BB Working Paper Series: WP No. 1903

The implication of foreign credit and higher saving certificate rate on banks' liquidity in Bangladesh

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September 2019

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Abstract

To find the factors influencing banking system liquidity, this study analyzes the liquidity behavior in the banking system of Bangladesh and finally examines its influences using an autoregressive distributed lag (ARDL) model with cointegration techniques and error correction term. The study finds that the growth of *liquidity in the banking system* is positively associated with the change of *foreign credit* and negatively influenced by the *return rate difference between real saving certificates rate and real bank deposit rate, overnight money market rate (call money rate)* and some liquidity and stock market linked policy turning points, categorized as *dummy variable* in the paper. The model establishes a long run relation between banking system liquidity and its tested variables. However, if the variables influence liquidity in different way the new interrelation may sustain for 6 months at best and after that the original relationship will return.

JEL Classification: E49 & E50

Keywords: bank liquidity, money and interest rate

* The authors of the study are all Bangladesh Bank officials. Views expressed in this paper are authors' own and do not necessarily reflect that of Bangladesh Bank. The authors are thankful to Dr. Akhtaruzzaman, Executive Director (Research) and Dr. Ezazul Islam, General Manager, Bangladesh Bank for their valuable comments and suggestions that helped to improve the earlier versions of this work. Contact email: bayazid.sarker@bb.org.bd,

1. Introduction

Liquidity of an organization is the sum of cash, availability of cash (Archer and D'Ambrosio, 1971) and other assets those can be easily converted into cash or to meet up short term liabilities within the marketability. Marketability refers to the ability to convert an asset into cash at a short notice. In fact, it depends on market efficiency and level of maturity of the economy. It is one of the basic indicators of efficiency and adjustability for a business entity or even for a non-profit organization. Nonetheless, it is assumed that money is the ultimate standard of full liquidity (Neuman, A. M., 1936) as all entities' liquidity (about 88 percent in case of Bangladesh) move toward a particular bank at the end of the day. This study considers only banking system liquidity includes mostly cash and near-cash assets which are en-cashable without losing value. According to Bangladesh Bank (BB) definition **liquidity in the banking system** (of Bangladesh) as the sum of :

- all SLR (*statutory liquidity ratio*) eligible assets (mostly government treasury bonds & bills and BB bills) held by each commercial bank which includes mainly un-encumbered approved securities;
- cash on hand, Balance with Sonali Bank as agent of BB;
- balance maintained with BB in foreign currency clearing account; and
- excess reserve maintained with BB.

Maintaining adequate liquidity is required for both regulatory requirement and to meet maturity and investment demand. Every bank or financial institution has its own way of liquidity management aiming to meet both short and long run cash flow needs. However, monetary authority is keen to oversee the issue in line with its monetary policy objectives. Therefore, liquidity in the banking system measured as sum of financial assets maintained or held by the banking industry, come under the purview of regulatory liquidity requirement. To understand behavior of banking system liquidity as well as influencing factors, need to be examined to meet the policy perspective of Bangladesh Bank.

In every economy, neither excess nor shortage of liquidity is expected as both positions have some drawbacks. For excess amount, bank has to bear the fund cost as well as to maintain the regulatory requirement. On the other hand, shortage situation may cause higher fund cost, and even reputational cost. In case of Bangladesh, a long debate remains on whether banks' investment in first class securities (*instruments claims on central government or central bank*) in excess of regulatory requirement should be treated as excess liquidity or not. It is evident that during 2012 to 2015 banking industry experienced such situation of lower fund demand (Chart-1 & 3.1). Theoretically, lower demand for loanable funds implies slower credit flow creates a liquidity glut (Sarker, M. B., 2014) in the banking system that may create downward pressure on lending rate. However, lending rate takes longer than expected time lag to decrease (Chart-1 & 3.1). Few events stated below, may be responsible for this downward rigidity of interest rate:

i. Stock market debacle in 2011.
ii. Business entities became conservative for fresh investment.
iii. Credit growth is reshaping with normal growth trend after a higher growth regime.
iv. Downward rigidity in credit pricing and operational cost adjustment in banking industry.
v. Allowing low-cost foreign credit when available loanable funds could have been used in domestic investment.
vi. Public borrowing through savings certificates by offering non-market responsive higher rate of interest instead of low cost borrowing from banking system.

To find the proper causes behind the credit-liquidity and interest rates situation, an empirical investigation is needed to analyze the behavior of banking system liquidity in Bangladesh that may aid the policy makers for future policy formulation.

The main objective of the paper is to analyze the banking liquidity behavior to find major factors of liquidity supply and finally examine the long run and short run relationship between the banking system liquidity and its explanatory variables i.e., credit flow, deposit-credit gap, interest rates, interest rate differential, foreign credit, government saving certificates sale and stock market capitalization.

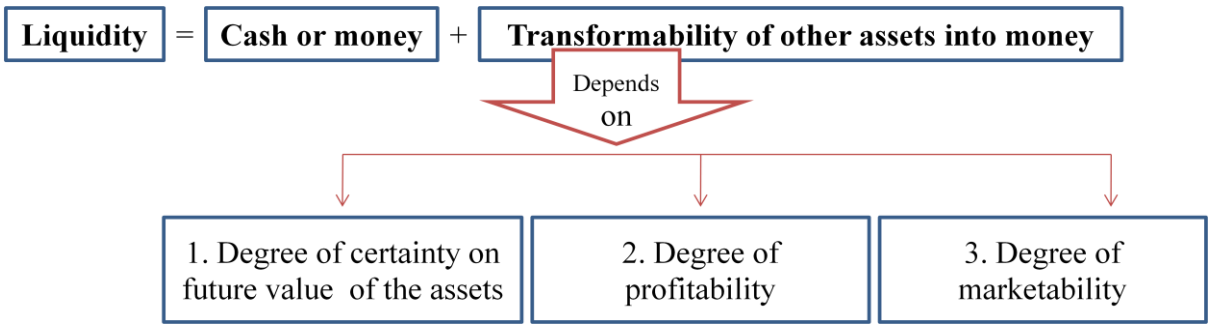
The remainder of the paper is organized as in the following segments:
Section-2 describes different views of liquidity in the banking system. Section-3 covers survey of related studies and identifies gap in the existing literature. Section-4 analyses the liquidity behavior in the banking system of Bangladesh. Based on study surveyed gap and liquidity analysis, a model is developed (*quantitative analysis*) in Section-5. Section-6 contains diagnostics and stability of the model and finally, a conclusion is given in section-7.

2. Different Views of Liquidity in the Banking System.

2.1 Micro to macro views of liquidity

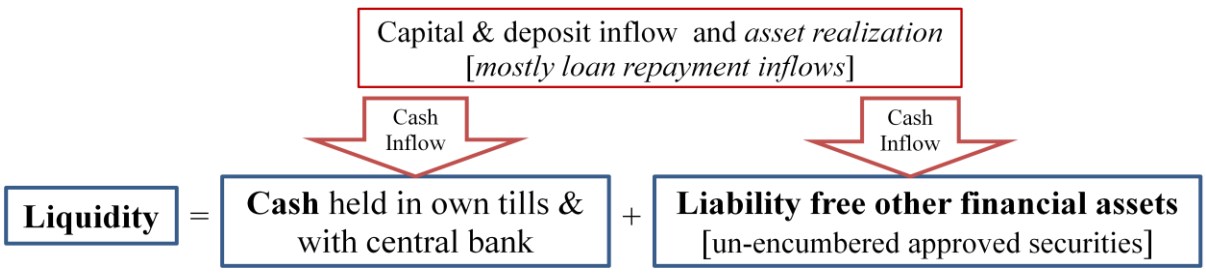
Liquidity can be distinguished from micro and macro perspectives. An individual entity's ability of cash and availability of cash can be defined as micro level liquidity where as macro level is embodied into banking system liquidity. In general, liquidity can be categorized in three ways:

1. Individual or Firm's (*other than financial institution*) Liquidity:



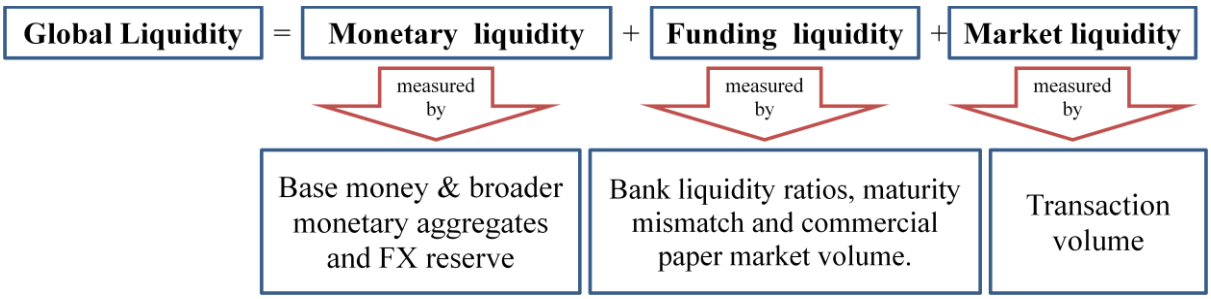
According to the doctrine of liquidity (Neuman, A. M., 1936) the factors affecting liquidity can be distinguished into three broad areas: (1) the degree of certainty as to the future value of assets; (2) the degree of profitability; (3) the degree of salability of asset. The first element refers to (a) solvency and (b) accurate time of payment; the second to the income obtainable from the asset relative to other incomes; the third is in equilibrium mainly determined by divisibility, cost of investment, and imperfections in the market.

2. Bank or Financial Institution's Liquidity:



Liquidity in the banking system can be categorized as banks solvency and efficiency to maintain sufficient cash and other financial assets ready for transforming into cash to meet the demand for investment (bank credit) and early or maturity encashment of issued instruments as well as to meet regulatory requirement. Conversely, stock market liquidity is mainly focused on individual or firm type liquidity. However, it has significant consequences with banking system liquidity. Liquidity in the banking system is also linked with global liquidity (Domanski et al., 2011; Eickmeier et al. 2013) that depends on the degree of economic openness of a specific country/area.

3. Global Liquidity:



Monetary liquidity: refers to stock of money and to ease of converting monetary asset.
Funding liquidity: The International Monetary Fund (IMF) defines funding liquidity as "the ability of a solvent institution to make agreed-upon payments in a timely fashion" (IMF, 2008)
Market liquidity is a market's feature whereby an individual or firm can quickly purchase or sell an asset without causing a drastic change in the asset's price.

Though different types of liquidity can be interlinked, directly or indirectly to each other this study is mainly concerned with banking system liquidity defined by the regulatory authority of Bangladesh.

2.2 Regulatory views of liquidity in the banking system

Bangladesh Bank (BB) defines Liquidity as the sum of all SLR (*statutory liquidity ratio*) eligible assets held by each commercial bank which includes mainly un-encumbered approved securities, Cash on hand, Balance with Sonali Bank as agent of BB, balance maintained with BB in foreign currency clearing account and excess reserve maintained with BB. The term "Excess of SLR" (commonly referred to as "Excess Liquidity") is defined as the amount of liquid assets in excess of required liquidity (SLR). The term "Excess Reserve" is defined as the cash maintained daily in excess of the prescribed bi-weekly average of CRR or cash reserve ratio (at required rate of cash reserve) with BB. At present, the regulatory obligation for maintenance of CRR is 6.5% on bi-weekly average basis with a provision of maintaining not less than 6% daily for all banks (The rates have been revised downward to 5.5 percent and 5.0 percent respectively with effect from April 2018). On the other hand, the Regulatory obligations for maintenance of SLR for conventional and Islamic banking are 13% and 5.5% respectively on daily basis.

The various approved securities held by banks in excess of SLR are issued or guaranteed by the government and BB. These approved securities bear zero specific risk. By issuing such securities government borrows funds from banking sector to meet the budget deficit.

3. Survey of Studies and Identifying Gap

Based on global financial crisis 2007-2008, banks liquidity defined as maturity transformation (Hartlage, A.W, 2012), inefficient management of banks' borrowing for short terms and lending for long terms in fact, create the mismatch ultimately causes contagious bank failures and aggregate liquidity (Diamond, D.W. and Rajan, R. G., 2005). Then government needs to provide adequate liquidity in an efficient way (Gorton, G. and Huang, L. 2004), otherwise the bailout decisions may

raise the excess demand for liquidity, further insolvencies, and indeed, a meltdown of the entire system (Diamond, D.W. and Rajan, R. G., 2002). After the global financial crisis Bank for International Settlement (BIS) introduced the liquidity coverage ratio (LCR) in a view to minimizing risk. However, the standard of the LCR components ultimately undermine the goals of effective liquidity regulation (Diamond, D.W. and Rajan, R. G., 2002).

Thus, banking liquidity management is important otherwise it may cause for downgrade the economy as a whole. For efficient liquidity management, major influencing factors need to be identified especially for Bangladesh as a developing economy. Khemraj, T.,(2010) shows that lending rate, financial liberalization, foreign interest rate, marginal transaction costs, and a risk premium have influence over banks' liquidity. Interbank rate (Freixas, et al., 2011) and international transmission (Schnabl, P., 2012) are also important for banks liquidity. On the other hand, income tax (Listokin, Y, 2011), countercyclical approach (Acharya, et al., 2011), business cycle (Næs, et al., 2011) and liquidity in foreign exchange market (Mancini, et al., 2013) are important factors for stock market liquidity.

As a financial institution mainly invest in illiquid business it needs long-term financing, however, increased liquidity can paradoxically be bad (Myers, S.C. and Rajan, R. G., 1998). Increasing the price of illiquid assets may raise the stock market liquidity (Diamond, D.W., 1997; Brunnermeier, M.K. and Pedersen, L. H., 2009). Conversely, negative market returns decrease stock market liquidity (Hameed, et al., 2010), especially during the periods of tightness in the funding market.

In practice, banks hold excess liquidity for voluntary and involuntary basis (Saxegaard, 2006). Using Sub-Saharan data, the study found that involuntary liquidity is created in the book of bank due to lower demand of credit; a case that is somewhat similar to the practices of the banking industry of Bangladesh. The paper also mentioned the incident known as 'the liquidity trap' where rate of return on loans is not enough to cover the intermediation costs and hence banks put all their assets as reserves with the central bank. It found that underdeveloped interbank money market, inefficiencies in the payment systems and the absence of liquid and competitive bond market may cause involuntary excess liquidity in the banking system.

Lower credit demand is not only the cause. Lower risk targeted (Assaf Net, 2003) high liquidity gives low profits in the business. Consequently it can be seen that current assets are generally less profitable than fixed assets (Chandra, 2001).

In case of Bangladesh, by using panel regression with 1997-2014 quarterly data Begum (2017) found nonperforming asset and income-expenditure ratio are more concern on banks' profitability than liquidity.

It is commonly thought that money supply and credit are fundamental factors for banks' liquidity. Very few papers found any evidence of these two variables having any influence over liquidity.

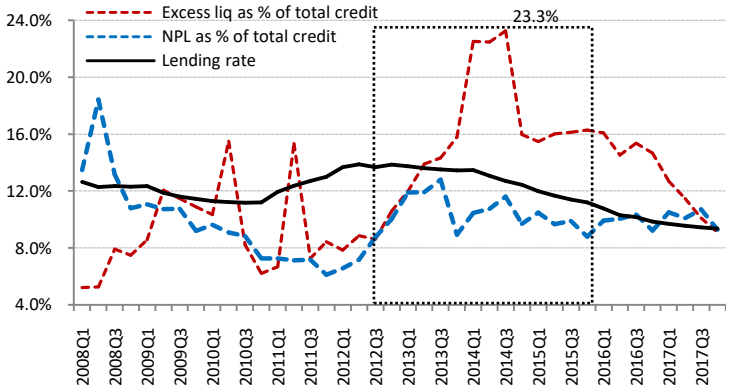
After assessing the mentioned studies in the area of liquidity a strong relation with credit demand appears to be quite robust. Other variables such as money supply, private sector credit, foreign exchange market, interbank rate and lending rate also draw significant results as explanatory variable of liquidity in different studies. Until now, no study has been found to determine the long run relation of determinants of liquidity in Bangladesh especially using interest rate differential and foreign debt flow as the explanatory variables of banks' liquidity.

Therefore, conducting study for testing banking system liquidity in Bangladesh can aid the policy makers in Bangladesh in their decision making process. In addition, sales of government issued saving instrument and the interest rate difference between saving certificate rate and deposit rate are the new factors, first time to be tested as explanatory variable of banks' liquidity in the area of economic research.

4. Analysis of Liquidity Behavior in the Banking System of Bangladesh

If banks hold excess reserves (balance with BB in excess of CRR, which is one of the components of SLR but at the present situation it acts as free reserve) that ultimately increases their lending capacity. As there is an evidence of aggressive lending by some banks, imminently due-diligence might have been compromised that resulted in higher non-performing loans (NPLs). However, no strong support is concluded from real data plotting (Chart-1). It means recent cases of rescheduling at simpler condition may be the prime cause of lower credit demand and therefore, lower appetite of expanding loanable funds.

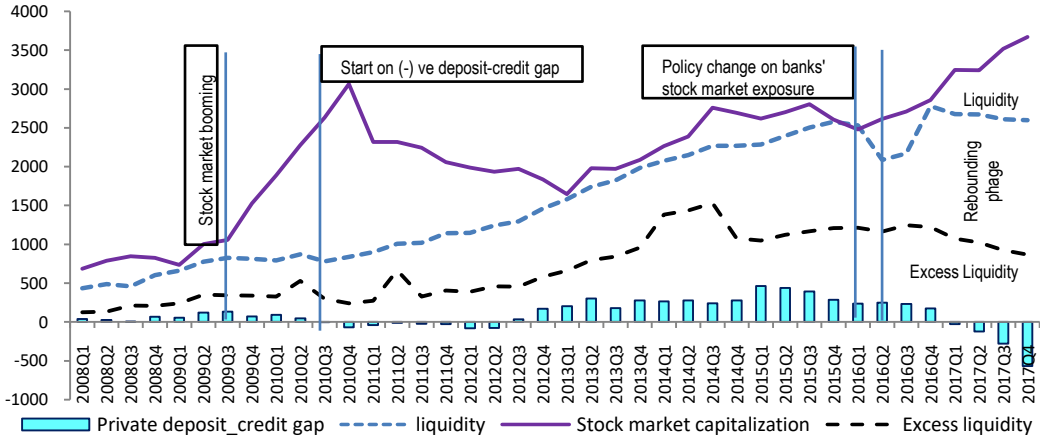
Chart-1: Excess Liquidity and NPL as percentage of total credit



Source: Major Economic Indicator, MPD & BBQ, Bangladesh Bank

Higher credit growth compared to that of deposit, constitute a liquidity risk in the banking system and also indicate a probable liquidity crunch situation in the near future. The much higher growth of credit over deposit during 2010Q1 to 2011Q3 may indicate two possibilities- (a) a part of new loans are used to adjust previous loans payment or (b) funds disbursed against new loans, part of it can be diverted and not coming back to the banking system. Excess reserve as percentage of private credit was much lower than the usual level, support to fund diversion into capital market as the market was boom during the same time (Chart-2 & 3.1). The higher credit growth situation has come again from 2016Q1 to 2017Q4 that also leads downward excess reserve-private credit ratio (Chart-3.1). During the second phase of higher credit growth, stock market capitalization is also in upward trend (Chart-2). However, it may have the influence of changing policy on banks' capital market exposure through DOS Circular No-03/2015, dated December 20, 2015. The new policy favors banks for new calculation of capital market exposure by excluding own subsidiary's equity holdings. Prior to that, banks were facing hurdle to bring back to the regulator specified limit of capital market exposure.

Chart-2:Policy linked turning points: Deposit-credit gap, stock market growth, liquidity and excess liquidity



Source: Major Economic Indicator, MPD, BB.

Private credit flow from foreign sources (about 28 percent growth in 4th quarter 2017) influenced in reducing deposit demand. While growing government borrowing through saving certificate (SS) diverted fund from banking credit channel (Chart-3.2).

Chart-3.1: Private credit growth and deposit growth

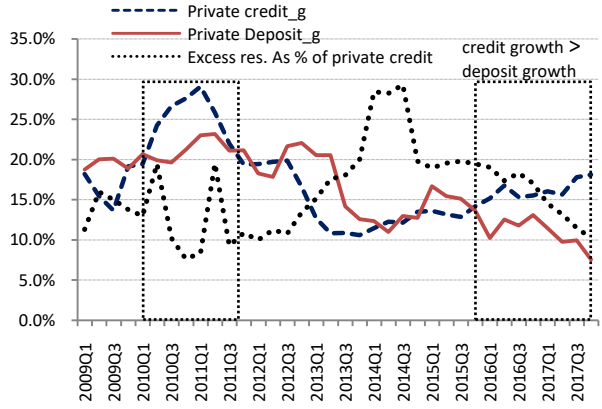
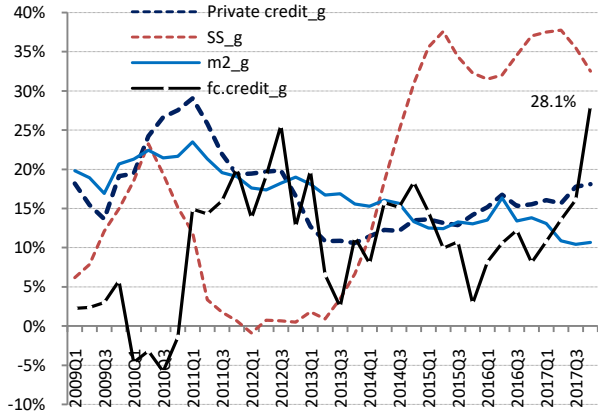


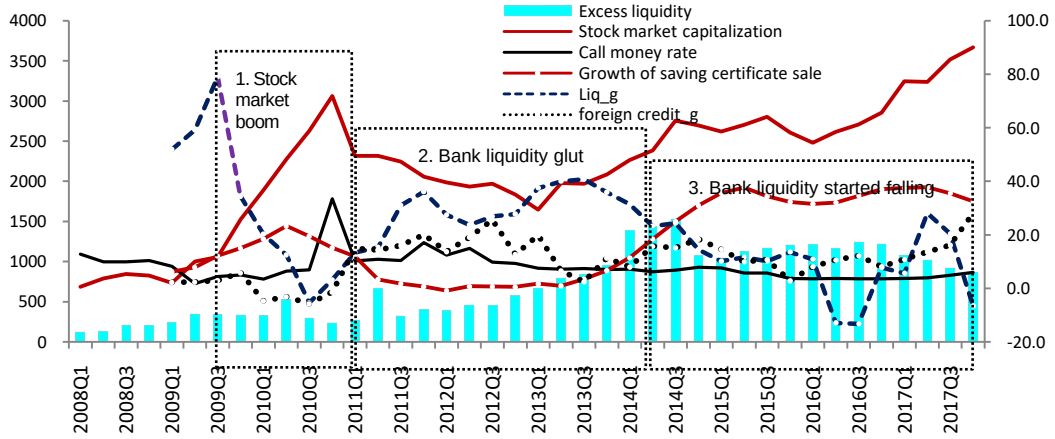
Chart-3.2: Growth trend of foreign private credit & saving certificate



Source: Major Economic Indicator, MPD, BB; NSD and ERD of Ministry of Finance

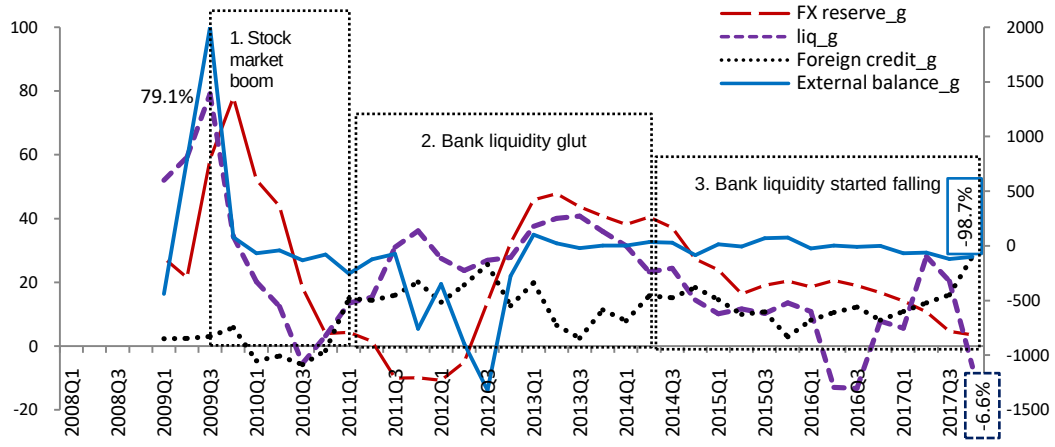
Banking system liquidity trend during the study period (2008Q1 to 2017Q4) can be categorized into three phases. In *the first phase, 2009Q3 to 2011Q1*, banks' liquidity continued falling and stock market conversely started booming up to 2010Q3. It may indicate that a part of banks' liquidity was probably diverted to stock market during the same period evidently supported by a record peak of call money rate in 2010Q4 (Chart-4.1).

Chart-4.1: Banks' liquidity trend from 2008Q1 to 2017Q4



Source: Major Economic Indicator, MPD, BB; Statistics Department, BB & NSD

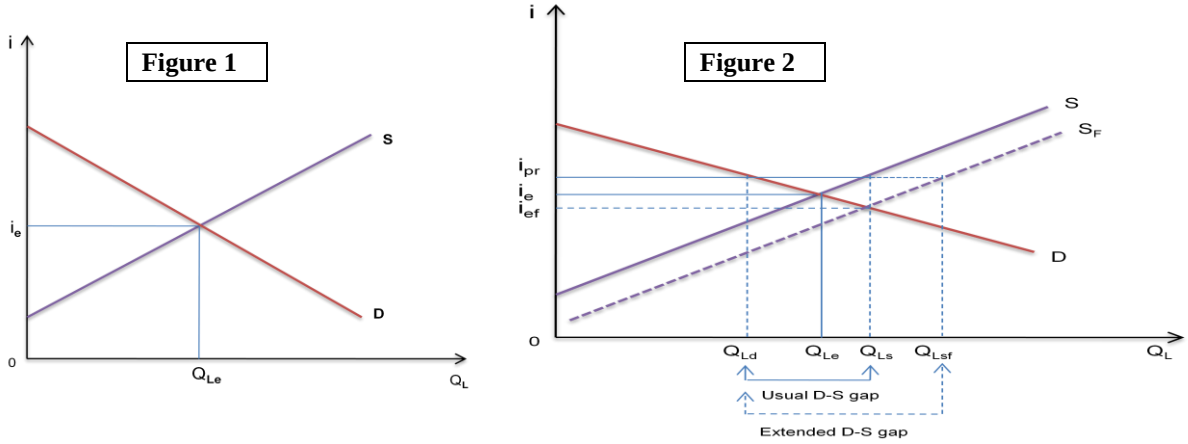
Chart-4.2: Banks' liquidity trend with external flows from 2008Q1 to 2017Q4



Source: Major Economic Indicator, MPD, BB and Statistics Department, BB.

The second stock market debacle took place at the end of 2010 after a decade from the first debacle in 1996. Investors' confidence stumbled second time over stock market, surplus fund owners moved back to banking system again. However, investors became indecisive for fresh investment as news of financial scams by Hall Mark and Bismillah Group in 2012 in the banking sector came to light. At the close of national election during January 2014, investors remained cautious about the prospects of fresh investment. Credit flow, the ultimate demand side of loanable fund moved slower and liquidity in the banking system increased significantly. This is *the second phase, starting from 2011Q2 to 2014Q2*, where banking industry faced liquidity problem when excess liquidity started to rise, stock market became slow and foreign credit flow went up (Chart-4.1).

Though foreign credit flow put pressure on local market lending rate to come down, it prolonged the liquidity glut in the domestic credit market along with a foreign exchange repayment risk. The problem is hypothetically depicted in the following figure-1 & figure-2:



It indicates that demand-supply gap had been in increasing trend for allowing private foreign borrowing during that time. Figure-1 represent the market responsive interest rate, i_e . Figure-2 depicts the Bangladesh case. Equilibrium interest rate should be i_e for domestic credit market with very usual level of foreign debt inflows and i_{ef} for domestic credit market with increasing foreign debt inflow. Despite of excess loanable fund in the market, banking industry charges interest rate at i_{pr} , that is higher than i_e and much bigger than i_{ef} . Therefore, because of recent increase in foreign debt inflows, economy bears the negative demand-supply gap (i.e., excess loanable fund) of $Q_{Ld}\,Q_{Lsf}$, that is much higher than the expected gap of $Q_{Ld}\,Q_{Ls}$. In *the third phase, 2014Q3 to 2017Q4*, banking system liquidity started falling again and higher interest bearing saving certificate sale rose sharply. Stock market rose with a mixed trend.

During the same period, stock of foreign exchange reserve and net foreign asset moved parallel to the liquidity trend with a post lag effect but private sector credit showed a mix trend with liquidity trend (Chart-4.2).

The above analysis based on quarterly data from 2008Q1 to 2017Q4, indicates that stock market capitalization, private credit flow from foreign sources and government borrowing through saving instruments played an important role in liquidity movement in the banking system of Bangladesh. Therefore, these variables require to be empirically tested for better understanding the confluence of relevant factors of private credit supply.

5. Model for Liquidity in Banking System of Bangladesh

5.1 Data

In this study, we consider calendar year instead of fiscal year. Calendar year quarterly data sets taken from Bangladesh Bank are used in this study. Time series data published in the Monthly Economic Trend, Monthly Economic Indicator, Scheduled Bank Statistics and Bangladesh Bank

Quarterly covering first quarter of 2008 to fourth quarter of 2017 is taken into the estimation. The duration of data has been selected based on the availability of all variables especially liquidity, the dependent variable. Though stock market capitalization data and sales of government saving certificate data are taken from Bangladesh Bank publications, the ultimate data sources were Bangladesh Securities and Exchange Commission (BSEC) and National Savings Bureau.

5.2. Assumption and Limitation of the Model

Quarter to quarter calculated differences of stock data are assumed as a proxy of flow data especially for government savings certificate sales. Only the best fit model is reported in the paper. For example, theoretically money supply or real money supply and credit flow should have an influence on liquidity. However, for stationarity problem ultimately those variables are kept aside in final model selection. Causal directions among the variables are determined based on macroeconomic sense for Bangladesh economy.

5.3 Methodology and Model Selection

The initial step of the empirical study is to select the variables and method based on theoretical background, unit root testing and variables' of best fit to the model. The projected model is

$$L = f(FC, RD, MR, PL)$$

Here, L is the liquidity of all banks (billion BDT), quarterly.

FC is the outstanding of foreign credit both public and private (equivalent billion BDT), quarterly.

RD is the return rate difference between real savings certificate rate and real deposit rate, quarterly

MR is the overnight money market rate commonly known as *call money rate*, quarterly

PL is the dummy variable representing liquidity and stock market linked policy turning points (*that leads to a significant change over the bank liquidity*). Stock market capitalization started booming in 2009Q3 that led to a negative private deposit to private credit gap in 2010Q3, may also be influenced by the increase of repo and reverse repo rates by 100 basis points (*MPD Circular No-03/2010, dated-August 19, 2010*). Another policy change commenced on banks' capital market exposure (*DOS Circular No-03/2015, dated- December 20, 2015*) leads sharp fall of banks liquidity, also declines the stock market capitalization in 2016Q1. However, liquidity starts sharp rebounding in 2016Q2. The turning points of these major linkages between liquidity and stock market are taken into consideration in case of model analysis.

We take natural logarithm with the banking system liquidity (L) and foreign credit (FC) variables. The prefix "L" before a variable name indicates natural logarithm of that variable. Other variables (RD and MR) are taken in absolute form. A data series plot is shown in Figure-A1.

Others variables are tested in the model but finally reported are:

LM2 – Log of money supply (stock variable)
CRF – Total credit (flow variable)
GPDP_PCR – Growth of deposit-credit gap (flow variable)
LR – Lending rate
LST_CAP – Log of stock market capitalization (stock variable)
SS – Growth of saving certificate sales (flow variable)

The variable LM2, LRM2, CRF and LR have no strong support in unit root test in favor of I(0) after their first difference. If consider I(0) even, the model shows irrelevant sign against their coefficients, model cannot pass in bound test or in diagnostic tests. GPDP_PCR and LST_CAP are I(0) after their first difference, but their inclusion in the model ultimately fail to satisfy the bound test and diagnostic tests.

Therefore, some theory supported factors such as money supply, credit flow; deposit-credit gap, stock market, foreign exchange reserve and net foreign asset capitalization have no significant association with liquidity they do not fit to the model.

5.3.1 Unit Root Test

All variables (except the dummy) are tested by applying three popular unit root tests, namely, Augmented Dickey-Fuller (ADF) test, Philips-Perron (PP) test, and Kwiatkowski-Philips-Schmidt-Shin (KPSS) test. The order of integration, suggested by different tests, is summarized in the Table-1. Based on the test, we get mixed results. According to the test results, variables of liquidity (LL), foreign credit (LFC) and return rate difference between real saving certificate rate and real bank deposit rate (RD) are I(1). Overnight money market rate known as *call money rate* (MR) are stationary i.e., I(0). These four variables are transformed into I(0) in first difference, implying that no one is in I(2). A summary of all variables' (included & excluded in the model) stationarity test are shown in Table-A1 and A2 in the appendix.

Table-1: Summary of Unit Root Test Result

H_0 :Variable has a unit root (*for ADF & PP*)
H_0 :Variable is stationary (*for KPSS*)

Variables	Intercept			Intercept & Trend			Decision
	ADF	PP	KPSS	ADF	PP	KPSS	
Log of Liquidity (LL)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Log of Foreign credit (*LFC*)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Return rates difference (RD) , real saving certificate rate minus real deposit rate	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Overnight money market rate (MR)	I(0)	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)

5.3.2 Model Development

Since the order of integration is noticeable with the variables of both I(1) and I(0) and no variable with I(2), the situation permits us to use ARDL bound test approach of cointegration techniques (Pesaran and Shin, 1999 and Pesaran et al., 2001). This methodology is quite handy to estimate long run relationship among the variables with small sample data. Therefore, the ARDL regression model is finally selected as:

$$LL_t = \alpha + \sum_{i=1}^{p} \beta_i LL_{t-i} + \sum_{i=0}^{q_1} \beta_i LFC_{t-i} + \sum_{i=0}^{q_2} \beta_i RD_{t-i} + \sum_{i=0}^{q_3} \beta_i MR_{t-i} + \sum_{i=0}^{q_4} \beta_i PL_{t-i} + \varepsilon_t \ \ldots(1)$$

Here, LL denotes log level of liquidity in the banking system, LFC denotes log level of foreign credit flow, RD represents return rate difference between real saving certificates rate and real bank deposit rate, MR denotes overnight money market rate (call money rate) and PL represents the dummy variable for important policy impacts that influence liquidity. α stands for intercept term, β_i $(i = 1 \ldots 4)$ signifies the coefficients on respective variables, and ε_t denotes for error terms.

The model is modified for bound test cointegration as follows:

$$\Delta LL_t = \alpha + \sum_{i=1}^{p} \beta_i \Delta LL_{t-i} + \sum_{i=0}^{q_1} \gamma_i \Delta LFC_{t-i} + \sum_{i=0}^{q_2} \delta_i \Delta RD_{t-i} + \sum_{i=0}^{q_3} \mu_i \Delta MR_{t-i} + \sum_{i=0}^{q_4} \tau_i \Delta PL_{t-i} + \theta_0 LL_{t-1} + \theta_1 LFC_{t-1} + \theta_2 RD_{t-1} + \theta_3 MR_{t-1} + \theta_4 PL_{t-1} + \varepsilon_t \ \ldots(2)$$

Here, Δ denotes the first difference of respective variables. θ_i $(i = 1 \ldots 4)$ signifies the coefficients on respective lagged level and $\beta_i, \gamma_i, \delta_i, \mu_i, \tau_i (i = 1 \ldots q)$ denotes coefficient on

respective lagged variables. ε_t stands for error terms where coefficients are unrestricted and p denotes the maximum lag length selected by the user. In this model, lag length is selected according to the Akaike Information Criteria (AIC), commonly used to select the order of ARDL model. To check the existence of long-run relationship bound test provides F statistics of checking joint significance hypothesized as coefficients on lagged level are zero. H_0: $\theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$

5.3.3 ARDL and Error Correction Estimation

After variable selection and their required Granger causality test along with unit root test, we conduct an ARDL bound test. Theoretically we know, if computed F-statistic is below the lower bound, the variables are I (0), so no cointegration is possible. If the F-statistic exceeds the upper bound, it indicates to have a cointegration. If the F-statistic falls between the bounds, the test is inconclusive. Accordingly we have compared F-test value with the bounds critical value tables provided by bound test result since the study used relatively smaller sample size. The results are summarized in Table 2 & 3.

Table 2: Result of ARDL Bound Testing (Joint significance test)

Variables	F-Statistic	Result
LL (FC, RD, MR, PL)	5.050**	Cointegration

***, ** and * denotes statistical significance at 1%, 2.5% and 5% levels respectively

Table-3: Critical Values of Bound Test

Significance Level	Lower Bound I(0)	Upper Bound I(1)
1%	3.74	5.06
2.5%	3.25	4.49
5%	2.86	4.01
10%	2.45	3.52

k=4, number of independent variables.

From the above result of bound test provides the F-Statistic calculated value 5.050 is higher than the critical value (Table-2 & 3) at 2.5% significance level. Thus, the null hypothesis of no cointegration can be rejected. It implies that there is a long run relationship among the variable of the model. In addition, t-statistic of LL_{t-1} is -4.65 for k=4, statistically significant at 1% significance level. Therefore, t-statistic is also in favor of long run relationship among the variables of the model.

For estimating short run dynamics, model is transformed again containing coefficient of error correction term (ECT) as follows:

$$\Delta LL_t = \alpha + \sum_{i=1}^{p} \beta_i \Delta LL_{t-i} + \sum_{i=0}^{q_1} \gamma_i \Delta LFC_{t-i} + \sum_{i=0}^{q_2} \delta_i \Delta RD_{t-i} + \sum_{i=0}^{q_3} \mu_i \Delta MR_{t-i} + \sum_{i=0}^{q_4} \tau_i \Delta PL_{t-i} + \sigma ECT_{t-1} + \varepsilon_t \quad \ldots\ldots (3)$$

5.4 Estimated Output

Long run Relation:

Results of long run coefficients are estimated by using ARDL approach, shown below:

$$\widehat{\Delta LL} = -5.60 + 1.87\, LFC - 0.24\, RD - 0.04\, MR - 0.45\, PL$$

t-statistics	-8.20	22.44	-6.48	-4.19	-3.99
Probability ()	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)

According to the estimated output from selected ARDL (3, 2, 4, 4, 4) model, all coefficients are statistically significant even at 1% level. It also indicates that foreign credit has positive relation

with bank liquidity and difference of government saving certificates rate with market rate and the dummy of stock market linked turning points ultimately have negative influences over banks' liquidity in long run.

Short run Relation:

In short run dynamics, ordinary least square (OLS) equation is estimated by using the selected ARDL (3, 2, 4, 4, 4) model. The estimation output gives a negative coefficient ($\sigma = -0.5010$) for lagged error correction term (ECT) and it is statistically significant at 1% level. It implies having a strong speed up adjustment to equilibrium (Table A3).

5.5 Result Interpretation:

According to the equation (3) and corresponding Table-A3, the negative coefficient value of lagged ECT indicates the short-run dynamics is in integration with long-run relationships. As the coefficient is statistically significant at 1% level, it entails that the independent variables (*foreign credit, return rate difference between real saving certificates rate and real bank deposit rate, overnight money market rate* and *dummy of liquidity and stock market linked policy turning points*) cause growth of banks' liquidity in long run. The value of the Table-A3 also signifies that the causal long-run relations are positive for each independent variable at 1% significance level. The coefficient value of -0.5010 implies strong and relatively faster speed of adjustment to equilibrium. It means, if long run equation is distorted i.e., liquidity is influenced in different way that may sustain at best 6 months and afterword it will converge to the original relation.

Banking system liquidity may increase by 1.87 percent for 1.0 percent growth of foreign credit inflow. If gap between real government savings certificate rate and real bank deposit rate expands by 1.0 percentage point, bank liquidity will go down by 24 basis points. A 1.0 percentage point increase in call money rate may decrease bank liquidity by 4 basis point.

6. Diagnostic and Stability of the Model

6.1 Residual Diagnostic

The selected ARDL (3, 2, 4, 4, 4) model is checked following standard econometric tests. Based on Q-Statistics (Correlogram of Residuals) and Correlogram Squared Residual tests result, the model has no auto-correlation or partial auto-correlation among the residuals. The Breusch-Godfrey Serial Correlation LM test result indicates that model has no serial correlation and Breusch-Pagan-Godfrey Heteroskedasticity test results indicate that the model has no serial correlation and no hetroskedasticy among the residuals (Table 4). Normality (Jarque-Bera) test result signifies that residuals are normally distributed (Table 4). Finally, we can conclude that residuals of the model are white-noise.

Table 4: Model Diagnostic Test Results

Test	χ^2	Probability
Breusch-Godfrey Serial Correlation LM test [F(2,12)]	0.015	0.202
Breusch-Pagan-Godfrey Heteroskedasticity test [F(21,14)]	0.649	0806
Jarque-Bera	0.241	0.886

6.2 Coefficient Diagnostic:

Wald Test for coefficients of all independent variable signifies that external balance, foreign credit, return difference, money market rate and policy (dummy) have short run influence over the banks' liquidity(Table -5). Bound test result has already revealed a long run relationship among the variables in this ARDL model (Table -2 & 3).

Table 5: Wald Test Results

Independent Variables	χ^2	Probability
LFC	27.83	0.000
RD	28.11	0.000
MR	23.73	0.000
PL	65.60	0.000

6.2 Stability of the Model:

Goodness of fit of the model is examined through the Actual/Fitted/Residual plot of the unrestricted error correction mechanism (ECM) shows that the model is fitted well. Ramsey RESET test output implies the model is fitted well (Table 6).

Table 6: Ramsey RESET Test (ARDL 3, 2, 4, 4, 4)

t-statistic	F-statistic	Probability
0.861	0.742	0.4047

The robustness of the estimated results is also tested through the cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals of squares (CUSUMQ). Both CUSUM and CUSUMQ remain within the 5 percent critical bound. It implies that model is stable with no systemic change and all coefficients of variables are significant at 5 percent level over the study period (Figure 1 & 2).

Figure 1: Plot of CUSUM Tests

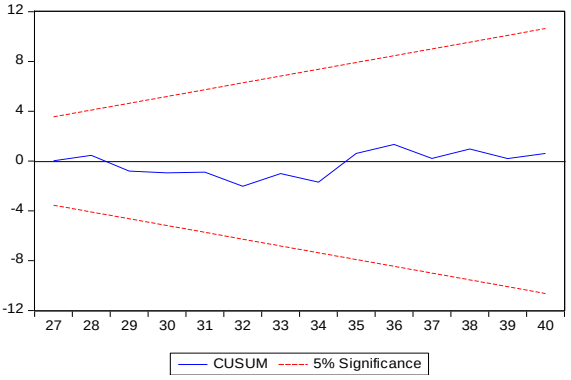
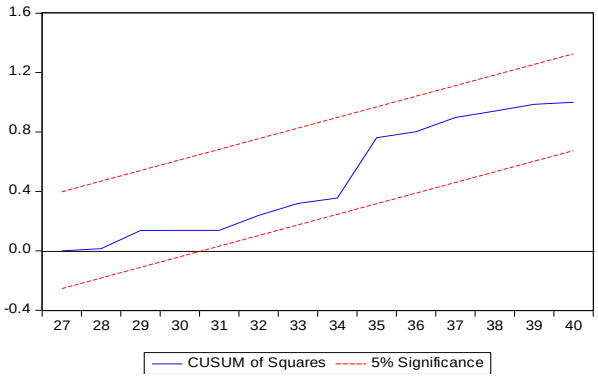


Figure 2: Plot of CUSUM of Square Tests



7. Conclusion and Policy Options

The study empirically establishes the long-run relationship between liquidity in the banking system and its explanatory variables: foreign credit, interest rate difference between real saving certificate rate and real deposit rate, overnight money market rate (call money rate) and dummy of liquidity and stock market linked turning points. It also explores the short-run stability and speed of convergence to reach the long-run equilibrium. In short, the study results indicate that the foreign credit flow has a significant role to liquidity growth, and in our study we found that foreign credit flow increased the level of liquidity in the market. Positive real interest rate difference between saving certificate and bank deposit rate (spread) has a negative association with liquidity growth in the long run. Call money rate also has inverse association with bank liquidity. Once the established relationship between different explanatory variables and liquidity supply break down in the short-run, the model result found that the original relation will get back by 6 months. Hence, for any disruption in banks' liquidity, government or central bank can think about their policy support initiative considering a readjustment period of about 6 months to bring back balance. The study result implies that recent foreign credit flow is widening the credit-liquidity (demand side) response. In addition,

higher non-market responsive rate bearing government saving certificates ultimately feed government borrowing without banking intermediation. Fiscal borrowing through government saving certificate with higher rate needs to be justified to bring back expected response of market interest rate on liquidity supply-credit demand for which a strong fiscal-monetary coordination is also expected.

References:

Acharya, et al., 2011. Crisis resolution and bank liquidity, *The Review of Financial Studies*, Oxford University Press, 2011. Vol. 24(6), pp2166-2205

Archer, S.H., and D' Ambrosio, C.A., 1971. *Business Finance: Theory and Management*, New York, p. 445.

Assaf Neto.,2003. *Finanças Corporativas e Valor. São Paulo: Atlas*, 2003. Retrieved on October 10, 2017 from http://www.ijsr.net/archive/v4i6/SUB155170.pdf

Bangladesh Bank, 2017a. *Monthly Economic Trend (Time series)*, Statistics Department, Bangladesh Bank, August 2017.

_____, 2017b. *Major Economic Indicators*, Monetary Policy Department, Bangladesh Bank, August 2017.

_____, 2017c. *Schedule Bank Statistics*, Statistics Department, Bangladesh Bank, Jan-March 2017.

_____, 2017c. *Bangladesh Bank Quarterly*, Chief Economist's Unit, Bangladesh Bank, March-June 2017.

Begum, M. N., 2017. Is there a relationship between liquidity and profitability in the banking sector in Bangladesh: A panel data analysis. *Bangladesh Bank Policy Note No. 1702*

Brunnermeier, M.K. and Pedersen, L. H., 2009. Market liquidity and funding liquidity, *The Review of Economic Studies*, Oxford University Press, 2009. Vol. 22(6), pp2201-2238

BIS, 2017. BIS global liquidity indicators: methodology, *BIS Quarterly Review*, September 2017.

Chandra, P., 2010. Financial Management. 7 th edition. *McGraw-Hill.* Retrieved on October 27, 2017 from http://www.diva-portal.org/smash/get/diva2:409560/fulltext01

Diamond, D.W., 1997. Liquidity, banks, and markets. *Journal of Political Economy*, The University of Chicago Press, 1997. Vol.105(5), pp928-956.

Diamond, D.W. and Rajan, R. G., 2002. Bank bailouts and aggregate liquidity. *The American Economic Review*, Vol. 92(2), pp38-41.

Diamond, D.W. and Rajan, R. G., 2005. Liquidity Shortages and Banking Crises. *The Journal of Finance*, Vol. 60(2), pp615-647

Domanski et al., 2011. Assessing global liquidity, *BIS Quarterly Review*, December 2011.

Eickmeier et al, 2013. Understanding global liquidity, *BIS Working Papers No 402*. Monetary and Economic Department, Bank for International Settlement.

Freixas, et al., 2011. Bank liquidity, interbank markets, and monetary policy, *The Review of Financial Studies*, Oxford University Press, 2011. Vol. 24(8), pp2656-2692.

Gorton, G. and Huang, L. 2004. Liquidity, efficiency, and bank bailouts. *The American Economic Review*, Vol. 94(3), pp455-483.

Hameed, et al., 2010. Stock market declines and liquidity, *The Journal of Finance*, Vol. 65(1), pp257-293.

Hartlage, A.W, 2012. The Basel III liquidity coverage ratio and financial stability. *Michigan Law Review*, Vol. 111(3), pp453-483.

IMF, 2008. *Global Financial Stability Report*, 2008, International Monetary Fund, Washington, DC. p.xi

Johansen, S., 1988. "Statistical Analysis of Co-integrating Vector", *Journal of Economic Dynamics and Contro*l, 12, 231-54

_____, 1991. "Estimation and Hypothesis Testing of Co-integrating Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 1551-80

Johansen, S. and K. Juselius 1990. "Maximum Likelihood Estimation and Inference on Co-tegration with the Application to the Demand for Money, *Oxford Bulletin of Economics and Statistics*, Vol. 52, pp. 169-210.

Khemraj, T., 2010. What does excess bank liquidity say about the loan market in Less Developed Countries? *Oxford Economic Papers*. Oxford University Press, New Series, Vol. 62(1) pp. 86-113.

Khwaja, A.I. and Mian, A. 2008. Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *The American Economic Review*, Vol. 98(4), pp1413-1442.

Listokin, Y, 2011. Taxation and liquidity. *The Yale Law Journal*, Vol. 120(7), pp1682-1732.

Mancini, et al., 2013. Liquidity in the foreign exchange market: measurement, commonality, and risk premiums, *The Journal of Finance*, Vol. 68(5), pp1805-1841.

Myers, S.C. and Rajan, R. G., 1998. The paradox of liquidity. *The Quarterly Journal of Economics*, Oxford University Press, 1998. Vol. 113(3), pp733-771.

Neuman, A. M., 1936. The doctrine of liquidity, *The Review of Economic Studies*, Oxford University Press, 1936. Vol. 3(2), pp81-99.

Næs, et al., 2011. Stock Market Liquidity and the Business Cycle, *The Journal of Finance*, Vol. 66(1), pp139-176.

Pesaran, M. H., and Shin, Y, 1999. An autoregressive distributed lag modeling approach to cointegration analysis. *Econometrics and Economic Theory in the 20th Century: The Ranger Frisch Centennial Symposium*, S. Storm, Ed. Cambridge University Press, 1999, pp371-413.

Pesaran, M. H., Shin, Y, and Smith, R. J., 2001. Bound testing approaches to the analysis of level relationship, *Journal of Applied Econometrics*, Vol. 16, pp289-326, 2001.

Sarker, M. B., 2014. An analysis of recent slow-moving credit flows. *Seminar paper* presented on June 02, 2014, Executive floor, Bangladesh Bank, Dhaka.

Saxegaard, M., 2016. Excess liquidity and effectiveness of monetary policy: Evidence from Sub-Saharan Africa, *IMF Working Paper No. 06/115*. Retrieved on October 10, 2017 from https://www.imf.org/en/Publications/WP/Issues/2016/12/31/ Excess-Liquidity-and-Effectiveness-of-Monetary-Policy-Evidence-from-Sub-Saharan-Africa-18899.

Schnabl, P., 2012. The international transmission of bank liquidity shocks: Evidence from an emerging market. *The Journal of Finance*, Vol. 67(3), pp897-932.

Shim, J. K. and Siegel, J. G., 2000. Financial Management. 2nd edition; *Barron's*. Retrieved on October 10, 2017 from http://www.diva-portal.org/smash/get/diva2:409560/fulltext01

Appendix

Figure A1: Plot of Individual Data Series

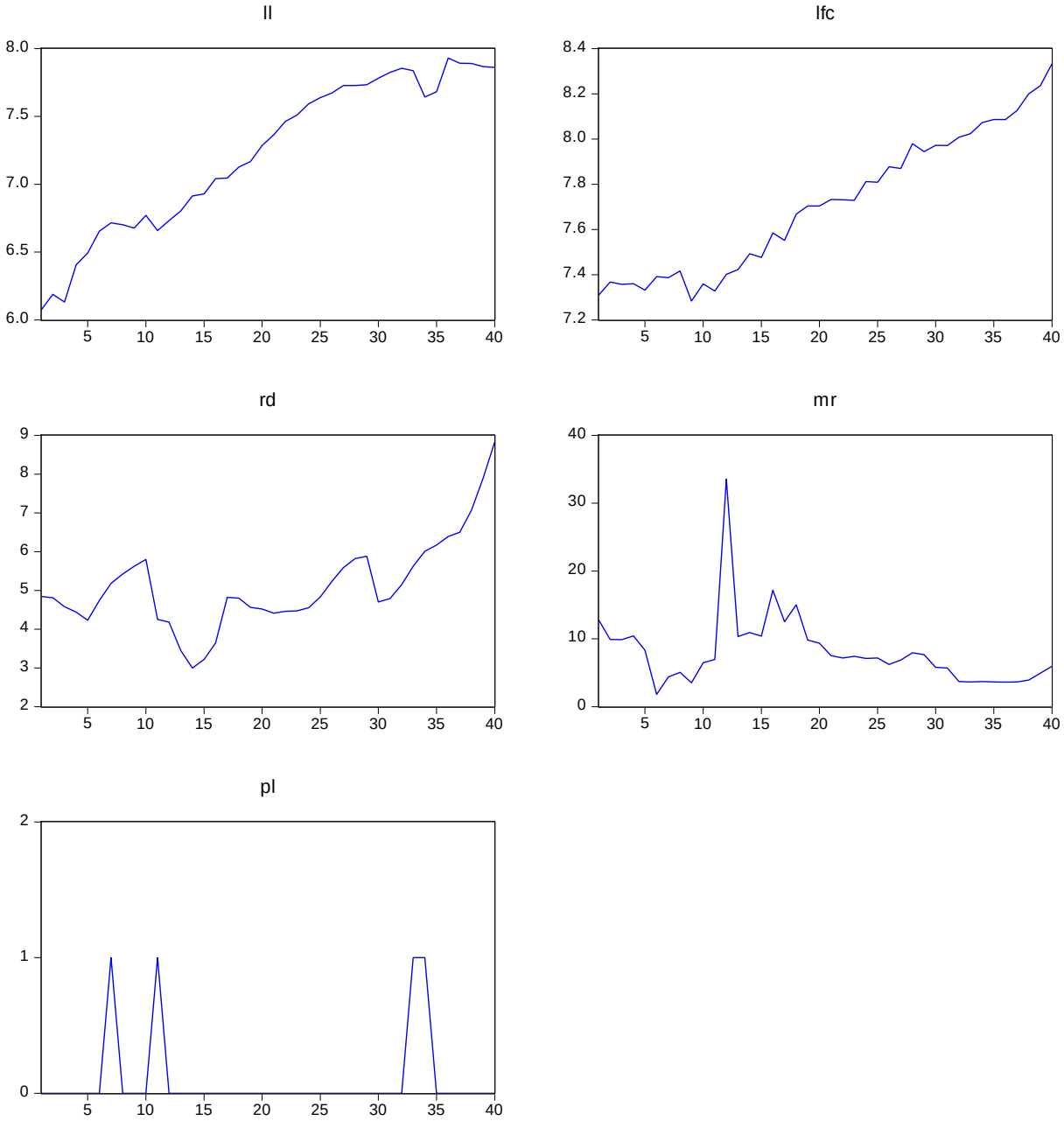


Table A1: Results of Unit Root Test

H_0 :Variable has a unit root (*For ADF & PP*)
H_0 :Variable is stationary (*For KPSS*)

Variables	Natural Log Level						Decision
	Intercept			Intercept & Trend			
	ADF	PP	KPSS	ADF	PP	KPSS	
Liquidity (LL)	- 1.889 (0.334)	-2.201 (0.209)	0.735**	-1.964 (0.601)	-1.925 (0.621)	0.145*	I(1)
Foreign credit (*LFC*)	0.815 (0.993)	-1.076 (0.996)	0.723**	-2.413 (0.367)	-2.727 (0.232)	0.126*	I(1)
Return rates difference (RD) , real saving certificate rate minus real deposit rate	0.755 (0.992)	0.323 (0.976)	0.550**	-0.520 (0.978)	-0.878 (0.948)	0.182*	I(1)
Overnight money market rate or *call money rate* (MR)	-4.291*** (0.001)	-4.233*** (0.002)	0.357	-4.651*** (0.003)	-4.625*** (0.003)	0.117	I(0)
FX reserve (LRS)	-1.487 (0.529)	-1.316 (0.612)	0.769***	-3.907** (0.022)	-2.091 (0.534)	0.062	I(1)
Net foreign asset (LNF)	-1.358 (0.600)	-1.363 (0.598)	0.959***	-1.808 (0.695)	-1.859 (0.669)	0.1976*	I(1)
Savings certificates sales (SS)	-5.555*** (0.000)	-5.555*** (0.000)	0.132	-5.473*** (0.000)	-5.473*** (0.000)	0.132***	I(0)
Total credit flow (CRF)	-2.853* (0.062)	-6.558*** (0.000)	0.381**	-2.832 (0.196)	-7.190*** (0.000)	0.085***	I(I)
Money supply (LM2)	-3.550** (0.012)	-8.060*** (0.000)	0.743	-1.374 (0.852)	-3.445* (0.060)	0.199**	I(1)
Real money supply(LRM2)	-2.312 (0.174)	-2.888* (0.056)	0.744	-3.289* (0.087)	-3.445* (0.060)	0.209**	I(1)
Variables	First Difference						
	Intercept			Intercept & Trend			
Liquidity (LL)	- 6.434*** (0.000)	-6.439*** (0.000)	0.274	-6.691*** (0.000)	-6.989*** (0.000)	0..086	I(0)
External balance (EB), *BOP overall balance*	-15.810*** (0.000)	-17.245*** (0.000)	0.101	-15.750*** (0.000)	-17.170*** (0.000)	0.087	I(0)
Foreign credit (*LFC*)	-10.749*** (0.000)	-10.344*** (0.000)	0.500**	-10.940*** (0.000)	-10.940*** (0.000)	0.500***	I(0)
Return rates difference (RD) , real saving certificate rate minus real deposit rate	-4.140*** (0.002)	-4.122*** (0.002)	0.433*	-4.500*** (0.005)	-4.534*** (0.004)	0.055	I(0)
Overnight money market rate or *call money rate* (MR)	-10.060*** (0.000)	-29.088*** (0.000)	0.133	-9.919*** (0.000)	-28.301*** (0.000)	0.222	I(0)
FX reserve (LRS)	-3.248** (0.025)	-5.340*** (0.000)	0.239	-3.393* (0.067)	-5.305*** (0.000)	0.072	I(0)
Net foreign asset (LNF)	-11.028*** (0.000)	-11.028*** (0.000)	0.087	-10.992*** (0.000)	-10.992*** (0.000)	0.070	I(0)
Savings certificates sales (SS)	-9.938*** (0.000)	-26.87*** (0.000)	0.212	-9.788*** (0.000)	-30.44*** (0.000)	0.210**	I(0)
Total credit flow (CRF)	-2.648* (0.094)	-33.080*** (0.000)	0.171**	-2.628 (0.271)	-40.035*** (0.000)	0.287	I(1)
Money supply (LM2)	-0.455 (0.887)	-6.642*** (0.000)	0.743	-3.277* (0.088)	-16.044*** (0.000)	0.151*	I(1)
Real money supply (LRM2)	-1.558 (0.492)	-8.708*** (0.000)	0.151*	-2.375 (0.384)	-14.72*** (0.000)	0.136	I(1)

***, ** and * denotes statistical significance at 1%, 5% and 10% levels respectively

Table-A2: Summary of Unit Root Test Result

H_0 :Variable has a unit root (*for ADF & PP*)
H_0 :Variable is stationary (*for KPSS*)

Variables	Natural Log Level						Decision
	Intercept			Intercept & Trend			
	ADF	PP	KPSS	ADF	PP	KPSS	
Liquidity (LL)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Foreign credit (*LFC*)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Return rates difference between real saving certificate rate and real deposit rate (RD)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Overnight money market rate or *call money rate* (MR)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
FX reserve (LRS)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)
Net foreign asset (LNF)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Savings certificates sales (SS)	I(0)	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)
Total credit flow (CRF)	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(1)
Money Supply (LRM2)	I(0)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)
Real money Supply (LRM2)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)
Variables	First Difference						Decision
	Intercept			Intercept & Trend			
Liquidity (LL)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
External balance (EB), *BOP overall balance*	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
Foreign credit (*LFC*)	I(0)	I(0)	I(1)	I(0)	I(0)	I(1)	I(0)
Return rates difference between real saving certificate rate and real deposit rate (RD)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
Overnight money market rate or *call money rate* (MR)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
FX reserve (LRS)	I(0)	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)
Net foreign asset (LNF)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
Savings certificates sales (SS)	I(0)	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)
Total credit flow (CRF)	I(1)	I(0)	I(1)	I(1)	I(0)	I(0)	I(1)
Money Supply (LRM2)	I(1)	I(0)	I(0)	I(1)	I(0)	I(1)	I(1)
Real money Supply (LRM2)	I(1)	I(0)	I(1)	I(1)	I(0)	I(0)	I(1)

Table A3: Estimate Results from Error Correction Mechanism

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LL(-1))	-0.075094	0.134015	-0.560343	0.5841
D(LL(-2))	0.469670	0.161985	2.899460	0.0117
D(LFC)	0.732571	0.232155	3.155532	0.0070
D(LFC(-1))	0.414699	0.251513	1.648818	0.1214
D(RD)	-0.110027	0.026266	-4.188967	0.0009
D(RD(-1))	0.043469	0.032376	1.342617	0.2008
D(RD(-2))	-0.026720	0.028512	-0.937162	0.3646
D(RD(-3))	0.025608	0.019672	1.301765	0.2140
D(MR)	0.004318	0.002157	2.002054	0.0650
D(MR(-1))	0.011312	0.002958	3.824003	0.0019
D(MR(-2))	0.000379	0.002392	0.158408	0.8764
D(MR(-3))	0.004550	0.002099	2.168039	0.0479
D(PL)	-0.055715	0.028350	-1.965257	0.0695
D(PL(-1))	-0.035956	0.042949	-0.837178	0.4166
D(PL(-2))	-0.152934	0.042152	-3.628195	0.0027
D(PL(-3))	0.175939	0.036992	4.756156	0.0003
CointEq(-1)	**-0.501085**	**0.107714**	**-4.652007**	**0.0004**

***, ** and * denotes statistical significance at 1%, 5% and 10% levels respectively