetary policy instruments.

Test of Stationarity

In time series analysis, it is an essential condition that the underlying time series needs to be stationary. A data series is termed to be stationary if the mean, variance and auto-covariance at different lags remain the same and do not vary with the time. If the time series is non-stationary, it might yield spurious result. If so, inference drawn based on the result may be inaccurate. Moreover, if one variable of a time series regression is non-stationary, the result of the regression will be spurious in spite of all other variables being stationary. In this sense, it is crucial to check the stationarity of time series data and if necessary, corrective measure should be adopted to make

data stationary. We apply Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test to examine the stationarity of data. The standard ADF can be expressed in the following regression -

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \epsilon_t \ldots\ldots\ldots\ldots(1)$$

Where ϵ_τ is a white noise error and $\Delta Y_{\tau-1} = (Y_{\tau-1} - Y_{\tau-2}$, $\Delta Y_{\tau-2} = Y_{\tau-2} - Y_{t-3}$ etc. The number of lagged difference terms can be determined empirically. Care should be taken that enough lagged terms are included so that the error term in (1) is serially uncorrelated. In the above ADF it would be tested whether $\delta = 0$ using the tau (τ) value.

The ADF test is based on a critical assumption that the residuals are statistically independent with constant variance. This assumption is relaxed in the PP test and the residuals are allowed to be weakly dependent with heterogeneous variance. The following model is applied with a constant and a time trend in order to conduct the PP test-

$$r_{it} = \theta_{i0} + \theta_{i1}\left(t - \frac{T}{2}\right) + \theta_{i2} r_{t-1} + \varsigma_{it} \ldots\ldots\ldots\ldots(2)$$

with a test statistic Z ($\theta i2$) for the null hypothesis $\theta_{i2}=1$. The lag selection in the PP test is performed automatically by Newey and West Bandwith using Barlett Kernal Spectral estimation method.

Test of cointegration and Granger causality

Data tested and corrected for stationarity is then analyzed to check the co-integration between and among variables. In this case, we apply Johansen co-integration test and vector error correction model (VECM). The cointegration theory posits that cointegration relationship may exist between the variables involved if they are integrated in the same order. Johansen and Juselius developed the Johansen co-integration test based on Vector Auto Regression (VAR). The Johansen multivariate co-integration test involves testing the association between the variables following the vector auto-regression (VAR) model:

$$\Delta \ln Y = \sum_{i=1}^{P} \Gamma_i \Delta \ln Y_{t-1} + \Pi \ln Y_{t-1} + BX_t + \epsilon \ldots\ldots\ldots (3)$$

Where $\Gamma_i = -\sum_{i=1}^{P} A_j$ and $\Pi = \sum_{i=1}^{P} A_j - I_m$. Y_t represents n*1 vector of I (1) variables. Γ and Π express n*n matrix of coefficients. The letter 'B' indicates n*h matrix and X_t symbolizes h*1 vector of I (0) variables. On the other hand, Π examines the long-run relationships in the variable and represents the rank of the matrix and is also equal to the number of independent co-integrating vectors. If rank of Π is 0, the variables in the equation are non-cointegrated. Two test statistics are developed by Johansen. One is the trace test and the other is the maximum eigen-value test. The null hypothesis of r=0 (no cointegration) against an alternative hypothesis of r > 0 (cointegration) is tested by λ_{trace} statistic. On the other hand, the task of the K_{max} is to test the null hypothesis that the number of cointegrating vectors is r against the specific alternative of r+1 cointegrating vectors. The test statistic values generated from λ_{trace} statistic and K_{max} test are compared against the asymptotic critical values of the two test statistics developed by Johansen and Juselius.

If cointegration is found between series, a long-term equilibrium relationship exists between them. If there is no cointegration between variables undertaken, there is no need for VECM. Granger causality test is directly used to test causal links between the variables.

$$\Delta Y_t = \alpha_1 + p_1 e_1 + \sum_{i=0}^{n} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{n} \delta_i \Delta X_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta Z_{t-i} \ldots\ldots\ldots\ldots (4)$$

$$\Delta X_t = \alpha_{12} + p_2 e_{i-1} + \sum_{i=0}^{n} \beta_i Y_{t-i} + \sum_{i=0}^{n} \delta_i \Delta X_{t-i} + \sum_{i=0}^{n} \gamma_i Z_{t-i} \ldots\ldots\ldots\ldots (5)$$

The co-integration rank demonstrates the number of co-integrating vectors in VECM. For example, if there is a rank of two, it indicates that two linearly independent combinations of the non-stationary variables are stationary. If the coefficient of the error correction term is found to be negative and significant, it indicates that a stable long run relationship between the variables is stimulated by any fluctuations between the independent variables and dependent variable. Selecting the lag length of an autoregressive process like VAR, VECM and Co-integration test is an empirical question. In this paper, we have applied some lag length selection criteria such as Hannan and Quinn information criterion (HQIC), likelihood-ratio test statistics (LR), Akaike's information criterion (AIC) and Schwarz's Bayesian information criterion (SBIC) to estimate the optimal lag length for the models used in this paper. The default maximum number of lags for the quarterly variables has been given considering the number of observations.

Results and Discussion

The Augmented Dickey-Fuller test has a null hypothesis that a data series follows a unit root process against an alternative hypothesis that the data series is stationary. The ADF test provides critical values at 1, 5, and 10 percent level and a test statistic. The absolute value of the test statistic must be smaller than all the absolute critical values at different levels with a significant Mackinnon approximate p-value for z (t) to confirm the null hypothesis. If the aforementioned guideline of the ADF test is violated, the alternative hypothesis will be accepted, or the data series will be termed as stationary. The lag length for the ADF test has been selected based on Schwarz information criterion.

Table 1 presents the result of the ADF test of the quarterly level and first differenced data. It is evident from the result that none of the variables are stationary even at 10 percent level of significance. However, all the variables are stationary at their first difference according to the ADF test. The PP test is a nonparametric test to test the stationarity of a time series having the null of unit root and the alternative of stationarity. It is evident from the results shown in Table 2 that none of the quarterly variables are stationary at the level as the absolute test statistic values for all the variables are less than their respective absolute critical values at all levels. However, the first difference of quarterly data rejects the null hypothesis that there is a unit root.

Table 1. Result of the ADF test

	Level Data			First differenced data		
Data series	**Lag Length**	**Test statistic**	**P-value**	**Lag Length**	**Test statistic**	**P-value**
Credit to private sector	1	-2.635704	0.2681	0	-3.131586	0.0338**
M2	5	-1.670277	0.7385	4	-2.846905	0.0642*
Interest rate	1	-1.808411	0.6778	0	-3.814484	0.0066***
Credit to government sector	0	-2.672187	0.2536	1	-4.878095	0.0004***

****, ** and * indicate 1%, 5%, and 10% level of significance respectively*

Table 2. Result of Phillips-Perron Test

	Level Data			First differenced data		
Data series	**Bandwidth**	**Test statistic**	**P-value**	**Bandwidth**	**Test statistic**	**P-value**
Credit to private sector	0	-1.735744	0.713	3	-3.074298	0.0384**
M2	3	-2.589652	0.287	15	-6.948198	0.0000***
Interest rate	3	-1.536262	0.7967	1	-3.821181	0.0065***
Credit to government sector	3	-2.720933	0.235	15	-7.978554	0.0000***

****, and ** indicate 1%, and 5% level of significance respectively*

Table 3. Result of lag length selection

lag	LR	FPE	AIC	HQIC	SBIC
0		2.9e-06	-1.38918	-1.32887	-1.20415
1	352.16	9.7e-11	-11.7169	-11.4153	-10.7918*
2	41.169	7.6e-11*	-12.0127	-11.4698*	-10.3474
3	20.204	1.3e-10	-11.6322	-10.8481	-9.22676
4	52.07*	9.4e-11	-12.2796*	-11.2542	-9.13406

** indicates suggested lag*

Table 4. Result of the Johansen Cointegration Test

Hypothesized No. of CE(s)	(Trace)			(Maximum Eigenvalue)		
	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	93.23868	47.21	54.46	58.19751	27.07	32.24
At most 1 *	35.04118	29.68	35.65	22.61295	20.97	25.52
At most 2	12.42823	15.41	20.04	11.95183	14.07	18.63
At most 3	0.476399	3.76	6.65	0.476399	3.76	6.65

***, * denote rejection of the hypothesis at 1% and 5% level respectively*

Results for optimal lag selection for autoregressive process like VAR, VECM and cointegration are given in Table 3. In regard to quarterly variables, the final prediction error (FPE) and the Hannan and Quinn information criterion (HQIC) suggest two lags for the autoregressive models while the likelihood-ratio test statistics (LR) and the Akaike's information criterion (AIC) propose four lags to be selected as the optimal number of lags. On the other hand, first lag is recommended by the Schwarz's Bayesian information criterion (SBIC). As AIC is followed very widely to select the optimal lag length and also supported by many scholars to be dominant over other criterion (Burnham & Anderson, 2002), the maximum lag length has been selected to be four suggested by both the LR and AIC.

We then proceed to Johansen cointegration test to examine if a set of variables is cointegrated or not. We have analyzed both Trace statistic and Maximum Eigenvalue statistic to find out the cointegration among the variables used in our study. The results are shown in Table 4. The null hypothesis of no cointegrating equation is rejected at both 5 percent and 1 percent level according to the Trace statistic. The Trace test signifies two cointegrating equations at 5 percent level of significance and one cointegrating equation at 1 percent level of significance. The findings of the Trace test are completely supported by the Maximum eigenvalue test. The Johansen cointegration

test implies that there is a long-term, or equilibrium relationship among the quarterly variables. Moreover, Johansen cointegration test also supports the viability of developing a vector error correction model with the variables considered.

The vector error correction model is a mechanism which explores the dynamic association of short run and long run upshots of the variables owing to an exogenous shock. The coefficient of error correction term signifies the long run relationship of the variables and its value is reasonably expected to be negative while the other coefficients indicate the short run effects due to an exogenous shock. The results of vector error correction model with a lag length of 4 are shown in Table 5. The significance of the equation's coefficient implies that there is a long run effect on private sector credit caused by interest rate, broad money supply and domestic credit to government to the extent that about 32 percent of the disequilibrium is corrected in one quarter. The results further show that private sector credit at lag two significantly influences its current level. Also, the credit to private sector is considerably affected by broad money supply at only lag 3. Moreover, once we omit the interest rate from the equation (considering only money supply as proxy for monetary policy), the VECM does not show any significant effect while omitting the money supply (considering only interest rate as proxy for monetary policy) reduces the speed of correction to 20 percent (from original 32 percent) but the coefficient is significant. This proves that money supply does not have any distinct influence on credit, rather it speaks through the interest rate. Interest rate at each lag up to four lags significantly affects private sector credit. Domestic credit to government at all lags, except at lag 3, have significant effect on private sector credit individually.

Table 5. Result of Vector Error Correction Model

Credit to private sector	Coef.	Std. err.	Z	p>[z]
_ce1 L1.	-.3196259	.088039	-3.63	0.000
Credit to private sector				
LD.	.2854789	.1777968	1.61	0.108
L2D.	.4074558	.2029078	2.01	0.045**
L3D.	.0429945	.1857499	0.23	0.817
L4D.	-.3709559	.2068672	-1.79	0.073*
Broad Money Supply (M2)				
LD.	-.2662891	.217078	-1.23	0.220
L2D.	-.2842203	.2433887	-1.17	0.243
L3D.	-.5956555	.2557719	-2.33	0.020**
L4D.	.2630943	.2046104	1.29	0.199
Interest rate				
LD.	.0120111	.0035444	3.39	0.001***
L2D.	.0084003	.0036574	2.30	0.022**
L3D.	.0104824	.0027449	3.82	0.000***
L4D.	.0068806	.0032254	2.13	0.033**
Credit to government sector				
LD.	-.1419214	.0555335	-2.56	0.011**
L2D.	-.1188458	.0513766	-2.31	0.021**
L3D.	-.0542704	.03757	-1.43	0.152
L4D.	-.093365	.0307333	-3.04	0.002***
_cons	.1120151	.0223866	5.00	0.000

****, **, ** indicates 1%, 5%, and 10% level of significance respectively*

Table 6. Fitness of the VECM

Equation	Parms	RMSE	R-sq	Chi2	p>chi2
D_Credit to Private sector	18	.007678	0.9894	1123.082	0.0000

Table 7. Result of Joint hypothesis test

D_Credit to private sector	Chi2 (4)	Prob > chi2
Credit to private sector		
LD.+L2D.+L3D.+L4D.=0	17.24	0.0017***
Broad Money Supply (M2)		
LD.+L2D.+L3D.+L4D.=0	14.71	0.0053***
Interest rate		
LD.+L2D.+L3D.+L4D.=0	16.37	0.0026***
Credit to government sector		
LD.+L2D.+L3D.+L4D.=0	17.13	0.0018***

**** indicates 1% level of significance.*

Table 8. Lagrange-multiplier test (Quarterly data)

lag	Chi2	df	Prob > chi2
1	9.5264	16	0.89017
2	9.4913	16	0.89181
3	19.3753	16	0.24968
4	18.8630	16	0.27583

H0: no autocorrelation at lag order.

Furthermore, the hypothesis that the coefficients of a particular quarterly variable at its all four lags jointly equal to zero or they jointly don't have any influence on private sector credit is examined through the joint hypothesis test and the results are provided in Table 7. The results show that private sector credit and broad money supply at their all lags significantly affect private sector credit. Likewise, interest rate and domestic credit to government influence private sector credit as the p-values of the joint hypothesis are 0.0017, 0.0053, 0.0026 and 0.0018 respectively. The fitness of the model is also tested with Lagrange-multiplier (LM) test which checks whether the model as a whole has autocorrelation or not. The results of LM test for the quarterly variable model are given in Table 8. The results indicate that there is no autocorrelation in the model as a whole or it is a good model.

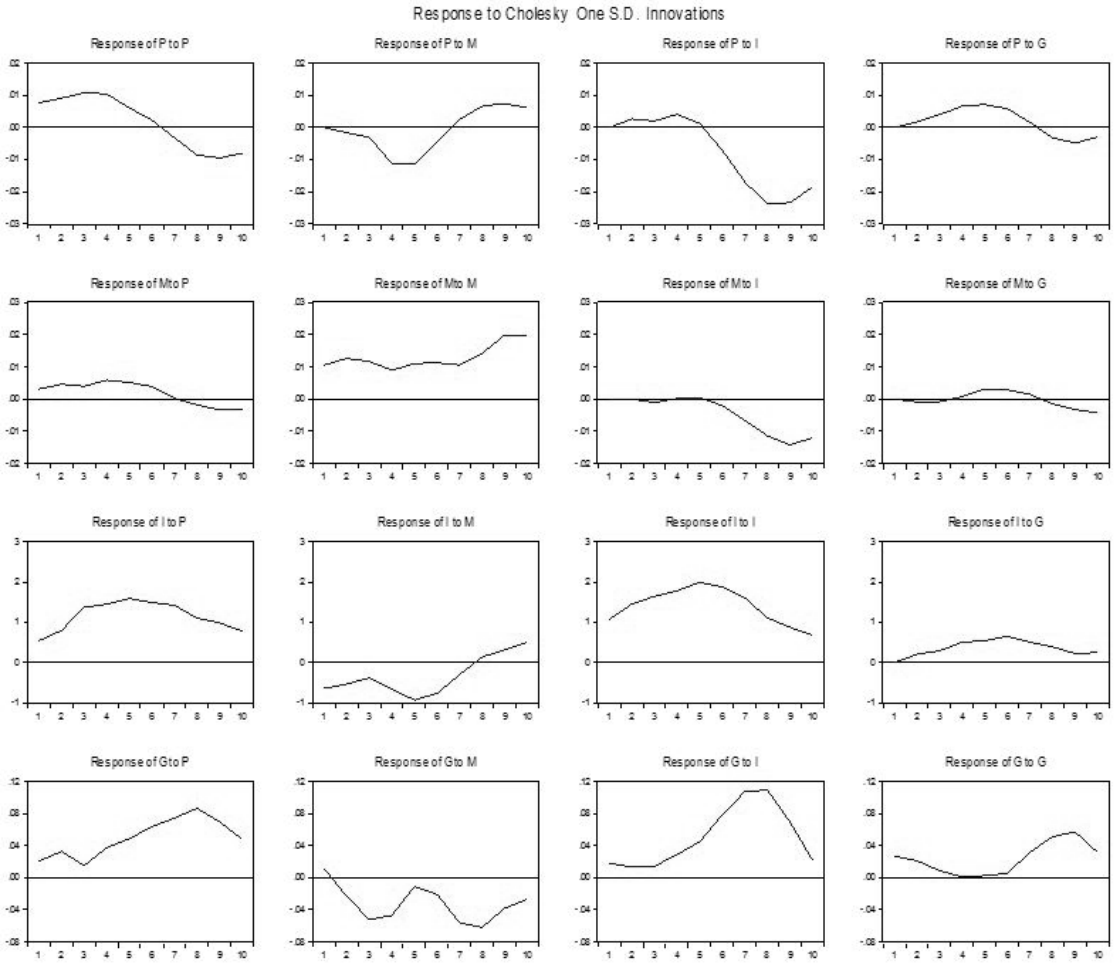
The Impulse Response Function

Granger-causality however, does not precisely articulate the interactions between the variables of a system. As a result, it is often important to examine the response of one variable if a shock on the error term is introduced. This is known as impulse response function (IRF) which is often applied to measure the impact of a change in one standard deviation in one variable that results from stochastic disturbance on the current and future values of the other variables. The results of impulse response analysis are presented in Figure 1.

Four individual pictures of the first row in Figure 1 show the response of private sector credit to its own lag, money supply, interest rate, and government borrowing. The response of

private sector credit to a unit shock of its own error shows a stable positive impact until the 4th quarter when it starts declining and becomes negative until the effect is stabilized in 8th quarter. This implies that the current level of credit to the private sector impacts itself positively which persists up to a year. The negative response afterwards can be explained by the fact that money injected to the private sector is utilized for a year. By this time, the investment grows up and the sector creates internal funds leading to a slight decline on further demand for credit. The effect of money supply to private sector borrowing is u-shape. There is no response of private credit to money supply in the first six months. After a short period of stability (one quarter) an increasing trend is followed which implies that it takes at least one year for the money supply to get its effect on the economy so far as private sector borrowing is concerned. This result is very much consistent with the effect of interest rate. The response of private sector credit to interest rate is almost none for the first year. Afterwards, there is a sharp negative downward trend, the reverse of money supply, which is logical. This construes that it takes a year to feel the impact of interest rate to private sector borrowing. The logic is that the frictions of markets including high transaction costs and asymmetry of information in Bangladesh like other developing countries are pretty high which avert prompt reaction of private sector credit in response to interest rate change. On the other hand, the response of private sector credit to government borrowing is positive but not significant until the 6th quarter and becomes negative afterwards. Again, like the cases of money supply and interest rate, it takes more than one year to feel the impact of crowding out. These results are quite consistent to each other proving that monetary policy impact exists although the impact is not immediate.

The impulse of money supply to private sector credit is positive until the 7th quarter but not significant. However, the effect of current money supply on its own is positive. The response of money supply to an innovation in the interest rate is none until the 5th quarter after which the impact remains negative. The response of money supply to government borrowing is none which proves that government does not influence monetary policy to its favor when it needs to borrow. As expected, the responses of interest rate to an innovation of its own, private sector credit, and government borrowing, are positive. However, the interest rate response to government borrowing is insignificant. This makes sense because the government will always try to keep the interest rate unaffected while it borrows due to the greater interest of the economy. It may be the case that government borrows at a time when the demand for private credit is sluggish. The response of interest rate to money supply remains negative until the second year (7th quarter) and then becomes positive which is very logical as an increase in money supply negatively affects the interest rate. This confirms our finding in the VECM that money supply has no distinct power to influence private sector credit, but the effect is transmitted through the interest rate. Again, the reaction of interest rate to government borrowing is positive but insignificant and shows a mean reversion trend. The impulses of government borrowing to private sector credit and interest rate are positive and unstable whereas the response is negative to money supply. Regarding the response from government, all trends show unstable and mean reverting.



Conclusion

The paper has attempted to examine the impact of monetary policy on private sector investment in Bangladesh. The results of VECM confirm the conventional money view of monetary policy. The central bank can restrict the lending of financial intermediaries by tightening monetary policy or can increase the supply of money by loosening the policy when required. The result further shows that the broad money supply does not have any distinct effect of its own on the private sector borrowing, rather the effect is transmitted through the interest rate. This finding conforms to major literature which finds that interest rate channel is the key to monetary transmission. However, unlike developed and matured economies, the effect is not immediate but delayed for more than one year. This result however, is not illogical taking other socio-economic

factors of the country into consideration. For instance, the friction in the financial market is evident which delays the communication of the policy through various mechanisms. This is what makes the task obviously difficult for policymakers to ascertain the time and mechanism for policy shocks. It is problematic to forestall the need for policy action one year ahead because changes in some critical macroeconomic variables in the future, which may not be anticipated in advance, could possibly impede the objectives of monetary policy. Thus, while friction is necessary for lending channel to be effective, the central bank should strive to remove too much friction from the market otherwise the unintended delay in communicating the monetary policy will fail. It is to be noted that alternatives to bank financing are not flourished in Bangladesh. As a result, borrowers are heavily dependent on this source and hence removing friction will not allow them to switch to other financers easily. Since this study concentrates only on money view of monetary policy, it cannot draw a comparative picture on the time lag required for other channels. This demands further research which we intend to accomplish in the future.

The paper also finds evidence to support the crowding out hypothesis which has some implication for the economy in general and monetary policy in particular. Unlike a mature economy, developing countries believe in the golden rule of economic development through fiscal spending. There are both pros and cons of public spending. The benefit of government borrowing is that big infrastructural development is accomplished through public budget. Private sector feels shy to undertake such projects either because the cost-benefit analysis does not come to private terms or there is a lack of sufficient supply of private funds for such big projects. Thus, it is essential to shed a light as to whether the public borrowing crowds consumer loan out. If so, there is an effect of crowding out. Conversely, taking into account the anomalies involved with public spending in developing countries there are reasons to believe that market can better distribute resources for development purpose than the government. However, the impulse response shows that public borrowing does not increase interest rate. This can be explained, as we mentioned earlier, by the fact that government may borrow at times when private borrowing is sluggish and hence does not put an upward pressure on the interest rate. Or, government devises some coercion mechanisms by which financial system is kept unaffected by its borrowing. This proves that the central bank has a good control on the financial system which supports our main finding on the existence of monetary policy. The finding of this research will facilitate the authority involved in monetary activities, the government, development economist and also the private sector investors to take necessary steps to stimulate the private sector credit which in turn, will help Bangladesh develop faster.

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