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Disaggregate Analysis of Broad Money and Outlook of Key Monetary Aggregates

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Abstract:

This study analyzes and projects various components of broad money from liability side using structural and non-structural models. Our analysis suggest that non-structural models of aggregate variables and structural models of component ratios perform better as compared with non-structural models of component ratios in making projections for monetary aggregates.

Key Words: Monetary aggregates, Model Evaluation, Forecasting

JEL Classifications: C15, C53, E51

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Non-Technical Summary

Monetary aggregates have been considered as important policy variables in the achievement of central bank's mandated objectives. However, the potential role of money in achieving price stability has been criticized, especially during early 90s, due to its weak predictive power in explaining inflation and economic growth. It has been argued that increased financial innovation and resultant change in household preferences had considerably weakened the relationship of money with inflation and growth. Nevertheless, central banks of many emerging and advanced economies, particularly European Central Bank (ECB), continue to focus on the developments of monetary aggregates as they hold that money contains important economic information which helps to predict the future path of inflation and growth.

In this background, this study investigates the behavior of the monetary aggregates, both at aggregate and disaggregates levels, in case of Pakistan by developing various scenarios. The main objective is to formulate models which can predict movements in the monetary aggregates. At the aggregate level, we separately estimated base money (M0) and money multiplier and used them to project broad money. For the disaggregate analysis, our approach is two-fold. First, various ratios of money multiplier are estimated along with base money and then used for broad money projections. Second, to capture preferences of households and importance of financial sector, this study estimates behavioral equation of liability-side components of broad money.

Our results show that incorporation of agents' behavior in the estimation of monetary aggregates plays important role in their projection. This particular feature sets this study apart from the earlier literature, where monetary aggregates projections were mainly carried out at the aggregate level. We also compare the forecasting performance of both aggregate and disaggregate models and found that disaggregate level analysis provides relatively better projection of monetary aggregates in case of Pakistan.

I. Introduction

Monetary aggregates have long been used by the central banks as intermediate targets in achieving their prime objective of price stability. However, since early 90s the role of money in monetary policy making has increasingly fallen out of favor. Some central banks have abandoned targeting monetary aggregates altogether, particularly developed economies, while others continue to pay close attention to their evolution. The main reason monetary aggregates gradually lost their usefulness in the eyes of policy makers was due to a weak and unpredictable relationship of money with inflation and output. Contrary to the general perception that *inflation is always and everywhere a monetary phenomenon*, some empirical studies proved a weak relationship between money and inflation.[1]

It is also argued that financial deregulation and innovation significantly changed the preferences of household and financial sector, by allowing them to economize their cash holdings, and thus destabilized money demand function (Arrau *et al*, 1991, Bernanke, 2006).[2] As a consequence many developed and developing countries changed their nominal anchor and switched from monetary aggregate targeting regime to inflation targeting.

In perspective of controlling inflation through monetary aggregates, debate on money as exogenous or endogenous takes central place in monetary policy formulation. The interpretation of exogenous money assumes that a central bank can influence broad money through controlling narrow money whereas endogenous money does not assume this. According to Monetarist school of thought, from a theoretical standpoint, controlling monetary growth plays critical role in achieving price stability. However, the New Keynesians' approach focuses on interest rate setting for price stability and considers money as endogenous.

Since early 1990s, State Bank of Pakistan (SBP) has used broad money (M2) as an intermediate target, while kept reserve money (RM) as operational target in order to achieve mandatory objective of price stability. However, over the period, high government borrowing from the central bank has undermined central bank's ability to control RM hence strengthening the case of endogeniety of money. The findings of some empirical studies that money demand function is

[1] See for example, Roffia *et al*, (2007), and De-Grauwe *et al*, (2005).
[2] "Increased use of credit, better synchronization of receipts and expenditures, reduced mail float, more intensive use of money substitutes, and more efficient payments mechanisms will tend to permanently decrease the transaction demand for money over time" (Lieberman C., 1997).

unstable in case of Pakistan has further questioned central bank's ability to maneuver monetary aggregates to arrest inflationary pressures.[3] Consequently, in 2006, SBP started to target (implicitly) short-term money market interest rate until August 15, 2009 when it explicitly announced to target overnight money market repo rate within the announced interest rate corridor. As a consequence of this reform, money is now considered endogenous. The SBP does not announce explicit target of M2, but rather provides projections of m2, contingent upon the behavior of different sectors/economic agents of the economy. However, endogeneity of M2 does not mean that it is irrelevant for formulation of monetary policy.

Notably, monetary aggregates contain important information that can still be used for monetary policy framework. Detailed assessment of monetary trends provides useful information regarding demand pressures in the economy. Moreover, recent empirical studies, showing a stable velocity of money and money demand function, have rekindled the debate about the role of monetary aggregate in monetary policy formulation.[4] In addition, a strong empirical relationship of money supply with inflation and GDP growth further highlights the importance of monetary aggregates.[5]

To analyze the significance of monetary aggregate in policy framework, it is pertinent to analyze money both at the aggregate and disaggregated level and to assess the preferences of economic agents – household, businesses and financial institution – through different behavioral relationships. The objective of this study is to investigate the behavior of the liability-components of monetary aggregates, which includes currency in circulation (CIC), demand and time deposits, resident foreign currency deposits (RFCDs), and bank reserves. We have employed both the behavioral equations and data generating processes of time series models in our analysis. Our analysis suggest that non-structural models of aggregate variables and structural models of component ratios perform better as compared with non-structural models of component ratios in making projections for monetary aggregates, which is consistent to earlier empirical studies (Arby, 2000).

[3] See, for example, Moinuddin (2007) and Saqib and Omer (2009).
[4] Qayyum, (2005), Omer, (2010), Jan and Bokhari (2012) unpublished manuscript (forth coming).
[5] For studies advocating strong positive relationship between money supply and economic growth, see Ali *et al*. (2008), Mohammad *et al*. (2009), Jawaid et al. (2010), and Jawaid et al. (2011). For studies supporting strong positive relationship between money supply and inflation, see Nasim (1997), Kemal (2006), and Khan and Schimmelfenning (2006).

Next section provides a historical overview of the evolution of monetary operations in Pakistan, followed by section III, which delineates stylized facts of the monetary aggregates during 1992-11. Section IV provides estimation of monetary aggregates and its components. Section V describes data and different variables used in the analysis. Section-VI reports empirical estimation and discusses the results. Section VII describes forecasting evaluation of non-structural models. Section VIII narrates the simulation and discusses forecasting of broad money and the last section concludes.

II. Evolution of Monetary Operations

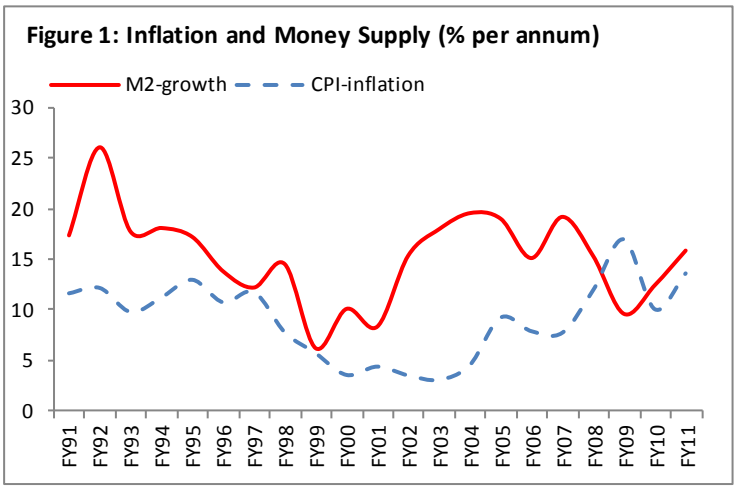
During 1972-1992, SBP carried out its monetary and credit operations by exercising direct controls on interest rates and credit rationing. As a part of financial sector reforms initiated in early 1990s, SBP discontinued direct intervention in the market and adopted a market-based monetary and credit management system. In 1992, SBP introduced auction of governments' treasury bills (6-months T-bills). Moreover, SBP replaced the system of credit ceiling with a system in which banks were free to extend credit within limits in relation to credit-deposit ratio. As a step forward, SBP eventually abolished the use of credit-deposit ratio as an instrument of credit control in 1995 as it was against the spirit of financial market liberalization and introduced *indicative* annual targets of monetary aggregates. Under this approach the targeted monetary and credit expansion was being realized by maintaining reserve money through various techniques like open market operations, discount rate, changes in cash reserve requirements (CRR)and statutory liquidity requirements (SLR). During the period 1988-03, monetary and credit policies continued to operate within the framework of Annual Credit Plan in which the credit expansion during the year was calculated on the basis of growth and inflation targets set by the government and the forecast of balance of payments (to gauge NFA of the banking system). In 2006, SBP abolished the annual credit plan and implicitly started to target short-term money market interest rate until 15th August 2009 when SBP explicitly announced to target money market repo rate within the announced interest rate corridor.

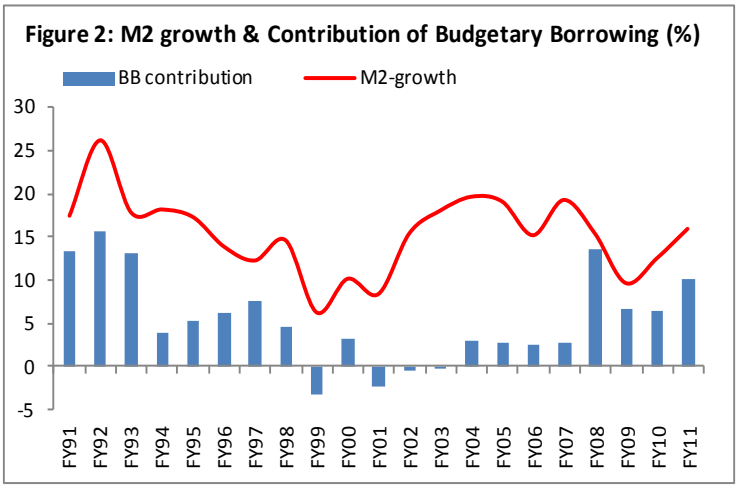
III. Stylized facts

During the last two decades, nominal money increased, in absolute term, by 16 times to the level observed in FY90, with an average growth of almost 15 percent per annum. This phenomenal growth in money contributed to an increase in general prices level; CPI inflation witnessed a rise

of 6 times compared to FY90 level. A relatively high growth in broad money compared to the price level posits an ongoing monetization of the economy. On the other hand, the real money balances increased by 2.8 times compared to FY90, closely matching the 2.2 times rise in real income during the same period. In purchasing power terms, a Rupee in FY90 is equivalent to Rs 1.54 in FY11 signifying erosion of around 54 percent in the purchasing power.[6] To highlight which component of M2 contributed how much in the increase in money growth, this section analyzes the behavior of various components of M2 both from asset and liability side.

Two factors that contributed significantly in the creation of money during the last two decades were government borrowings from the banking system for budgetary support and foreign capital inflows. There are two episodes, during this period, where money supply remained exceptionally high (Figure-1). First episode was observed in early 90s,[7] largely due to significant government borrowing from the banking system to finance budgetary gap (Figure-2). In addition, a significant increase in number of financial institutions as well as permission to residents to open foreign currency accounts in the early 90s boosted the deposits of the banking system which increased money creation.[8] Second episode of high money growth took place in year 2001





[6] The value obtained by simply multiplying Rs. 1 by percentage increase in GDP deflator (in purchasing power terms) from FY90 to FY11. However, the value stands at 6.2 (or 515%) by using percentage increase in consumer price index (CPI) in the same period.

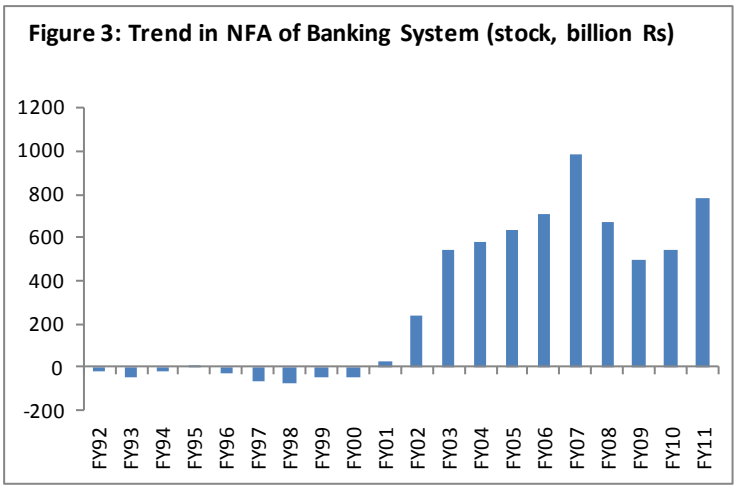
[7] Average (geometric) growth in M2 during 1992-95 was around 19.8 percent.

[8] Introduction of foreign currency accounts in early 90s induced the general public to deposits their hard currency in banks. As foreign currency holding is considered to be store of value (saving instrument) and medium of exchange in informal economy

mainly due to capital inflows in the form of remittances, payments under logistic support and official loans. Moreover, monetary policy remained accommodative during period of 2001–05, where interest rates were kept at historically low levels. From FY08 onwards, the government again relied heavily on the banking system for budgetary support, particularly through borrowing from the SBP. However, it does not reflect in broad money growth as net foreign assets (NFA) during the period were contractionary, therefore, offsetting the increase in net domestic assets (NDA).

Net Foreign Assets of the Banking System

NFA of the banking remained contractionary during most of the 90s and a major portion of the money supply was backed by the creation of domestic assets. On the other hand, during 2000s NFA witnessed a significant expansion and remained relatively more erratic (Figure-3). NFA started to pick up in 2001 on account of availability of external financing from International financial institutions (IFIs) and aggressive efforts of SBP to increase liquid reserves through *kerb* market purchases and foreign exchange swaps.



The initial increase in NFA received a major push after October 2001 in the form of sustained remittances, especially from USA, and payments for logistic support. Having received access to the external financing, government retired its debt from the SBP and relied on non-bank borrowing through NSS and PIBs. As a result of the government retirement, NDA of SBP significantly decreased during 2001-04. During 2004-05, government faced a shortfall in external receipts, which resulted into a moderate expansion in NFA. However, a phenomenal increase in NFA was observed in 2007 that was mainly driven by the hefty inflows under logistics support. A substantial increase in the foreign direct and portfolio investments and aid from international agencies also contributed in the NFA expansion.

(Aslam (1998)). A reasonable rate of return on these deposits and a continued depreciation of Pak Rupee resulted in sharp growth in these deposits up till May 1998, when these deposits were frozen.

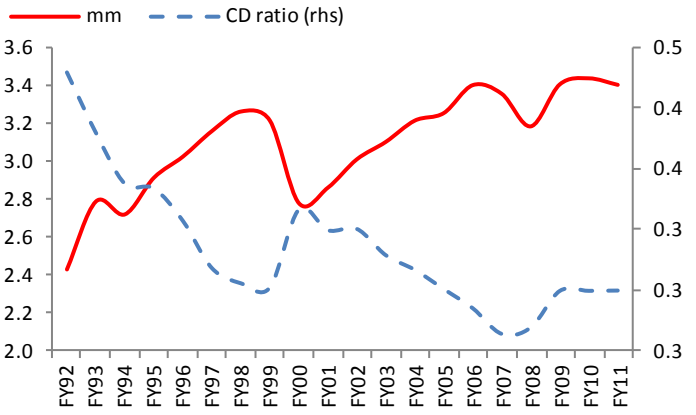
Unpredictability of foreign inflows and balance of payment situation manifested once again in 2008 when a rapid deterioration in balance of payment resulted in a sharp decline of NFA. Government financing from external sources also fell short of the target which forced government to rely more on domestic borrowing, especially on borrowing from the central bank. This trend of contraction in NFA was reversed in 2010 when government received funds in the form of logistic support and a loan from IMF for bridge financing (USD 1.1 billion). At the same time, capital and financial account also recorded some improvement, which is reflected in NFA expansion during FY10 and FY11.

Currency in Circulation

Currency in circulation (CiC) is an important component of money supply that signifies the behavior of economic agents regarding their liquidity preference. These behaviors are reflected in money multiplier in the form of different ratios: currency-deposit ratio (CD ratio); excess reserve-deposit ratio (ED ratio); and required reserve-deposit ratio (RD ratio). It is through the variation in money multiplier that translates changes in CiC into the overall money supply.

The CD ratio declined by 40 percent during 1990s (Figure 4), while money multiplier increased by 33 percent, thus increasing the money supply considerably during 1990s, with an average growth of around 15 percent per annum. In fact, founding of new private banks offered opportunity for the general public to open accounts, and introduction of foreign currency deposit (RFCDs) accounts – both for residents and non-residents – enhanced the deposit base of the banking system and thus reduced the CD ratio during this period.[9] Moreover, dollarization in the economy gained pace during mid 1990s due to frequent devaluation of domestic currency and rising inflationary pressure[10]. However, with freezing of the foreign currency deposits, subsequent to the nuclear detonation in

Figure 4: Currency-Deposits Ratio and Money Multiplier



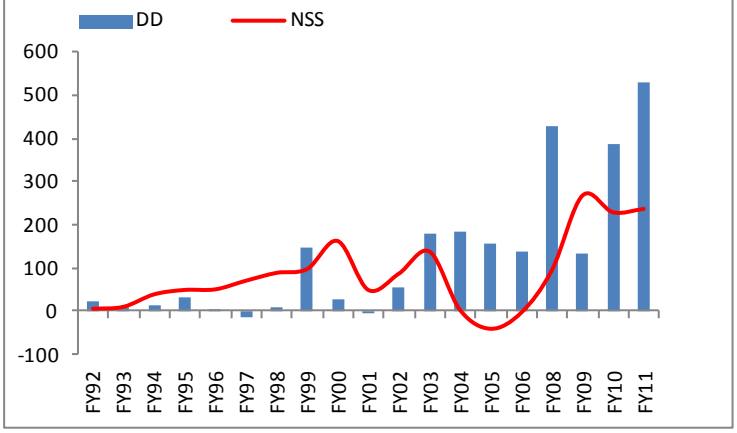
[9] New Banks include Bank Al-Habib, Soneri, Union Bank, Mehran, Indus Bank, Prime Commercial Bank, Askari Commercial Bank, Bolan and Capital Bank.
[10] Dollarization refers to the substitution of foreign currency, mostly USD, against domestic currency.

FY98, coupled with heavy reliance of government on non-bank borrowings during FY00 induced the general public to hold money in hand, raising CD ratio during this period.

During the last decade, increasing financial innovation, particularly electronic fund transfer, credit cards and ATMS, have contributed in the decline of CD ratio. However, more recently, CD ratio has started to move upward probably due to the introduction of withholding tax on cash withdrawal from banks and negative real return returns on deposits.[11]

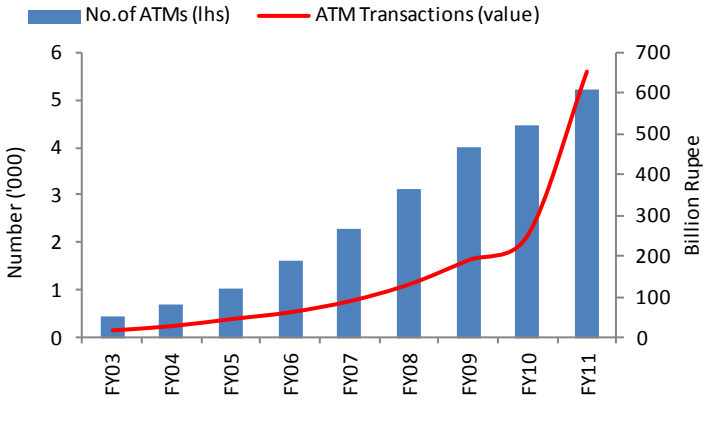
After continuous decline during 1990s, CD ratio observed a significant rise in FY00. This rise in CD ratio seem to be a direct result of higher government borrowing from the central bank, since it increases currency into the system; government borrowing from SBP rose by 48 percent (YoY) during FY00. Higher investment in national saving schemes (NSS) by the general public in FY00 may also have reduced the deposit base of the banking system, causing CD ratio to rise (Figure-5). It is pertinent to mention that over 75 percent of budget deficit was financed through NSS in FY00. Both factors—borrowing from SBP and NSS— reveal that the sources of budget deficit financing were principal factors behind increase in CD ratio in FY00.

Figure 5: NSS and Demand Deposits (yearly flow, billion Rs.)



CD ratio started to decline again during FY01-07. Two vital factors could be considered behind such a fall in CD ratio. Firstly, strong inflow of remittances which helped in increasing the deposits base of the commercial banks. Secondly, increase in financial transactions

Figure 6: Number of ATMs and Transactions



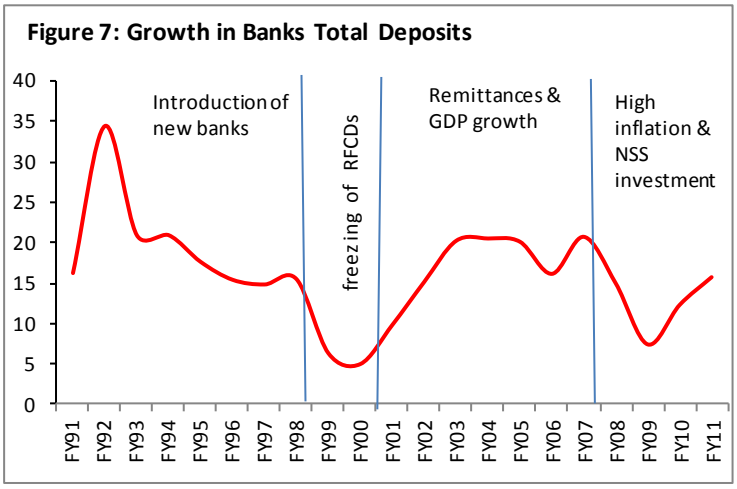
[11] Government imposed withholding tax @ 0.1% and 0.2% in 2005 and 2006 respectively on cash withdrawals from banks exceeding Rs 25,000.

using internet banking, ATMs and credit cards (Figure-6).

Since credit card is a convenient mode for payment, an increase in use of credit cards can reduce cash demand from individuals and, therefore can cause a decrease in CD ratio. The impact of automatic tellers machines (ATMs) on cash demand is, however, not clear as there are two opposing theories in this regard. First theory suggests that more use of ATMs makes it unnecessary to carry cash for transaction purposes, thereby lowering demand for currency holdings (Simwaka, 2006). The other theory suggests that ATMs enhances the cash availability thus increase CD ratio (Cassino *et. al*., 1997). Considering that CD ratio declined during FY01-07 whereas number of ATMs and value of transactions grew significantly during this time, it appears that first theory works in case of Pakistan (Figure 6). Although usage of ATMs continues to grow after FY07, CD ratio recorded an uptick in FY08; this could be due to the higher inflation during this period.

Bank Deposits

While the currency in circulation shows central bank's control over reserve money, the behavior of deposits determine the overall level of liquidity in the system. The share of total deposits in M2, which is almost 75 percent, also highlights its importance.



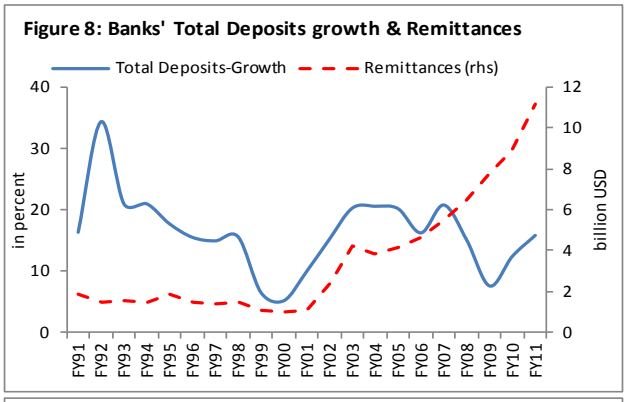
To analyze the growth pattern of total deposits, we divided it into four periods (Figure-7). During the first period (1991-97), deposits grew with an average growth of over 20 percent. The main reasons for this growth are (1) the entry of new banks in the private sector, which expanded deposit base of the banking system, and (2) higher interest of general public in opening of foreign currency accounts, which were introduced in 1991.[12] Following the spike in 1991-92, the growth in deposits started to moderate as the banks mobilized all the untapped deposits.

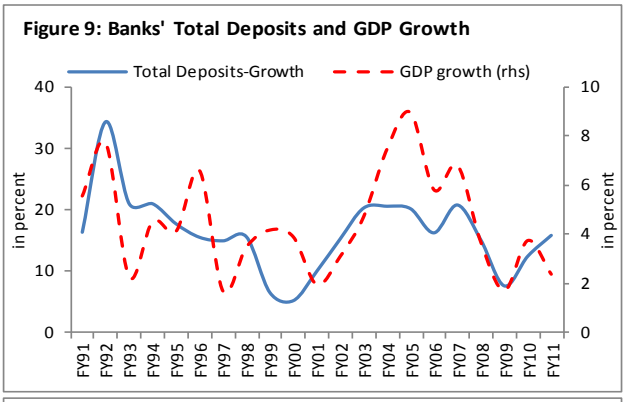
[12] F.E. Circular No.2 1991, Exchange Control Department

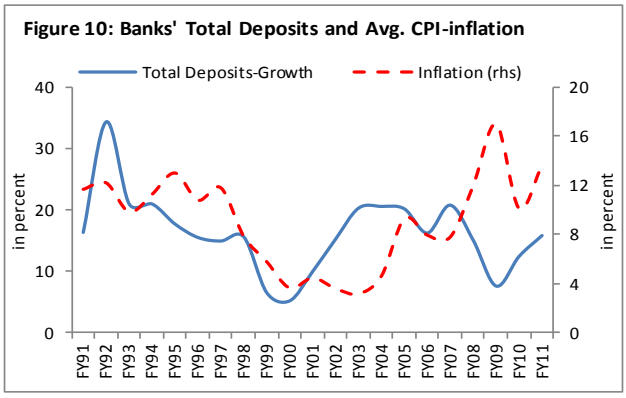
In the second episode (FY98-99), the growth in deposits observed an abrupt decline reaching to its lowest level in 20 years. It was solely the impact of withdrawals of foreign currency accounts frozen after nuclear detonation in May, 1998.[13]

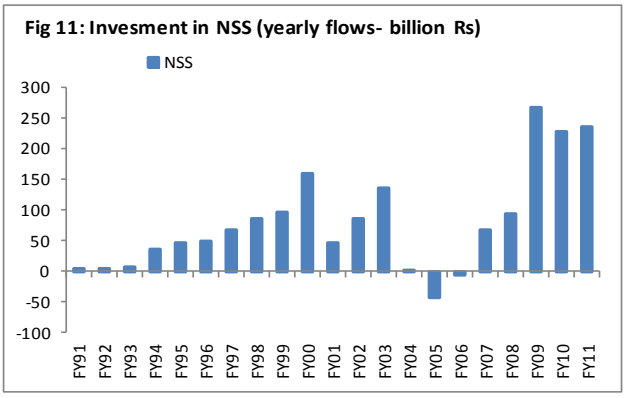
In the third period (FY01-07), deposits continued to grow mainly on account of higher inflows of remittances and robust GDP growth (Figure 8 and 9). Generally, a rise in economic activity translates into higher savings and thus generates more deposits (Dadkhah and Mookerjee., 1988). In case of Pakistan, deposits growth and GDP growth appears to be positively correlated, especially during 2000s (Figure 9).

In the fourth episode (FY08-11), although remittances continued to increase, the growth in deposits started to decelerate. Contrary to previous episodes, inflation remained exceptionally high in this period, and could be one reason behind deceleration in deposits growth as it increases the transactional demand for money (Figure 10). Another reason seems to be the higher investment of general public in National Saving Schemes (NSS) during this period, which caused deposits to decelerate (Figure 11).



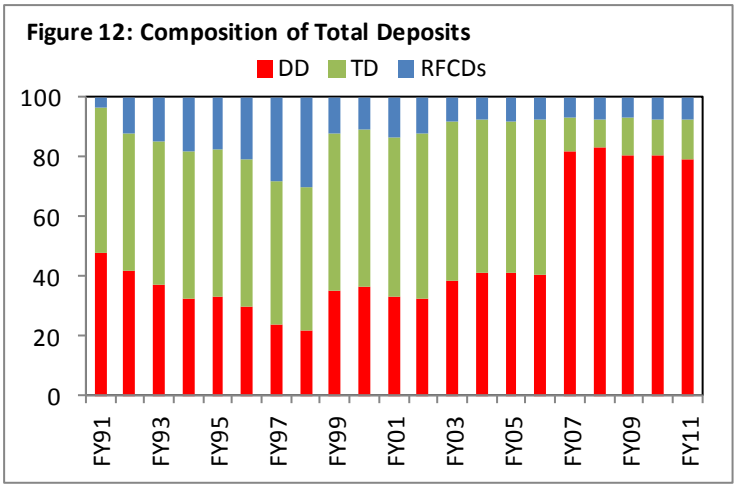






[13] RFCD, which constituted almost one 3rd of total deposit in 1998, were decreased by 56 percent in 1999.

Analyzing the composition of total deposits during 90s, we find a remarkable shift in the preference of depositors; share of demand deposits (DD) in total deposits declined to 22 percent in 1998 from 47 percent in 1991 (Figure 12). While for the same period, share of Resident Foreign Currency Deposits (RFCDs) grew up to 30 percent from 4 percent. The surge in RFCDs can be attributed to the depositor's desire to hedge their currency holdings in view of frequent devaluation of Pak Rupee and high inflation during 90s.[14] The share of time deposits in total deposits, nonetheless, remained same and hovered around 50 percent. A sudden increase in the share of demand deposits in 2007 and a simultaneous decline in time deposits were due to a definitional change of demand and time deposits.[15]



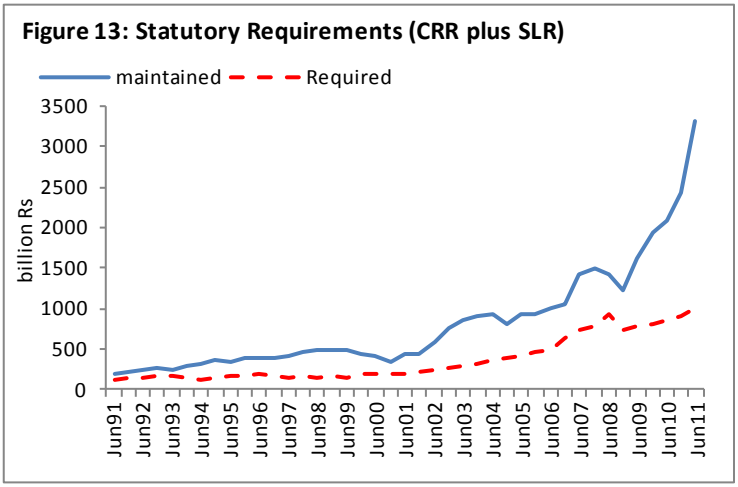
The share of RFCDs in total deposits continued to rise in successive years, and reached to 30 percent before they were frozen on 28th May 1998, when Pakistan carried out nuclear tests. Although depositor's rights were temporarily suspended, they were authorized to convert their foreign currency accounts into domestic currency. This temporal suspension, however, had a lasting impact: average share of RFCDs in total deposits during 1999-11 was only 10 percent compared with 18 percent during 1991-98. Freezing of foreign currency accounts marked a shift in the pattern of compositional share. In contrast to 1990s, the share of RFCDs in total deposits either remained stagnant or declined, whereas share of DD increased.

Reserves Requirements

Changes in reserve requirements (RR) also have an impact on the evolution of money multiplier. RR is an important and direct monetary policy instrument for countries where financial sector is less developed or have relatively large informal financial sector (Chu, 2006). Reserves requirement is non-remunerated and serves as interest foregone or reserves "tax", where it effect

[14] The exchange rate depreciated around 50 percent from Rs.22.3/USD in 1991 to Rs.44.2/USD in 1998.
[15] Effective 22-July 2006, time deposits of less than 6 months have been included in demand deposits and effective 4-August 2007, time deposits of less than one year have been included in demand deposits.

directly the depository institutions and customers (Feinman, 1993). In Pakistan, RR has changed quite frequently during the last two decades after remaining constant at 5 percent since 1968. In October 1991, SBP introduced special cash deposit (SCDs) – a remunerated CRR- when banks were required to maintain 7 percent of their outstanding credit in addition to 5 percent non-remunerated CRR. The SCDs requirements were dropped in 1992; nevertheless, the banks were redirected in 1995 to maintain SCDs, first, 1.5 percent and then 3.5 percent in addition to CRR. In 1997, SBP solicited the banks to maintain CRR at 5 percent on weekly basis with minimum 4 percent on daily basis. Afterwards, CRR has changed in the range of 3.5 to 9 percent on weekly basis and 2.5 percent to 8 percent on daily basis. In addition to that, the banks were also required to invest certain amount –as statutory reserves requirement (SLR) - of their demand and time liabilities in government's papers and this required ratio has also changed quite frequently, particularly during the last two decades, in the range of 13 percent to 40 percent of total demand and time liabilities. Interestingly, during the last three years (FY09 to FY11), the banks invest heavily in the government securities due to lower risk entailed to these securities and high finance demand of the government for budgetary support (Figure 13).



Other Deposits with SBP

Other deposits with SBP includes SBP's staff fund, sundry deposit[16] account except IMF account, counterpart fund, and deposits of foreign central banks, governments and international organizations. Ratio of other deposit with SBP is fairly stable over time except some volatility witnessed during early 90s on account of delayed settlements of some of the deposits. Therefore, there is no significant effect of other deposit on both base money and broad money, while its effect is nullified in money multiplier. Similarly, ratio of currency in tills of scheduled banks has

[16] These are deposits of international organizations (including non-governmental organizations) to provide credit line to the Central Bank.

remained fairly stable over time; nevertheless in absolute term its shows significant rise during the last ten years as more private and foreign banks enter the domestic financial market and existing banks expanded their network across the country.

IV. Empirical Estimation

Using liability side of the balance sheet, broad money (M2) is estimated, where M2 is multiple of reserves money, as

$$Broad\ Money(M2) = money\ multiplier(mm) * Reserve\ Money(RM) \qquad (1)$$

In this study we develop different scenarios to estimate and forecast broad money. In the first scenario, broad money is forecasted using non-structural model, where stationary time series is modeled via recursive and non-recursive linear filter. The generalized form of a non-stationary time series is as following

$$\left(1 - \sum_{i=1}^{p} \propto_i \ L^i\right)(1 - L)^d \ X_t = \left(1 + \sum_{i=1}^{q} \delta_i \ L^i\right)\varepsilon_t \qquad (2)$$

Where, L is the lag operator, $\propto_i$ is the parameter of autoregressive part, d represents order of integration, δ_i shows moving average part, X_t is real number with t as integer index and ε_t is independent and identically distributed (i.i.d.).

In the second scenario, we apply non-structural model to forecast both money multiplier (mm) and reserve money and then calculate M2 using equation (1).

In the third scenario, different components of money multiplier are forecasted using ARIMA process and then calculate money multiplier (mm) using its modified form as follows

$$Money\ Multiplier = (1 + cd_t + od_t)/(exd_t + rd_t + cd_t + od_t + citd_t) \qquad (3)$$

Where cd_t is currency in circulation to total deposits ratio, exd_t represents excess Reserves to total deposits ratio, od_t, rd_t and $citd_t$ are other deposits, required reserves and cash in tills to total deposits ratios respectively.

Once the mm is calculated using equation (3), the M2 is then calculated using equation (1).

The instability of the money multiplier signifies the changing behavior of households and responses of banking sector to underlying economic fundamentals (Figure-4). The main reasons behind variability of money multiplier, during the last two decades, are perhaps due to the

financial sector liberalization and development and evolution of market-based monetary and credit management system. This enabled economic agents to enhance their portfolio management. Therefore, in the fourth scenario, we model each component of MM using behavioral relationships that include household preferences and financial sector.

Household Preferences

Currency and deposits are two major components of money and are considered to be close substitutes. The households keep cash in hand for buying goods and services as it is a convenient and cost effective medium of exchange. On the other hand, to avoid opportunity cost of holding money households also keeps a part of their money in deposit taking institutions. Since currency is one of the major parts of money, estimation of demand for currency should have same theoretical basis as that of demand for money. Following is the functional form of currency

$$(currency)_t = f((gdp^{fc})_t, (interest\ rate)_t,\ (cpi)_t, (fd)_t, \dots) \quad (4)$$

Where $(gdp^{fc})_t$ is gross domestic product, where transactional demand for money increases with the economic activity, $(interest\ Rate)_t$ represents opportunity cost of holding money, $(cpi)_t$ is a consumer price index representing price level; a proxy for nominal yield on physical assets and has positive impact on cash in hand, $(fd)_t$ indicates financial deepening (M2/GDP ratio) that has a negative impact on currency held by economic agents.

Similarly the functional form of demand and time deposits are as following

$$dd_t = f((gdp^{fc})_t, (interest\ rate)_t, cpi_t, (fd)_t, (roa)_t, (rem)_t, (er)_t, (tr)_t, \dots) \quad (5)$$

Where, $(rem)_t, (er)_t,\ (roa)_t\ and\ (tr)_t$ represent total workers' remittances, exchange rate, rate of return on alternative assets and tax rate respectively.

Since currency and deposits are considered as close substitute to each other, we estimate both variables simultaneously.

Financial sector

This study captures the behavior of financial sector using excess reserves, which is the non-remunerative reserve maintained with SBP- over and above the required reserves ratio, as follows.

$$ex_t = f((ipi)_t,\ (bon.rate)_t,\ (crr)_t, \dots) \qquad (6)$$

Where ipi_t represents economic activity in the economy, $(bon.Rate)_t$ is the rate of return on government's paper, $(crr)_t$ is the cash reserves requirement of SBP. Some empirical studies also used variables like economic uncertainty (deviation of economic output from potential level), treasury settlement, interest rate deviation, carry-in transaction etc. Since we are using quarterly data and time series of some variable is not available, therefore, we stick to these three determinants of excess reserves to measure the financial sector behavior.

Since most of the variables in equation (4) to (6) are endogenous therefore, we use Johansen co-integration (1992) to determine household behavior and financial sector response.

V. Data Description

We use quarterly data of different variables from 1992 to 2011. These data is collected from various statistical publications of SBP. The time series of excess reserves is calculated by taking the difference between commercial banks' deposits maintained with SBP and actually required. Since we are using quarterly data, therefore, industrial production index (IPI) is used instead of gross domestic product. Workers' remittances are the monthly sum of respective quarter. Consumer prices index represents general prices level in the economy. Exchange rate is the average of daily rates of respective quarter. We use equity index as a rate of return on alternative assets. For interest rate structure, we use weighted average lending and deposit rates and the weighted average rate of 6-months T-bills. All the variables are in log form except interest rate. Augmented Dickey-Fuller (ADF) is used to check stationarity of the variables (Appendix-B, Table-1).

VI. Estimation Results

Scenario-I

In the first scenario, broad money is forecasted using non-structural model, where stationary time series of M2 is modeled via recursive and non-recursive linear filter as following

$$(1-\beta_1 L^2)\,(1-L)\,m2 = \alpha_0 + (1+\emptyset_1 L^2 + \emptyset_2 L^3 + \emptyset_3 L^4)\varepsilon_t \qquad (7)$$

$$\beta_1 = \begin{Bmatrix} 0.66 \\ (7.04) \end{Bmatrix}, \alpha_0 = \begin{Bmatrix} 0.03 \\ (4.96) \end{Bmatrix}, \emptyset_1 = \begin{Bmatrix} -0.68 \\ (-11.82) \end{Bmatrix}, \emptyset_2 = \begin{Bmatrix} -0.27 \\ (-3.78) \end{Bmatrix}, \emptyset_3 = \begin{Bmatrix} 0.78 \\ (16.59) \end{Bmatrix}$$

$adj.R^2$ (0.62); DW (2.09); σ_{resid} (0.019); t − statistics in parenthesis

The estimates of all autoregressive and moving average coefficients are highly significant at conventionally level. Moreover, the residual of estimated model is white noise with minimum standard error, thus indicating overall stability of the model. High coefficient of autoregressive term (β_1) shows that the inertial impact of m2 is high. Specifically, the last period contributes around 66 percent in the change of current period broad money. Likewise, the impact of a shock to M2 takes at least two to four quarters to fade away. These shocks or measurement errors reflected from the significant coefficients of the moving averages.

Scenario-II

In the second scenario, non-structural models for money multiplier and reserve money are estimated as following

$$(1-\gamma_1 L^2)\,(1-L)\,mm = \alpha_0 + (1+\emptyset_1 L^1)\varepsilon_t \qquad (8)$$

$$\alpha_0 = \begin{Bmatrix} 0.01 \\ (1.82) \end{Bmatrix}, \quad \gamma_1 = \begin{Bmatrix} -0.29 \\ (-2.50) \end{Bmatrix}, \qquad \emptyset_1 = \begin{Bmatrix} -0.34 \\ (-2.90) \end{Bmatrix}$$

$adj.R^2$ (0.16); DW (2.02); σ_{resid} (0.05); t − statistics in parenthesis

The significance of autoregressive coefficient $'\gamma_1'$ of money multiplier suggests that two subsequent periods are correlated with each other, while the impact of innovation $'\emptyset_1'$ in money multiplier would only last one time period.

$$(1-\delta_1 L^1 - \delta_2 L^2)\,(1-L)\,rm = \alpha_0 + \beta\, seas(2) \qquad (9)$$

$$\alpha_0 = \begin{Bmatrix} 0.01 \\ (1.99) \end{Bmatrix}, \delta_1 = \begin{Bmatrix} -0.35 \\ (-3.15) \end{Bmatrix}, \delta_2 = \begin{Bmatrix} -0.32 \\ (-2.99) \end{Bmatrix}, \beta = \begin{Bmatrix} 0.08 \\ (5.11) \end{Bmatrix}$$

$adj.R^2$ (0.40); DW (2.1); σ_{resid} (0.05); t − statistics in parenthesis

The reserve money is also correlated with its past as reflected from the significant coefficients of two autoregressive terms. In addition, reserve money also depicts seasonality pattern in its trend particularly during second quarter of each year.[17]

The estimates of all autoregressive coefficients of both models are highly significant. The residuals of both estimated models are stationary and standard errors are at minimum.

Both the money multiplier and reserve money are forecasted using these non-structural models and then calculated the broad money by multiplying both variables.

Scenario-III

In the third scenario, various components of money multipliers are estimated using Box-Jenkins methodology. These components include currency-deposit ratio, excess reserves-deposits ratio, required reserves-deposit ratio, other deposits and cash in tills deposit ratio. The non-structural model of each variable is following

Currency-deposit ratio:

$$(1 - \zeta_1 L^1 - \zeta_2 L^2 - \zeta_3 L^3 - \zeta_4 L^4)\, cdratio = \alpha_0 + (1 + \eta_1 L^1 + \eta_2 L^2)\varepsilon_t \qquad (10)$$

$$\alpha_0 = \begin{Bmatrix} 0.31 \\ (18.99) \end{Bmatrix}, \quad \zeta_1 = \begin{Bmatrix} 0.27 \\ (2.50) \end{Bmatrix}, \quad \zeta_2 = \begin{Bmatrix} -0.45 \\ (-5.49) \end{Bmatrix}, \quad \zeta_3 = \begin{Bmatrix} 0.36 \\ (3.27) \end{Bmatrix}, \quad \zeta_4 = \begin{Bmatrix} 0.51 \\ (6.05) \end{Bmatrix},$$

$$\eta_1 = \begin{Bmatrix} 0.09 \\ (3.48) \end{Bmatrix}, \quad \eta_2 = \begin{Bmatrix} 0.97 \\ (66.27) \end{Bmatrix}$$

$adj.R^2$ (0.78); DW (1.95); σ_{resid} (0.02); t − statistics in parenthesis

Currency –deposit ratio is correlated to its past value as shown in high significant coefficients of auto-regressive terms. In addition, the innovation occurs in CD ratio last for only two periods.

Excess reserves-deposits ratio:

$$(1 - \kappa_1 L^1 - \kappa_2 L^4)\,(ex.res/dep\ ratio) = \alpha_0 \qquad (11)$$

$$h_t = \rho_0 + \varpi_1 \epsilon_{t-1}^2 + \lambda_1 h_{t-1} \qquad (11.1)$$

[17] The average growth of reserve money in Q2 is 10 percent during FY91 to FY11, while it shows a growth of 0.7, 1.7 and 1.2 percent in Q1, Q3 and Q4 respectively. Anecdotal evidence suggests that high growth in reserve money in Q2 each year is mainly due to two reasons. First, normally revenue collection in Q2 (particularly in October and November) slows down and government turns to SBP borrowing to fill the revenue-expenditure gap. Second, schedule banks lodge higher claims for refinance with SBP against their lending under export finance scheme as in this period the export of raw cotton and its related products starts.

$$\alpha_0 = \begin{Bmatrix} 0.03 \\ (7.56) \end{Bmatrix}, \quad \kappa_1 = \begin{Bmatrix} 0.39 \\ (4.58) \end{Bmatrix}, \quad \kappa_2 = \begin{Bmatrix} 0.34 \\ (3.85) \end{Bmatrix}, \quad \rho_0 = \begin{Bmatrix} -3.5E-06 \\ (-1.64) \end{Bmatrix}, \quad \varpi_1 = \begin{Bmatrix} 0.09 \\ (1.45) \end{Bmatrix},$$
$$\lambda_1 = \begin{Bmatrix} 0.89 \\ (17.08) \end{Bmatrix}$$

$adj.R^2$ (0.26); DW (1.96); σ_{resid} (0.02); t − statistics in parenthesis

The significant coefficient of AR(p) shows that current value of excess reserves-deposit ratio (ERD) is correlated with the past values. On the other hand, the variance of the ERD ratio is observed as time dependent. In order to control for conditional hetroskedasticity, the univariate equation is re-estimated by incorporating ARCH/GARCH effects. ϖ_1 and λ_1 are coefficients of ARCH and GARCH respectively.

Required reserves-deposit ratio:

$$(1 - \nu_1 L^1)\,(rr/dep\ ratio) = \alpha_0 \qquad (12)$$

$$h_t = \varrho_0 + \varphi_1 \epsilon_{t-1}^2 \qquad (12.1)$$

$$\alpha_0 = \begin{Bmatrix} 0.05 \\ (32.82) \end{Bmatrix}, \quad \nu_1 = \begin{Bmatrix} 0.65 \\ (13.42) \end{Bmatrix}, \quad \varrho_0 = \begin{Bmatrix} 1.6E-05 \\ (11.05) \end{Bmatrix}, \quad \varphi_1 = \begin{Bmatrix} 1.39 \\ (3.95) \end{Bmatrix}$$

$adj.R^2$ (0.06); DW (2.10); σ_{resid} (0.01); t − statistics in parenthesis

The significance of AR(1) coefficient shows that past information also explain the current value of required reserves-deposit ratio. We also use ARCH effect to control for time varying conditional variance of the variable, which is significant at conventional level.

Cash in tills-deposit ratio:

$$(1 - \chi_1 L^4)\,(cash\ in\ tills) = \alpha_0 + (1 + \psi_1 L^1 + \psi_2 L^2 + \psi_3 L^3 + \psi_4 L^4)\varepsilon_t \qquad (13)$$

$$\alpha_0 = \begin{Bmatrix} 0.02 \\ (9.35) \end{Bmatrix}, \quad \chi_1 = \begin{Bmatrix} 0.74 \\ (16.56) \end{Bmatrix}, \quad \psi_1 = \begin{Bmatrix} 0.47 \\ (4.24) \end{Bmatrix}, \quad \psi_2 = \begin{Bmatrix} 0.46 \\ (4.26) \end{Bmatrix}, \quad \psi_3 = \begin{Bmatrix} 0.47 \\ (4.41) \end{Bmatrix},$$
$$\psi_4 = \begin{Bmatrix} -0.52 \\ (-4.58) \end{Bmatrix},$$

$adj.R^2$ (0.56); DW (1.83); σ_{resid} (0.002); t − statistics in parenthesis

The significance coefficient of autoregressive term shows that there is enough memory in the process which is passing on in the current value of cash-in-tills to deposit ratio. In addition, the shocks occur in the ratio persist for at least one to four quarters.

Other deposits with SBP ratio:

$$(1 - \xi_1 L^1)\,(odratio) = \alpha_0 + \varepsilon_t \qquad (14)$$

$$\alpha_0 = \begin{Bmatrix} 0.001 \\ (11.62) \end{Bmatrix}, \qquad \xi_1 = \begin{Bmatrix} 0.67 \\ 7.98 \end{Bmatrix},$$

$adj.R^2$ (0.46); DW (1.95); σ_{resid} (0.0003); t − statistics in parenthesis

Similarly, the inertial impact of other deposits is high as reflected from high significance of autoregressive term.

The estimated parameters of autoregressive and moving average of all the models are significant and high value of the adjusted R^2 indicates goodness of fit. Moreover, the low standard error of the residual of each equation depicts overall stability of model.

We forecast each series by using non-structural model for currency-deposit ratio, excess reserves-deposit ratio, required reserves –deposit ratio, cash in tills-deposit ratio and other deposits with SBP. Money multiplier is calculated using these ratios and then projected the broad money by multiplying money multiplier with estimated reserve money.

Scenario-IV

In order to test long-run relationship of currency and its determinants we apply the Johansen co-integration technique. Unrestricted vector autoregressive (VAR) models at the log level of currency and its determinants are estimated. At the outset, variables are checked for unit root and Augmented Dickey-Fuller (ADF), which confirms that all variables are non-stationary at level while become stationary with first difference, hence are integrated of order one I(1) (Appendix-B, Table-1). Various lag length criteria are used to determine optimal lag length of all variables. Sequential Log-likelihood ratio (LR) test statistics and Schwarz information Criteria (SC) suggest optimal lag length of 6 and 2 respectively, while Final Prediction Error (FPE), Akaike (AIC) and Hannan-Quinn (HQ) information criteria suggest lag length of 8. Since we are using quarterly data with large number of variables, therefore we prefer Schwarz Information Criteria (a conservative criteria for lag length selection), to avoid loss in degree of freedom. Co-integration relationship is determined by using trace and maximum Eigenvalue statistics. However, it is important to make assumptions regarding deterministic trend specification and drift term before estimating the rank. In macroeconomic literature, two specifications are more common i.e. restricted intercept without deterministic trend in co-integration relationship and

unrestricted intercept with linear deterministic trend in short run equations. We use the latter specification both on statistical and empirical ground.[18]

Using specification of unrestricted intercept and linear deterministic trend, the trace statistics shows three co-integrating vector between currency and its determinants, while two by maximum Eigenvalue statistics (Appendix B, Table-2). Considering two co-integrating vector, the estimated long-run relationship of currency and deposits is as following

$$\log(cic)_{t-1} = 13.16 - \underset{(-8.62)}{0.85} * \log(total\ deposits)_{t-1} + \underset{(7.52)}{1.00} * \log(IPI)_{t-1} + \underset{(5.93)}{1.29} * \log(cpi)_{t-1} - \underset{(-3.14)}{0.01} * \log(lending\ rate)_{t-1} + \underset{(4.81)}{0.02} * trend \quad (7)$$

$$\log(total\ deposit)_{t-1} = 15.98 + \underset{(11.21)}{3.12} * \log(IPI)_{t-1} + \underset{(8.92)}{2.97} * \log(CPI)_{t-1} + \underset{(6.97)}{1.23} * \log(EX)_{t-1} - \underset{(-3.53)}{0.04} * \log(deposit\ rate)_{t-1} + \underset{(8.12)}{0.08} * trend \quad (8)$$

Equation-7 shows long-run relationship between currency-in-circulation (CiC) and its determinants. The estimated results show that currency in circulation is a close substitute of deposits as currency in circulation declined with the increase of total deposits. Performance in Industrial production is found to be positively related with CiC, which confirms general observation that enhancement of industrial performance increases the income of economic agents and the transaction demand of money. It is also believed that high inflation affects the households' consumption basket. Thus increasing cost would induce the household to keep more money in hand to meet day-to-day expenses. Positive long-run relationship among consumer prices and CiC found in this study is in line with this general perception. According to liquidity preference theory of interest rate the demand for money is negatively associated with interest rate. Thus increasing interest rate (return on assets) is likely to increase the opportunity cost of holding money. In this study, lending rate is use as a proxy for rate of return on investable assets, which is negatively related with CiC.

[18] (1) As Akaike and Bayesian Information Criteria suggest for specification of unrestricted intercept and linear deterministic trend. (2) Most of empirical literature uses the linear trend in the level data and an unrestricted constant in co-integration equation (see Coenen et al, (1999), and Belke et al, (2010))

The empirical realization of the speed of adjustment to long-run equilibrium $\hat{\alpha}$ takes the following values

$$\hat{\alpha} = \begin{bmatrix} dlog(cic) & dlog(cic) \\ dlog(total\ deposits) & dlog(total\ deposits) \\ dlog(IPI) & dlog(IPI) \\ dlog(cpi) & dlog(cpi) \\ dlog\ (er) & dlog\ (er) \\ d(lending\ rate) & d(lending\ rate) \\ d(deposit\ rate) & d(deposit\ rate) \end{bmatrix} = \begin{bmatrix} -0.480\ (0.163) & -0.212\ (0.093) \\ -0.504\ (0.190) & -0.340\ (0.108) \\ -0.223\ (0.223) & 0.314\ (0.127) \\ 0.111(0.046) & 0.038(0.026) \\ 0.042(0.115) & 0.079(0.065) \\ -2.212(2.304) & -3.250(1.315) \\ -1.684(0.848) & 0.122(0.484) \end{bmatrix}$$

The first element of the column shows error correction parameter of estimated currency function, which indicates speed of adjustment from short-run deviation to the long-run equilibrium. In other words, value of adjustment coefficients signifies necessary adjustment back to equilibrium once it has temporarily distorted. All the adjustment parameters, except industrial production, consumer prices and exchange rate, are quite significant at conventional levels. This suggests that IPI, consumer prices and exchange rate are weakly exogenous. To further check exogeneity of these variables, we apply LR test and the statistics shows that these variables are weakly exogenous. In addition, the adjustment parameter slightly changed when short-run dynamic equations of currency and other variables re-parameterized to estimate a parsimonious relationship.

Equation-8 indicates long-run relationship of total deposits with its determinants. Total deposits increase with the increase in economic activity and exchange rate depreciation. Nevertheless, contrary to the theory, deposit rate has negative impact on total deposits. This may be due to large portion of current account deposits with no or limited rate of return.

To capture the response of financial sector, Johansen's co-integration technique is used to find long-run relationship between excess reserves and its determinants. We use optimal lag length of 4 as suggested by LR, FPE, AIC and HQ. The trace and maximum Eigenvalue statistics suggest one co-integrating equation with linear deterministic trend in data and unrestricted constant in co-integrating equation (Appendix-B, Table-3). The estimated long-run relationship of excess reserves is following

$$\log(Excess\ reserves.)_{t-1} = 26.37 - \underset{(-4.20)}{2.36} * \log(crr)_{t-1} - \underset{(-4.61)}{0.66} * (mtb)_{t-1} + \underset{(1.70)}{1.75} * \log(ipi)_{t-1} + \underset{(5.58)}{0.08} * trend \quad (9)$$

The banks are likely to reduce their excess reserves with the increase in cash reserves requirement. Similarly, if the return on other assets (i.e. government paper) increases, then banks prefer to invest in these assets rather than keeping their assets (with no return) with SBP. On the other hand, increase in economic activity has positive but insignificant impact on excess reserves. The speed of adjustment to the long-run equilibrium has following values

$$\hat{\alpha} = \begin{bmatrix} dlog(ex.res.) \\ dlog(crr) \\ d(mtb) \\ dlog(ipi) \end{bmatrix} = \begin{bmatrix} -0.369\ (0.138) \\ 0.046\ (0.054) \\ -0.064\ (0.052) \\ -0.084\ (0.019) \end{bmatrix}$$

The first element of the column shows error correction parameter of estimated excess reserves function, which indicates high speed of adjustment towards equilibrium once shocked. The alpha values of cash reserves requirement (crr) and 6-month T-bills rate (mtb) is insignificant thus suggesting that these two variables are weakly exogenous to the system.

We estimated the long-run relationship of currency, deposits and excess reserves in equation 7 to 9. On the other hand, the short run dynamic are captured by taking quarterly changes in the long-run determinants. The dynamism is introduced by incorporating the past changes of each economic determinant in explaining the growth in CiC, deposits and excess reserves. These variables are then modeled and solved simultaneously to produce projection for currency in circulation, total deposits and excess reserves. The money multiplier is then calculated using the projected values of these variables. Finally projection of broad money is then computed using money multiplier and estimated reserves money.

VII. Forecasting Evaluation of Non-structural Models

We use various criteria to evaluate the forecasting ability of aggregate model of money multiplier and component ratio models (Appendix-B, Table-3). The comparison was made between the projected values of non-recursive models and actual values between the periods of Q3-FY10 to Q4-FY11. The test statistics shows that Theil Inequality Coefficient and Mean

Absolute Percent Error (MAPE) of aggregate model of money multiplier is lower than component ratio model, which indicates that the aggregate model can perform better in forecasting money multiplier as compare with money multiplier estimated from component ratios model.[19]

VIII. Forecasting of Broad money and Simulation

Using structural and non-structural models, we report projections of broad money (M2) growth for FY11 and compare it with actual growth (Table 1). The non-structural model of M2 that takes only the trend of broad money, projects growth of 12.03 percent, which is 3.9 percentage points lower than actual growth of 15.89 percent for FY11. In the second scenario, we separately estimated the money multiplier and reserves money using both recursive and non-recursive linear filter. The broad money is then derived by multiplying the estimated money multiplier and reserve money. This model projects M2 growth at 15.30 percent for FY11, which is slightly lower than the actual growth. In the third scenario, component ratios of money multiplier are estimated using non-structural models. The broad money is then derived from multiplier (from component ratios) and estimated reserve money. This model projects M2 growth at 11.65 percent, which is 4.2 percentage points lower than actual growth for FY11.

In the fourth scenario, we estimate currency in circulation, total deposits and excess reserves using un-restricted VAR model. The two component ratios, currency-deposits and excess reserves-deposit, of money multiplier are derived from this model. Since other component ratios of MM cannot be structured as (1) ad-hoc determination of Required Reserves ratio at the Bank level, (2) no significant change in the Other Deposits with SBP, (3) very low variation in cash-in-tills to meet day to day cash requirements of their customers. The last three ratios are projected using non-structural model. Money multiplier is then calculated using these components. Using money multiplier and reserves money, M2 growth is then projected at 15.62 percent for FY11, which is quite consistent with the actual growth of 15.89 percent for FY11.

[19] These results are consistent with Arby (2000).

Table 1: With-in Sample Forecast of Broad Money (M2) for FY11					
	Q1	Q2	Q3	Q4	FY11
Actual	0.61	8.31	0.39	5.94	15.89
Forecast					
Non-structural model of M2	0.48	5.14	1.44	4.53	12.03
Non-structural model of MM & RM	4.16	3.81	2.91	3.62	15.30
Non-structural model of MM-components	0.50	2.78	4.19	3.75	11.65
VAR model of CIC, Deposits & Excess Reserves *	2.30	-1.29	0.47	13.96	15.62
Average Forecast	**1.86**	**2.61**	**2.25**	**6.47**	**13.65**

* In VAR model, we use actual data for IPI growth (0.95%), CPI-inflation (13.92%), Exchange rate average(85.6); Lending rate avg. 13.9 and Deposit rate avg. 5.9 for FY11

* component wise multiplier is calculated using currency-deposit ratio and excess reserves deposit ratios derived from VAR model and required ratio, cash-in-tills ratio and other deposits are estimated using non-structural models.

Note: Quarterly values show the M2 growth during the respective quarter, while FY11 values show YoY growth.

Conclusion

This study analyzes and projects various components of broad money from liability side using structural and non-structural models. Our analysis suggests that non-structural models of aggregate variables and structural models of component ratios perform better as compared with non-structural models of component ratios in making projections for monetary aggregates.

This study also analyzes the behavior of various components of broad money. The stylized facts reveal that components of M2 were mainly influenced, during 90s, by banking sector reforms, introduction of resident foreign currency accounts and devaluation of domestic currency. Nevertheless, in 2000s, some other factors determined currency and deposits behavior including remittances, financial innovation, economic growth, inflation and National Saving Schemes (NSS).

We also found that money multiplier is not constant over time. The instability of the money multiplier signifies the changing behavior of households and response of the banking sector to underlying economic fundamentals.

References:

Ali, S., S, Irum., Ali., A, (2008), *Whether Fiscal Stance or Monetary Policy Is Effective For Economic Growth In Case Of South Asian Countries*, The Pakistan Development Review 47(4), pp. 791–799

Arby., M. F.. (2000). *Predicting Money Multiplier in Pakistan*, The Pakistan Development Review, 39, pp. 23-35.

Arrau, P., Jose, D. G., and Reinhart, C. M., and Wickham, P., (1995), *The demand for money in developing countries: Assessing the role of financial innovation*, Journal of Development Economics, 46: 317-340

Aslam, S., (1998), *The Underground Economy and Tax Evasion in Pakistan: Annual Estimates (1960-1998) and the Impact of Dollarization of the Economy*" The Pakistan Development Review 37:4, Part II (Winter) 621–631

Beenstock, M., (1989), *The Determinants of the Money Multiplier in the United Kingdom*, Journal of Money, Credit and Banking, 21(4), pp. 464-80.

Belke, A., and Czudaji, R., (2010), *Is Euro Area Demand (Still) Stable? Co-integrated VAR versus Single Equation Techniques*, Discussion Paper 982, DIW Berlin

Bernanke, B., (2006), *Monetary Aggregates and Monetary Policy at the Federal Reserve: A Historical Perspective*, Speech at Fourth ECB Central Banking Conference, Frankfurt, Germany

Bilquees, F., (1993), *Determinants of Money Multiplier*, The Pakistan Development Review, 32

Boughton, J. M., and Wicker, E. R., (1979), *The Behavior of the Currency-Deposit Ratio during the Great Depression*, Journal of Money, Credit and Banking, 2(4), pp. 405-18.

Cassino,.V and Misich, P., Barry, J., (1997), *Forecasting the Demand for Currency*, Reserve Bank Bulletin, vol. 60, no. 1

Coenen, G., and Vega, J., (1999), *The Demand for M3 in Euro Area*, Working Paper No. 06, European Central Bank

Chu, K.H., (2006), *Reserve Requirements and Money Multiplier Predictability: The Canadian Experience*, Banks and Bank Systems / Volume 1, Issue 3, 2006

Dadkhah, K. M., and Mookerjee, R., (1988), *The behavior of the currency deposit ratio in India, 1870- 1982*, The Journal of Developing Areas, 22, 359-72

Dadkhah, K. M., and Mookerjee, R., (1988), *The Behavior of the Currency Deposit Ratio in India, 1870-1982*, Journal of Developing Areas, 22(3), 359-72.

De Grauwe, P., and Polan, M., (2005), *Is inflation always and everywhere a monetary phenomenon?*", Scandinavian Journal of Economics, Vol.107, No.2, pp.239.260.

James,. P. D. Jr., (2001), *The Demand for Excess Reserves*, Southern Economic Journal, Vol. 67, No. 3, pp. 685-700.

Fatima, T. S. M., and Garcia, A. M., (2010), *The Demand for Excess Reserves in the Euro Area and the Impact of the Current Credit Crisis*, GEMF Working Papers 2010-01, GEMF - Faculdade de Economia, Universidade de Coimbra.

Feinman, J.N., (1993), *Reserve Requirements: History,Current Practice, and Potential Reform,* Federal Reserve Bulletin June 1993

Hafer, R.W., and Hein, S., (1984), *Predicting the Money Multiplier: Forecasts from Component and Aggregate Models*, Journal of Monetary Economics 14: 375-84.

Hamadani, M. H., (1976), *Money-Multiplier as a Determinant of Money Supply: The Case of Pakistan,* The Pakistan Development Review 15: 2.

Hasan, M. A., Khan, A. H., Pasha, H. A., and Rasheed, M. A., (1995), *What Explains the Current High Rate of Inflation in Pakistan?* Pakistan Development Review, 34: 927-943.

Hasan, M. S., (2001), *The behavior of the currency-deposit ratio in mainland China*, Applied Financial Economics, 11, 659-668

Jan A., Bukhari, A.H., and Bukhari, S.K.H., (2012), *On the (IR) Relevance of Monetary Aggregate Targeting in Pakistan- An Eclectic View*, Forthcoming SBP Working Paper

Jawaid, S. T., Arif, I., and Naeemullah, S. M., (2010), *Comparative analysis of monetary and fiscal Policy: a case study of Pakistan*, MPRA Paper 30850, University Library of Munich, Germany, revised Dec 2010

Jawaid, S.T and Qadri, F. S., Nasir, A., (2011), *Monetary-fiscal-trade policy and economic growth in Pakistan: Time series empirical investigation*, International Journal of Economics and Financial Issues Vol. 1, No. 3, 2011, pp.133-138

Kaplan, M., Kalyoncu, H., and Yucel, F., (2008), *Currency Substitution: Evidence from Turkey*, International Research Journal of Finance and Economics, ISSN 1450-2887 Issue 21

Kemal, A., (2006), *Is Inflation in Pakistan a Monetary phenomenon?* Pakistan Development Review, 45: 213–220.

Khan, M. A., (2010), *Testing of Money Multiplier Model for Pakistan: Does Monetary Base Carry Any Information?*, Economic Analysis Working Papers

Khan, A. H. and Qasim, M. A., (1996), *Inflation in Pakistan Revisited*, The Pakistan Development Review 35:4 Part II (Winter 1996) pp 747 - 759

Khan, M. and Schimmelpfennig, A., (2006), *Inflation in Pakistan* Pakistan Development Review, 45: 185-202

Lieberman, C., (1977), *The Transactions Demand for Money and Technological Change*, Review of Economics and Statistics, 59: 307 – 317

Dadkhah, K. M. and Mookerjee, R., (1988), *The behavior of the currency deposit ratio in India, 1870-1982*, The Journal of Developing Areas Vol. 22.1988, 3, p. 359-372

Mangla, I. U., and Ladenson, M., (1978), *Short-run Forecast of Money Stock in Pakistan*, The Pakistan Development Review 17: 2

Sulaiman, M., Wasti, S. K. A., Lal, I., and Hussain,. H., (2009), *An Empirical Investigation between Money Supply, Government Expenditure, output & Prices: the Pakistan Evidence*, European Journal of Economics, Finance and Administrative Sciences, Issue 17, 60-68

Moinuddin, (2007), *Choice of Monetary Policy Regime: Should SBP Adopt Inflation Targeting* SBP Working Paper Series, No. 19

Naqvi, S. N. H., Khan,. A. H., Ahmed, A. M., and Siddiqui, R., (1994), *Inflation in Pakistan: Causes and Remedies*, Islamabad: Pakistan Institute of Development Economics.

Nasim, A., (1997), *Determinants of Inflation in Pakistan*, Karachi: State Bank of Pakistan.

Ndanshau, M. O. A., (2004). *The Currency Ratio in Tanzania*, African Development Bank, Vol. 16, Issue 2,269-286

Omer, M., (2010), *Stability of Money Demand Function in Pakistan*, SBP working paper series, No. 36, State Bank of Pakistan

Qayyum, A., and Ahmed, U., (2001), *Money Supply Function in Pakistan: An Econometric Investigation*, Journal of Islamic Banking and Finance, April-June, 2001, pp. 40-46

Qayyum, A., (2005), *Modeling Demand for Money in Pakistan, Pakistan Development Review*, 44: 233–252

Roffia, B., and Zaghini, A., (2007), *Excess Money Growth and Inflation Dynamics*, International Finance, 10(3): 241-80

Saatcioglu, (2006), *Stability of Money Multipliers: Evidence from Turkey*. Journal of Business and Economics Research, vol. 4, number 10

Saqib, O. F., and Omer, M., (2008), *Monetary Targeting in Pakistan: A Skeptical Note* SBP Working Paper Series, No. 25

Simwaka, K., (2006), *The Determinants of currency in circulation in Malawi*, Research and Statistics Department Reserve Bank of Malawi

Simwaka, K., Mwale, M., Mososa, C., Sichinga, O., Chawani, R., and Palamuleni, A., (2006), *The Determinants of currency in circulation in Malawi*, Reserve Bank of Malawi

Stavreski, Z., (1998), *Currency in Circulation*, National Bank of Macedonia, Working paper No.1

Wicker, E. R., and Boughton, J. M., (1979), *The Behavior of Currency deposit Ratio during the Great Depression*, Journal of Money," Credit and Banking, Vol. 11, No. 4, pp. 405-418.

Zaki, M., (1995), *Forecasting the Money Multiplier and the Control of Money Supply in Egypt*, Journal of Development Studies 32: 97-111.

Zaki, M. Y., (1995), *The behavior of the currency ratio and the control of money supply in Egypt*, The Middle East Business and Economic Review, 7, 47-61

Zaki, M.Y., (1992), *Behavior and Determinants of the Currency to Demand Deposits Ratio in Egypt*, The Journal of Developing Areas 26(3), 357-370.

Appendix A: Literature Review

Currency Deposits

Author	Study	Empirical Approach	Variables	Data	Findings	Conclusions
James *et al*, (1979)	The Behavior of the Currency/ Deposit ratio during the Great Depression	Simultaneous Equations models, estimated through OLS methodology	Aggregate expenditures, bank failures, yield on demand deposits, yield on other-short-term assets	US (1921-36)	Aggregate expenditures and yield on demand deposits have negative relationship with currency deposits ratio whereas the others show positive.	The drop in interest rates paid on deposits and fall in income expenditures were the additional determinants of currency deposits ratio during the Great Depression.
Zaki (1992)	Behavior and Determinants of the Currency to Demand Deposits Ratio in Egypt	Log transformation	Nominal GNP, discount rate, inflation rate, lagged currency demand deposits	Egypt (1952-87)	Negative relation of GNP and discount rate whereas others have positive.	There is an inherent inflationary bias behind the decline in currency deposits ratio in early 1970s which required the central bank to take necessary monetary policy actions. Furthermore, the period of economic and political turmoil during 1960-73 induced public to hold currency that significantly influenced the ratio.
Dadkhah and Mookerjee, (1988)	The Behavior of Currency Deposits Ratio in India	Logarithmic, Random Walk, Cochrane-Orcutt	Real GNP, call money rate, inflation rate	India (1948-82)	Negative relation of GNP and discount rate whereas others have positive.	The strong impact of national income on currency deposits ratio suggests that monetary authorities can forecast money multiplier in short-run assuming marginal influence of income. However, in long-run decline in currency deposits ratio due to increased income should be taken into account.
Stavreski (1998)	Currency in Circulation	Graphical analysis, simple data analysis	-	Macedonia (1992-1997)	Insufficient development of non-cash payment instrument, agricultural production, payment of wages and pensions with cash,	The use of non-cash payment instruments should be promoted by modernizing bank services. The size of the shadow economy needs to be reduced through enforcing financial control and active engagement of fiscal policy.

					cash utilization in the cross border trade, gray economy, low interest rates on demand deposits	
Simwaka (2006)	The Determinants of Currency in Circulation in Malawi	Graphical analysis, first difference was taken in regression	Nominal GDP, inflation, financial deepening, agriculture production, real interest rate, ATM technology, smart card underground economy	Malawi(1965-2004)	Except real interest rate and smart cards, all others variables show positive relation with Currency to M2 ratio.	To reduce Currency/M2 ratio, two steps required. First, intense use of smart cards (alternative to cash). It will also reduce the positive impact of ATM on currency ratio. Second, educating rural areas and small-scale business for use of banking facilities as it will increase deposits taking hence reducing CIC.
Ndanshau (2004)	The Currency Ratio in Tanzania: An Econometric Analysis	OLS	Real GDP, expected inflation, branches of commercial banks, tax rate, share of public sector deposits in commercial banks, exchange rate, economic reforms, financial reforms	Tanzania(19687-20020	Expected inflation, public sector deposits and economic reforms bear positive relationship with currency to demand deposits ratio whereas others show negative.	There are two policy options to reduce demand for currency in the economy. First, maintaining price stability will increase banks deposits. Second, financial deepening could reduce demand for currency and this should be done through providing access to financial services in the informal sector.
Hasan (2001)	The behavior of currency - deposits ratio in mainland China	Spline Function, random walk, Huilderth Lu grid, Co-integration	Nominal income, interest rate on deposits, expected inflation	China (1952-1989)	Income and interest rate bear negative relationship whereas the expected inflation impact positively.	In short-run, money multiplier can be forecasted assuming it will remain at its previous level. However, in long-run, income and interest rate make money multiplier endogenous.

Money Multiplier

Authors	Study Title	Empirical Approach	Variables	Data	Findings/Remarks
Beenstock M. (1989)	The Determinants of the Money Multiplier in the United Kingdom	Ordinary Least Square Ordinary method, Three Stage Least Squares	Currency to Sight deposit ratio was regressed on GDP, return on long-dated gilts, return on building society share accounts, personal disposable income, and rate of interest on sight deposits. Time deposits to sight deposit ratio was regressed on rate of return on time deposits, rate of return on sight deposits, and economic activity.	1950- 1984	Paper has estimated different equations for the ratios used in money multiplier formula. Rate of interest on sight deposits was found as major determinant of currency to sight deposit ratio. For time deposit, it was found that as economic activity rises, the demand for time deposits rises relative to the demand for sight deposits. Results also show that when sight deposit rates rise relative to time deposit rates, the demand for sight deposits rises relative to the demand for time deposits.
Saatcioglu, *et al*, (2006)	Stability Of Money Multipliers: Evidence From Turkey	Unit root test, Co-Integration Analysis	Money multiplier and its component ratios	1990:Q – 2004:Q4	This paper has used different time series models to investigate whether the money multiplier process in the Turkish economy is stable and can be forecasted. Research results show that sub-components of the money multiplier do not support a stable money multiplier process in Turkey.
Zaki M. Y. (1995)	Forecasting the money multiplier and the control of money supply in Egypt	ARIMA	Money multiplier and its component ratios	Quarterly observations from 1980 to 1993	Paper has tested stability of money multiplier for Egypt economy. Results show that money multiplier in Egypt was unstable during period 1952-1990, the period when government was excessively relying on borrowing from the central bank. However, after 1991, the period when different financial sector reforms were undertaken in Egypt, the stability and predictability of money multiplier increased. Comparing component approach and aggregate approach for money multiplier forecasting during 1991-93, the study concludes that aggregate forecasting provides better results.

Hafer R. W. and Scott E. Hein	Predicting the Money Multiplier: Forecasts from Component and Aggregate Models	Time seriese models	Money multiplier and its component ratios	January 1959 to December 1979	Paper has investigated the predictive performance of aggregate and components-wise money multiplier approach. Findings of the paper show that aggregate forecasting yields superior results than component-wise forecasting.
Arby F. (2000)	Predicting Money Multiplier in Pakistan	Box-Jenkins time-series methodology,	Money multiplier and component ratios	Monthly Series July 1989 to June 1999	Money multiplier is estimated and forecasted through two ways: a) modeling aggregate money multiplier, b) developing models of different components of money multiplier and then calculate overall money multiplier by using its formula. Analyzing predictive performance of the two approaches, the paper concludes that aggregate money multiplier model gives a better forecast in the case of Pakistan as compared to the component models. Money multiplier and its components were found stable during the period.
Khan M. A. (2010)	Testing of Money Multiplier Model for Pakistan: Does Monetary Base Carry any Information?	Johansen (1988) and Johansen & Juselius (1990) multivariate co-integration and ECM	Reserve money, broad Money, money multiplier	1972:01 to 2009:12 Pre-liberalization (972:01 to 1990:12) & post-liberalization (1991:01 - 2009:12)	Paper has investigated long run relationship between Money Supply (M2) and Reserve Money (Mo). Results suggest that a one-way short-run causality, running from B to M, exists for the period 1972M1-2009M2. For the period 1972M1-1990M12, there is no evidence of short-run causality between M2 and Mo. The evidence of one-way short-run causality running from Mo to M2 exists for the post-liberalization period (1991M1, 2009M12). Study founds stationarity of money multiplier for the entire sample period and sub-periods.

Bilquees (1993)	Determinants of Money Multiplier	Ordinary Least Square Ordinary Least Square method	Ratio of Currency to Deposit, Gross National Product, Commercial Bank Deposit rate, Ratio of Time Deposit to Demand Deposit, Ratio of Total Reserves to Demand Deposit, Credit to Deposit Ratio, Government Borrowing, Difference between commercial bank loan rate and bank rate.	From 1975 to 1991	Paper has used behavioral equations for different components (ratios) of money multiplier. Estimated money multiplier is then compared with actual values to seek predictive ability of the model. The results show that given the values of monetary base and money multiplier, broad money(M2) can be predicted with an error margin of 5 to 6 percent.
Qayyum A. *et al*, (2001)	Money Supply Function in Pakistan: An Econometric Investigation	Ordinary Least Square Ordinary method	Currency in Circulation, Required Reserves, Lag of money supply, currency ratio (ratio (fraction of bank deposits held by the public in cash form)	Annual data from 1960 to 1999	Paper has estimated money supply (M2) function by using variables of high-powered money, required reserve ratio, and currency ratio in cobb-douglas functional as independent variables. Results indicate an elasticity of almost equal to one between high-powered money and money supply. One percent change in currency ratio and reserve ratio leads to 46 to 49 percent and 16 percent change in money supply, respectively.
Hamadani. M. H (1976)	Money Multiplier as a Determinant of Money Supply: The Case of Pakistan	Ordinary Least Square Ordinary method	Money supply, monetary base and its lag, lag of currency in circulation, treasury bills, and reserve requirements	Quarterly data from 1972 to 1974	Paper has estimated relationship between money supply (M2) and monetary base (RM) using simultaneous equations models. Explanatory variables for monetary base include its one period lag, lag of currency in circulation, treasury bills, reserve requirements, deposits, and a dummy variable capturing the effect of agriculture sector income on money supply. Paper has assumed that money multiplier is constant over the time and therefore has not discussed its determinants.
Mangla I. U. *et al*, (1978)	Short-run Forecast of the Money Stock in Pakistan	Ordinary Least Square Ordinary method	Ratio of currency to demand deposit, required reserve ratio, banks' desired excess reserve ratio, ratio of bank borrowing from central bank to total deposits, ratio of time deposit to demand deposit. Schedule bank lending rate and borrowing rates	Q1-1961 to Q4-1971	Paper has estimated different models for money supply process for Pakistan. Authors could not find enough evidence to declare a single model better in forecasting money supply in Pakistan rather they have suggested using different models for different quarter's forecasting. Their results show that Brunner-Meltzer model owns more predictive ability for first and fourth quarter while linear-liquidity model have better results for second and third quarter prediction.

Excess Reserves

Author	Study	Empirical Approach	Variables	Data	Findings	Conclusions
Fatima and Ana (2010)	The Demand for Excess Reserves in Euro Area and the Impact of Current Credit Crisis	Haussmann's test for endogeneity, instrumental variables method for estimation	Spread between Eurobar and MRO, average error of liquidity forecast by ECB, previous week excess reserves, credit crisis, end of month effect on reserves (dummy),effect of the end of reserve maintenance (dummy)	Europe (2004-08)	Average error and credit crisis variables proved statistically insignificant. The spread has positive impact on demand for excess reserves whereas rest of the variables bears negative relationship.	Credit institutions must focus on the cost of obtaining reserves in order to minimize it.
James (2001)	The Demand for Excess Reserves	AR(1) was performed for the regressions.	Demand deposits, carryover provisions, required reserves balance forecast, error in required reserves balance, federal fund rate, deviation of Federal fund rate from the target	US (1992-97)	Except deposits which bear positive impact, rest of the variables show negative relation with demand for excess reserves.	To analyze the operations of monetary policy, understanding of excess reserves demand is essential particularly shifting of monetary policy focus away from reserve requirements in future perspective.

Appendix B:

Table 1: Unit Root Test of the Variables

	Augmented Dickey-Fuller Test		
Variables	Level	Difference	Order of integration
Log(M2): broad money	-1.17	-4.007*	I(1)
Log(RM): reserve money	0.82	-11.19*	I(1)
mm (money multiplier)	-2.48	-9.40*	I(1)
Log(CiC): currency in circulation	2.91	-4.66*	I(1)
Log(dd): demand deposits	0.52	-17.4*	I(1)
Log(td): time deposits	-0.61	-10.48*	I(1)
Log(rfcd): resident foreign currency deposits	-3.29*	-	I(0)
Log(TotalD): total deposits	-0.97	-5.72*	
c/d (currency-deposits) ratio	-4.10*	-	I(0)
other/depoists (other deposits) ratio	-3.90*	-	I(0)
Excess reserves/deposit ratio	-5.42*	-	I(0)
required reserves/deposit ratio	-5.76*	-	I(0)
Log(IPI): Industrial production index	-1.93	-13.432*	I(1)
Log(CPI): Consumper price index	1.57	-3.6315*	I(1)
Inflation	-2.56	-5.545*	I(1)
log(Exchange Rate)	-0.30	-3.435**	I(1)
ER depreciation	-3.44**	-	I(0)
Lending rate	-1.48	-3.369*	I(1)
Deposit rate	-1.53	-4.32*	I(1)
6-month T-bills rate	-1.86	-6.01*	I(1)

Note: Level of significance, * at 1%, ** at 5% and *** at 10%; Critical values are from Mackinon (1996); SBC is used for lag selection ; Test estimation include intercept; All variables are in log except variant of interest rate, exchange rate depreciation and inflation.

Table 2: Estimates of Non-structural Models (Sample 1992q1 to 2011q4)				
	Parameters	**Estimates**	**Standard Error**	**t-statistics**
Equation: 7				
	α_0	0.03	0.01	4.96
	β_1	0.66	0.09	7.04
	$_1$	-0.68	0.06	-11.82
	$_2$	-0.27	0.07	-3.78
	$_3$	0.78	0.05	16.59
Equation: 8				
	α_0	0.01	0.00	1.82
	γ_1	-0.29	0.12	-2.50
	$_1$	-0.34	0.12	-2.90
Equation: 9				
	α_0	0.01	0.01	1.99
	β	0.08	0.02	5.11
	δ_1	-0.36	0.11	-3.15
	δ_2	-0.32	0.11	-2.99
Equation: 10				
	α_0	0.31	0.02	18.99
	ζ_1	0.27	0.11	2.50
	ζ_2	-0.45	0.08	-5.49
	ζ_3	0.36	0.11	3.27
	ζ_4	0.51	0.08	6.05
	η_1	0.09	0.03	3.48
	η_2	0.97	0.01	66.27
Equation: 11				
	α_0	0.03	0.00	7.56
	κ_1	0.39	0.09	4.58
	κ_2	0.34	0.09	3.85
	ρ_0	0.00	0.00	-1.64
	ϖ_1	0.09	0.06	1.45
	λ_1	0.90	0.05	17.08
Equation: 12				
	α_0	0.05	0.00	32.83
	ν_1	0.65	0.05	13.43
	ϱ_0	0.00	0.00	11.05
	ϕ_1	1.39	0.35	3.95
Equation: 13				
	α_0	0.02	0.00	9.35
	χ_1	0.74	0.04	16.56
	ψ_1	0.47	0.11	4.24
	ψ_2	0.46	0.11	4.26
	ψ_3	0.47	0.11	4.41
	ψ_4	-0.52	0.11	-4.58
Equation: 14				
	α_0	0.00	0.00	11.62
	ξ_1	0.67	0.08	7.98

Table 3: Cointegration Rank Test (Trace and Eigenvalue)

Series: Ln(CiC) Ln(Tot.deposits) Ln(IPI) Ln(CPI) Ln(ER) LR DR; Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE*(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.***
None **	0.5353	206.2824	150.5585	0.0000
At most 1**	0.4940	150.3373	117.7082	0.0001
At most 2**	0.4027	100.6132	88.8038	0.0054
At most 3	0.2928	62.99576	63.8761	0.0592

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.****
None **	0.5353	55.9452	50.59985	0.0128
At most 1**	0.4940	49.7241	44.4972	0.0124
At most 2	0.4027	37.6174	38.33101	0.0602

*Cointegration equations

** denotes rejection of the hypothesis at the 0.05 level

***MacKinnon-Haug-Michelis (1999) p-values

Table 4: Cointegration Rank Test (Trace and Eigenvalue)

Series: Ln(Exess reserves) Ln(CRR) MBT Ln(IPI); Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE*(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.***
None **	0.3928	80.05151	63.8761	0.0012
At most 1**	0.2487	42.63432	42.91525	0.0533
At most 2**	0.1843	21.19268	25.87211	0.1715

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.****
None **	0.3928	37.4172	32.11832	0.0102
At most 1**	0.2487	21.4416	25.82321	0.1707
At most 2	0.1843	15.2749	19.38704	0.1792

*Cointegration equations

** denotes rejection of the hypothesis at the 0.05 level

***MacKinnon-Haug-Michelis (1999) p-values

Table-5 Diagnostic of Forecasted Model (Q3-FY10 to Q4-FY11)

	RMSE	MAV	MAPE	Theil inequality coefficient
M2	0.015	0.012	2.93	0.018
Reserve money	0.015	0.011	2.16	0.011
Money multipliers	0.034	0.033	0.97	0.005
Components of MM				
Currency-deposit ratio	0.006	0.004	1.21	0.010
Excess reserves-deposit ratio	0.002	0.002	4.93	0.033
Required reserves-deposit ratio	0.005	0.005	11.97	0.059
Other deposits (with SBP) ratio	0.0002	0.0002	11.26	0.060
Cash in tills ratio	0.0001	0.0001	0.66	0.004

Note: RMSE (root mean square error); MAV (mean absolute value); MAPE (mean absolute percent error)