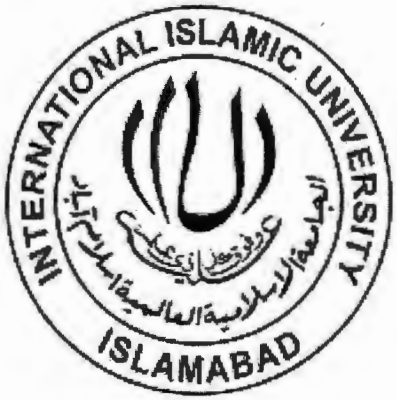
MS THESIS

Impact of Monetary and Other Economic Uncertainties on Demand for Money: A Case Study of Pakistan



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Money stock
Interest rate
Garch model

APPROVAL SHEET

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ABSTRACT

This study has two basic objectives. First objective is to investigate the impacts of monetary and economic uncertainties on demand for money for Pakistan in the short run as well as in the long run. Second objective is to check the stability of money demand function in the presence of two uncertainty variables. To comprehend the first objective of the study, the ARDL approach developed by Pesaran et al. (2001), is employed to annual data for the period of 1970 to 2014. Before applying the model, time series properties of the variables are checked with the help of ADF test. The results show that all variables included in the analysis are stationary at level except rate of interest.

The empirical results reveal that in the short run both measures of uncertainties are significantly related to demand for money in Pakistan. Whereas monetary uncertainty does not influence money demand in the long run while economic uncertainty has significantly negative impact on money demand. It means that high economic uncertainty declines demand for money in the long run. The results also indicate that there is long-run relationship between demand for money and other factors included in the analyses. Price level turns out a primary determinant of money demand for Pakistan. The estimates of error correction model (ECM) also support the co-integration among the variables. The error correction term of the model also indicates that the dependent variable adjusts towards equilibrium level at the speed of 51 percent per year.

To comprehend the second objective of the study which is about "the stability of demand for money function for Pakistan" two stability tests CUSUM and CUSUMSQ are applied to the residuals of the model. The findings of both tests confirm the long run stability of demand for money function for Pakistan even in the presence of uncertainty variables.

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LIST OF ABBRIVIATIONS

ADF	Augmented dickey fuller
ARDL	Autoregressive distributed lag
ARCH	Autoregressive conditional heteroskedasticity
AIC	Akaike information criteria
CPI	Consumer price index
CUSUM	Cumulative sum
CUSUMSQ	Cumulative sum of square residuals
D	Difference
DW	Durbin Watson
EX	Exchange rate
EU	Economic uncertainty
EUI	Economic uncertainty index
ECM	Error correction model
ECT	Error correction term
FDI	Foreign direct investment
GARCH	Generalized autoregressive conditional heteroskedasticity

GNP	Gross national product
GDP	Gross domestic product
IFS	International financial statistics
LR	Long run
L	Log
LM	Long range multiplier
LP	Log of CPI (Price level)
MD	Money demand
MP	Monetary policy
M2	Broad money supply
M1	Narrow money
M0	Reserve money
Min	Minimum
Max	Maximum
NEX	Nominal effective exchange rate
r	Interest rate
rb	Govt. bond yield

RBI	Reserve bank of India
SR	Short run
SBP	State bank of Pakistan
SC	Schwarz criteria
US	United state
USA	United state of America
VM2	Volatility of monetary aggregate M2
V	Volatility
VAR	Vector autoregressive
Y	Income

CHAPTER #1

1 INTRODUCTION

1.1 BACKGROUND

Money demand has a very crucial role both in macroeconomics and monetary policy formulation. In macroeconomics, it has a general impact through transaction, speculation and precautionary motives. While in monetary economics it has a very specific role to play regarding performance of monetary policy. The stability and specification of demand for money function is also very important for empirical analysis, forecasting of different variables, and the analysis of economic policies. It provides guidelines to the policy makers to forecast variation in the rate of interest, output, and price level.

According to the perception of conventional economics, real demand for money is a function of income and interest rate. The rise in income has the tendency to enhance money demand, while the increase in rate of interest declines the desire of economic agents to keep money with them. Monetary uncertainty is another determinant of money demand, which has positive impact on demand for money [Friedman (1984)]. When supply of money becomes more uncertain, people raise their demand for money and velocity of money declines. Economic uncertainty is another important determinant of money demand highlighted in the literature [Oskooee et al. 2011)]. The impact of economic uncertainty on money demand is uncertain. Economic uncertainty can have a positive impact on demand for money, as a risk averse agent will prefer to hold safe and liquid assets in the period of high economic uncertainty. If the value of money is expected to declines in future due to economic uncertainty, then it is expected that economic agents will prefer to hold

gold and commodities instead of risky assets, including money. Thus demand for money declines due to economic uncertainty. This shows that money demand may have positive or negative relation with economic uncertainty. Therefore the omission of economic uncertainty from money demand model can result in invalid conclusions which can also influence the monetary policy planning. Thus it is important to include economic uncertainty variable in money demand equation.

The stability of money demand function is also considered important for the achievement of an operational monetary policy. It is very important to have deep knowledge about the elements of demand for money because they influence monetary policy. It also allows us to know how variations in money and associated variables like interest rate, transmits to the economy and interrupts the level of economic activities. There are several objectives of monetary policy in which one main objective is to achieve price stability and it is possible only if money demand does not change unpredictably. However if money demand does not remain stable, then shocks to money demand brings changes in interest rate (real and nominal) which then results to fluctuations in the economy. An alternative, interest rate targeting monetary policy can provide opposite outcomes, as by keeping the interest rate constant the supply of money will be timely adjusted to the shocks in demand for money.

A stable demand for monetary aggregate M2 enables the policy makers to correctly estimate the impact of macroeconomic variables. As such, detecting a stable function of demand for money is crucial in establishing a link between appropriate monetary aggregate and nominal income (output). Thus, due to this importance of demand for money, it becomes necessary to search for an empirically stable money demand function whose parameters do not significantly change over time.

The above discussion implies that changes in demand for money matters for the conduct of monetary policy. Therefore researchers have tried to estimate money demand function by including several variables since 1930s in different countries at different economic conditions. The commonly used main determinants of money demand function are real or nominal income, price level or inflation rate, interest rate and exchange rate while uncertainty -monetary or economic- is also another factor of money demand. When an economic agent holds money for the purpose of getting better investment opportunity then his optimal level of holding will be influenced by economic uncertainty.

This study is important due to the fact that large number of researchers of both developed and developing countries have analyzed money demand function. Furthermore, with the considerable increase of globalization, financial innovation and financial deregulation, it is essential to inspect that whether the original characteristics of the demand for money function still hold or not (Melnick, 1995). A number of researchers such as Choi and Oh (2003), Mensah (2004), Oskooee et al. (2011), Kones (2014) analyzed the demand for money and its stability for different counties. They concluded that monetary and economic uncertainties are important determinants of the money demand function which can enhance its stability.

Research on demand for money got popularity in Pakistan since 1970. The prevailing literature points to the fact that considerable attention has been paid to the investigation of money demand function and its determinants in emerging economies like Pakistan. However these earlier studies on demand for money examined just the very common determinants by applying different techniques and have ignored the role of uncertainties as determinants of money demand in Pakistan.

Accordingly this study endeavors to contribute in filling the presented knowledge gap in the literature on demand for money function in Pakistan. Hence the study inclined to revisit the demand for money function in Pakistan by adding two more factors i.e. monetary uncertainty and economic uncertainty. The study also contributes to the available literature on demand for money in Pakistan by investigating whether monetary uncertainty (VM2) and economic uncertainty (EU), along with real income (Y), price level, rate of interest (r) and exchange rate plays any role in the stability of monetary aggregate M2 in Pakistan.

The study employs GARCH methodology for calculating monetary volatility from monthly data of M2, because GARCH is the most appropriate method for measuring volatility from time series data. Economic uncertainty is calculating by constructing an index of five variables through their standard deviations. This study aims to appraise the demand for money function of Pakistan for the time of 1970 to 2014. To accomplish this aim the study applies the error correction representation of Autoregressive Distributed Lag (ARDL) model and bound testing approach to co-integration. Some diagnostic tests like LM test and Durbin Watson (DW) test for serial/autocorrelation are also applied to the data. At the end stability of demand for money function is checked by applying CUSUM and CUSUMSQ tests to the residuals of the model.

1.2 RESEARCH OBJECTIVES

Main objectives of the study are:

- To estimate the short run and long run effects of monetary and economic uncertainties on demand for money
- To check the stability of money demand function

1.3 RESEARCH HYPOTHESES

In the light of the objectives described above, this thesis will test the following null hypotheses.

H_0^1: Monetary uncertainty doesn't have significant impact on demand for money

H_1: Monetary uncertainty has a significant impact on demand for money

H_0^2: Economic uncertainty doesn't have significant impact on demand for money

H_2: Economic uncertainty has a significant impact on demand for money

H_0^3: Demand for money function is unstable in Pakistan

H_3: Demand for money function is stable in Pakistan

1.4 IMPORTANCE OF THE STUDY

The present study helps the State Bank of Pakistan in making appropriate monetary policy. It provides information to the policy makers which help them in selecting monetary policy with constant money supply or with constant interest rate. It also helps them in controlling inflation and in assessing future threats to inflation. Money is demanded by agent's for different purposes such as transaction, speculation and precautionary. To stabilize an economy the stability of money demand is necessary. Supply of money is one of the factors which also bring changes in demand for money, whenever money supply becomes more volatile or uncertain people raise their demand for money. Thus to keep an economy stable it is necessary to have sufficient knowledge about the impact of such variables on money demand. Therefore this study is

providing knowledge about the impact of very important factors (i.e volatility of money supply and economic uncertainty) on money demand. The stability of economy becomes possible after getting a steady money demand function therefore this study plays important role in stabilizing the economy of Pakistan.

1.5 ORGANIZATION OF THE STUDY

The study is divided into five chapters. Introduction to the problem is discussed in chapter 1. In chapter two (2) the review of literature is presented, which shows the work done by different authors on the same problem for different countries in different time periods. Chapter 3 contains model specification and data description. There is detailed discussion about model, estimation methods, data collection and description of the data in chapter third. Chapter 4 is named as estimation results and interpretation, which contains the results of estimated model and different tests applied to variables. Chapter 5 is the last chapter of the study which consists of summary and conclusion along with recommendations to the policy makers regarding money demand and its determinants.

CHAPTER # 2

2 LITERATURE REVIEW

2.1 INTRODUCTION

This chapter briefly reviews some of the vital theoretical and empirical studies carried out on the stability of demand for money function and its determinants in different countries from all over the world. There are four sections of this chapter. First section (2.2) briefly discusses the evolution of money and its some theories. Second section (2.3) consists of the literature on developed and developing countries, Asian countries, African countries and emerging economies of Europe. The third section (2.4) of the chapter reviews the literature just related to Pakistan. The chapter is summarized in the fourth section (2.5).

2.2 Evolution of Money and Its Different Theories

Money has a central and crucial role both in business and private activities all over the world. It came into existence in the form of commodity money after the problems of barter system. Then it passes through many stages such as fiat money, token money, paper money etc now a day we have money in the form of plastic[1] money. The scope of money is extended over consumption, production and distribution. The economic agents hold money in the form of cash and assets. Therefore money has some important functions due to which it is demanded by people all over the world, such as; medium of exchange, store of value, unit of account and standard of deferred payment.

There are three main approaches of "Demand for Money" proposed in the literature, that are classical approach of money demand, Keynesian approach of demand for money and post-

[1] Credit cards, cash cards, debit cards, ATM cards etc

Keynesian's approaches. The classicals did not clearly formulate their own theory of money demand. Their theory of demand for money is derived from the "Quantity Theory of Money" presented by Fisher in 1911. According to quantity theory of money there is direct relationship between price level and money.

Fisher (1911) declares that the amount of money in an economy is related to income or aggregate output level (at full employment). This is based on the say's law that "supply creates its own demand". The Fisher's equation of exchange is

$$MV=PY$$

Where M shows the quantity of money, V is the velocity of money in circulation, P means price level and Y is aggregate level of income or output. Both V and Y were considered constant in the short run. Thus the quantity theory of money is that the raise in money supply increases price level significantly. This relationship can be modified further through dividing both sides of the equation by V such as

$$M=\frac{1}{V}.PY$$

As V is constant therefore $(\frac{1}{V})$ can be replaced with a constant, K, and at equilibrium level of money market money demand becomes equal to money supply. Thus the equation becomes as:

$$M_d = K.PY$$

Hence it is proved from the classical quantity theory of money that money demand is a constant and proportional function of income. But this theory ignored the importance of interest rate therefore Keynes (1936) rejected the view of classicals (1911) about money demand. Keynes developed their own money demand theory that emphasized the importance of interest rates in

money demand function. They introduced a new word "liquidity preference" in their "general theory of employment, interest and money". Keynes in his theory recommended three causes of the desire for liquidity in an economy that are; transactions, precautionary and speculative demand for money. The transaction motive of money demand is defined as the need for money in cash form for the purpose of current personal and business transactions. Precautionary demand is defined as the demand for holding money for unforeseen or unexpected events occurring in the future. While speculative demand is the demand for holding money in very liquid form for investment purposes. According to Keynes both precautionary demand and transaction motive are positively associated to income while, money demanded for speculative purposes is negatively related with interest rate.

Therefore according to Keynes, transaction and precautionary demand for money is a primary function of income level, L_t= f(Y) and speculative demand for money is a function of interest rate, L_s= f(r). Hence the total money demand is a function of both income level and the rate of interest and it can be derived from the summation of all the three functions that are, transaction, precautionary and speculative demand for money functions. Thus the proper Keynes (1936) approach is as follows:

$L = M_t\ (Y) + M_s\ (r)$

or L=f (Y, r)

Where L is the total demand for money, $M_t$is transaction and precautionary demand for money and M_s represents the speculation purpose of money demand, Y is GDP and r is rate of interest. It is proved from Keynes theory of liquidity preference that in addition to income, interest rate is also an important determinant of demand for money [Kundu and Mollah, (2014)].

To confirm the relation of demand for real monetary aggregate M2 with rate of interest and real GDP (income) the post Keynesian economists proposed a number of models. The role of money as a mean of exchange showed the way towards the inventory -theoretic formulation that highlighted the costs of transactions in situation of certainty. It also led to the models of money demanded for precautionary purposes which established the concept of uncertainty in otherwise transaction cost models" [Sriram (1999)].

A post-Keynesian economist Baumol (1952) proposes that interest rate is not only an essential determinant of speculative money demand but also of transactions demand for money. He also identified that the relationship between income and transactions demand for money is not linear and proportional. It is possible that only small changes occur in the transactions demand for money due to income because usually people spend their income for the transactions of the whole month gradually over the month. It is also possible that individuals divert a portion of the transaction balances to profitable securities. Therefore according to the latest observations, the transactions demand for money can be demonstrated as:

$$L1 = f(Y,r)$$

This means that transactions demand for money is the function of both income and interest rate. There is a positive but less than proportion relationship between L1 and Y but inverse relationship of L1 and r (interest rate) [Baumol, (1952)].

There were two major shortcomings of Keynes's theory of liquidity preference. First point was that his function of liquidity preference was depended on the expectations that in future interest rate will become inelastic. Second point was that, individuals be inclined to hold any one of

money and bonds at a time. Tobin (1956) removed these limitations of Keynes in his risk aversion theory of liquidity preference based on portfolio selection. Tobin's theory was based on the assumption that expected value of capital gain or loss from holding interest-bearing assets is always zero. But it was not depended on the future expectations about interest rate elasticity. Furthermore, Tobin's theory also provided explanation about the individual's portfolio that it always consists of both bonds and money at a time not on only one of these two [Faridi and Akhtar (2013)].

To understand the replacement of narrow money (M1) to broad money (M2) in various studies on money demand function the variable of exchange rate is also used as a determinant of demand for money in majority of developing countries including Pakistan. The insertion of changeable exchange rate variable in the standard money demand function was recommended for the first time by Mundell (1963).

On the other hand Friedman's volatility hypothesis (1984) stated that demand for money is affected by uncertainty of money demand. Whenever money supply becomes more uncertain in an economy, the velocity of circulation declines and demand for money rises. Therefore there is direct relationship between uncertainty and demand for money. Just like classicals, Neo classical economists also do not concentrate on interest rate as a determinant of money demand. According to them real money demand affects by the future uncertainty [Mall (2013)].

2.3 REVIEW OF STUDIES CONDUCTED ON DIFFERENT COUNTRIES

There is an extensive discussion in the literature on the factors affecting money demand and on the stability of demand for money function. The researchers conducted various studies to test the soundness of some selected models in checking the stability of money demand function.

Laidler (1980) concludes that M2 is a more appropriate monetary aggregate for empirical analysis and perhaps, for policy making in the US. The demand function for M2 is more stable than M1 in the time series analysis because the battery of motives fulfilled by holding M2 may have remained more consistent over time than those underlying the demand for any particular specification of M1. In 1982 there was a wonderful decline in income velocity of money in the US. Growth of nominal GNP declined significantly due to the decline in velocity, which causes real GNP to fall. According to Friedman's hypothesis (1984) about volatility this decline in velocity was due to increase in volatility of money supply because of announced variations in the operating techniques of Federal Reserve in October, 1979. Whenever money supply becomes more volatile the demand for money increases and velocity declines which in turn reduces GNP (Hall & Noble, 1987). There is positive effect of the uncertain money supply on money demand in the US but this effect of uncertainty declines by implementation of disinflationary policy. Whenever shocks occur to financial technologies and monetary policy, technology shocks dominate policy shocks then uncertainty affects demand for money positively. Thus the demand function of money in the US becomes well specified and highly stable (Choi & Oh, 2003).

However Friedman's volatility hypothesis which states "when money supply volatility rises, people's desire to hold money increases due to which velocity of money declines and demand for money increases" failed in case of Germany. Granger Causality tests for Germany shows that income velocity changes because of increased German volatility of monetary aggregate M3 due to which demand for money (M3) and income velocity declined [Bruggemann and Nautz, (1997)]. Oskooee and Bohl (2000) also get the same results for Germany and show some instability of M3 demand for money function.

There is a long run co-integration of M1 money balances, not M2; with its determinants i.e. exchange rate, GDP and rate of interest in Korea. While in the short run both monetary aggregates M1 and M2 are correlated with their determining factors [Oskooee and Rhee(1994)]. In contrast the study of Lee and Chung (1995) find a totally inverse situation in Korea regarding the stability of M1 and M2 monetary aggregates. They evidence that there is a long run cointegration of M2 with its determinants i.e. exchange rate, income and interest rate but no such relationship is found for M1. Thus it is suggested to the monetary authority of Korea to emphasize on the broad money (M2) instead of narrow money (M1) for regulating their monetary policy.

Previous studies were unable to find stability of money demand in Korea, that's why Oskooee and Bahmani (2014) reviewed the study of Lee and Chung (1995) in Korea for short run and the long run. In addition to other variables they included a monetary uncertainty measure to the methodologies employ in various studies to estimate the stability of money demand and points to two broad conclusions. First, there is positive relationship between uncertainty of money supply and demand for money both in the short run and long run i.e. the people's demand for money rises in the time period of more uncertain money supply. Second, there is a stable demand for M2 monetary balances in Korea.

Like monetary uncertainty the demand for money is also affected by economic uncertainty. Therefore by using general equilibrium theory it is analyzed in Canada that in the period of high uncertainty agents declines their demand for risky assets such as equities and mutual funds and raises demand for guaranteed investment certificates and money market mutual funds, which are safe assets. Thus it is clear that economic uncertainty raises demand for M1 but significantly declines demand for M2 monetary balances [Mensah (2004)]. Same is the case in Barbados

where the effect of economic uncertainty on money demand is positive in the short run but negative in the long run, since in the long run nominal assets become more risky and agents reduce their demand for these assets [Jackman (2010)].

There is a long run stable but short run unstable money demand function for M2 money balances with other macroeconomic variables in Malaysia. But, demand for narrow money M1 is not stable in the long run (Ibrahim, 1998). While in his next study for Malaysia, Ibrahim (2001) obtains that demand for both M1 and M2 is stable in the long run. He also fined that there is significantly positive impact of real stock prices on the demand for money behavior of public. The reason for this positive impact is the wealth effect which is more powerful than substitution effect.

Financial innovations and reform of 1980s made the demand for money unstable for India, due to which like other central banks the Reserve Bank of India (RBI) also switches from monetary targeting approach to multiple indicator approach in April 1998. Therefore the examination of the characteristics of money demand function for India can of great importance for the RBI's monetary policy. Thus, Inoue and Hamori (2008) analyze that whether supply of money is represented by M1 or M2, a cointegration vector exist between real money balance, output and interest rate. However, no long run cointegration found for M3 money balances. Therefore it is suggested to the central bank of India to concentrate on M1 or M2 monetary aggregates instead of M3 in managing monetary policy.

Economic conditions of Pakistan and India are very similar therefore Khan (1992) estimates the determinants of demand for money (M1 and M2) functions in Pakistan and India together. Interest rate variable is fined significantly negative for M2 for both countries but for M1 it is

significant explanatory variable just for India. The demand for money for another Asian country China has a long run stable relationship with its determinants (real income, stock prices, inflation and foreign interest rate). The stock prices have significantly positive relationship with demand for money therefore the price variable should be included in money demand function (MDF) of China [Baharumshah et al. (2009)].

It is clear from the above mentioned studies that monetary and economic uncertainties are important determinants of money demand function but in this context very little attention was given to Asia countries. Therefore Oskooee and Xi (2014) take into consideration the money demand function of six Asian countries[2]. They procure the short run significant impact of both measures of uncertainties in all the six countries but these short run effects lasts in the long run just for three countries (India, Singapore and Indonesia). Monetary volatility has long run positive influence on demand for money for Singapore but negative effects for Indonesia and India. Whereas, economic uncertainty has long run negative effects for Malaysia but positive in case of Singapore and Philippines. They also reveal insignificant effect of both monetary and economic uncertainties for Pakistan. The same study was done by Oskooee et al. (2014) for China by employing ARDL bound testing approach. The results unfold the fact that both measures of uncertainty affects china's demand for money in the short run but not in the long run.

There is short run dynamic and long run stable relationship of money demand with its determinants in Bangladesh [(Kundu and Mollah, 2014)]. Ajmi et al. (2015) acquire both bidirectional and unidirectional causality of money demand function for different country groups

[2] Malaysia, Indonesia, Singapore, Pakistan, India and Philippine

of ten Asian countries[3]. Real income has positive relation with money demand in East Asian countries. Whereas, inflation, rate of interest and real rate of exchange negatively affects money demand in these countries [Apergis, (2015)].

The preceding studies which estimated the demand for money function in Middle Eastern Economies applied either old estimation techniques or just popularized cointegration procedures. Therefore some of these studies suffered from spurious regression problems and others taken cointegration as a symbol of stability of the estimated parameters. Hence Bahmani (2008) incorporated the CUSUM and CUSUMSQ tests into cointegration analysis and showed that money demand (M2) is stable in most of the Middle East kingdoms.

Despite the availability of a huge number of studies in different developed and less-developed countries on the money demand stability, emerging economies of Eastern Europe were ignored. Therefore Bahmani and Kutan (2010) take these economies into consideration and found the stability of money demand in all these emerging economies of Eastern Europe such as Hungry, Russia, Poland, the Czech Republic, Bulgaria, the Slovak Republic and Armenia. But another study in the very next year [Dritsakit, 2011] shows that demand for money is not stable in Hungry. It was also examined by the study that in the long run money demand is negatively related to inflation and exchange rates. The negative impact of inflation rate on M2 supports the theoretical expectations that as inflation surges forward the money demand declines. While the inverse relation of exchange rate with money demand shows that demand for money declines because of devaluation of domestic currency.

[3] Malaysia, Singapore, Indonesia, Korea, Japan, India, China, Philippines, Fiji and Hong Kong

Oskooee (2001) for the first time applied ARDL cointegration technique to analyze the co-integration property of monetary aggregate M2 with interest rate and output in Japan. His study also examined the constancy of demand for M2 money balances. The velocity is taken as linear combination of income level, inflation/price level and money, which have a stable and linear relationship with demand for money. Thus it is concluded that demand for money function is stable for Japan. Oskooee and Gelan (2009) also attain the same results for the stability of M2 monetary aggregates in twenty one African countries by applying the same stability tests.

Tang (2007) examine the money demand function for five countries of South Asia i.e. Indonesia, Singapore, Malaysia, Philippine and Thailand. The results of the study show co-integration among M2 monetary aggregate, exchange rate, inflation rate and components of real income i.e. ultimate consumption expenses, expenses on investment goods and exports. Results of the study also indicated the existence of stability of money demand in five economies of Southeast Asia with the exception of Indonesia's short run demand for money. At the same time Owoye (2007) also observed a stable relationship of real demand for money (M2) with GDP (real), inflation and domestic rate of interest both in the short and long run for Nigeria.

While studies on money demand models have also conducted on developing countries including African, they have not included monetary and output uncertainties. Bahmani-Oskooee and Gelan (2009) carried out comprehensive investigation on the stability of demand for money function in Africa but they did not include output uncertainty and monetary uncertainties. Therefore Kones (2014) estimates money demand for 21 African countries[4]. The results showed that apart from

[4] Burundi, Cote d'Ivoir, Burkina Faso, Cameroon, Ethiopia, Gabon, Egypt, Ghana, Kenya, Morocco, Niger, Madagascar, Nigeria, Senegal, Mauritius, Seychelles, Rwanda, Sierra Leone, Tanzania, South Africa, and Togo.

Egypt, both measures of uncertainty (monetary and economic) are significantly related to demand for money in all 21 countries both in the short run and long run. It is also concluded that output have positive coefficients for all 21 countries while inflation and net export have negative coefficients, which implies that money demand for domestic currency declines with its depreciation. Demand for M2 is obtained as stable in included African countries with the exception of Egypt.

Kiptui (2014) tests the money demand function for stability by dealing with the data for a very small period i.e. 2000 to 2013 for Kenya. It is found that the elasticities for broader money M2 and M3 are lower than the elasticity of narrow money M1, which means that the demand for broader money is stable in case of Kenya. Thus there is positive impact of macroeconomic uncertainty on M2 monetary aggregate in Kenya. A number of studies are also carried out for Pakistan on money demand. Some important are reviewed below.

2.4 REVIEW OF STUDIES CONDUCTED ON PAKISTAN

Akhtar (1974) empirically analyzes the money demand function for Pakistan. The analysis is based on two alternative theories, modern quantity theory of money and accumulating capital framework. It is proved that real GDP (income) is a major component of demand for money function in Pakistan while interest rate is a secondary determinant and non-money assets are substitutes for money. It is concluded that because of various government policies such as (trade controls, distribution of commodity and prices for minimizing variations in prices), changes in price level do not have any considerable effects on the demand for real monetary aggregates in Pakistan. The effect of the ratio of investment/income on demand for money is positive but weak.

Abe et al. (1975) raised some serious objections on Akhtar's analysis and re-examined Akhtar's (1974) determinants of money demand. They suggested some alternative estimates of money demand function for Pakistan. According to them, 1) taking logarithm of elements of money demand is not possible for the period of 1950 to 1970 because of negative inflation for six years. 2) Expected inflation rate is substantially different from current inflation rate. 3) Industrial growth cannot be explained by the difference between planned investment and savings and industrial production index is not relevant to money demand. 4) Akhtar uses data of money stock for end of the year but as Monthly data is available for Pakistan therefore it is better to use annual averages of centered monthly data. 5) Estimates of money stock and income should be deflated by national income deflator instead of wholesale and consumer price indices. Their results support Akhtar's findings just at a single point that income is a primary determinant of money demand in Pakistan. However, unlike Akhtar's outcomes their results show that expected rate of inflation is highly significant to money demand. Both Akhtar (1974) and Abe et al. (1975) use current income rather than permanent income as a scale variable which should be there as an argument in the money demand function.

Thus Mangla (1979) re-examines the available empirical study on money demand function for Pakistan by including permanent income as a scale variable. Results of his study indicate that permanent income is a better explanatory variable than the measured income and also that inter-bank call money rate significantly affects demand for money. While Khan (1980) rejected some of the results of Mangla and Abe et.al by finding that, a) Elasticities of permanent income and measured income are not significantly different, therefore they can be substitutes for one another. b) Money demand is not significantly influenced by Inter-bank call money rate, which opposes Mangla's findings about call money rate. c) There are no significant relationship between

expected rate of inflation and money demand function for the period of 1959-1971 because of very low inflation rate. However after 1971 inflation rate rises even above ten percent, due to which its relation with money demand becomes significant. The study also argues that interest rate, expected inflation rate, income and degree of monetization are the most important factors affecting demand for money in Pakistan, and can explain most of the variations in demand function for money.

Another issue related to demand for money is the impact of interest rate on demand for money in developing nations. The question is whether it is interest rate which represents the opportunity cost of holding money or the rate of inflation. To answer this question Khan (1982) examined the demand for money function in six developing nations of Asia. A significant relationship of expected inflation rate with money demand in Pakistan, Korea and Sri Lanka is found. Contrary to other studies which show that interest rate cannot be used as variable reflecting opportunity cost in developing countries, the study suggested that interest rate has a considerable role in determining the opportunity cost of holding money in Pakistan, Thailand and to some degree for India. Nisar and Aslam (1983) also observe the same results regarding significance of interest rate for Pakistan. Hossain (1994) analyzes the stability of demand for money function in Pakistan over the period of 1951 to 1991. The results of his study are a little different from those of earlier studies and also have valuable suggestions for policy makers. But there is one main limitation of this study that it uses data for the period when Bangladesh was part of Pakistan. It creates an inescapable difficulty of data conformability.

Sarwar et al. (2010) investigate the money demand function for Pakistan through divisia approach. They also evaluate the demand for money function both in the short run and long run and discover a stable money demand function for Pakistan. Azim et al. (2010) inspect the money

demand function for Pakistan by employing ARDL model of cointegration and analyze that there is long run cointegration between monetary aggregate M2 and its determinants. The study revealed positive impact of income and inflation while negative impact of exchange rate on money demand. They also found a stable demand for money function for Pakistan in 1973 to 2007.

Money demand may be dissimilar for different sectors in a country therefore it is determined in Pakistan that money demand is significantly related to its determinants in the long run both in business and personal sectors. However there are some differences concerning the determinants and estimated elasticities of money holding in both sectors. Elasticity is less in personal sector than in business sector. The interest rate and inflation rate are also more effective in personal sector than in business sector [Qayyum (2001)].

Previous studies disregarded the time series characteristics of variables and also did not cover the full decade period of 1990, hence Qayyum (2005) analyzes the demand function for money and its stability in Pakistan for the time period of 1960 to 1999 by considering the time series property of the variables. It is indicated that M2 money demand has a long run constant association with the variables like return on bonds; inflation rate, call money rate and real income. He also concludes that income and inflation rates are key factors influencing the short run demand for money. The stability tests indicate that preferred model is stable but marginal models are not.

Khan and Sajjid (2005) examine the relationship of demand for real money balances with its determinants in Pakistan both in the short and long run. It is concluded that a long run stable relationship exist between demand for money and real variables i.e. rate of inflation, real income,

foreign interest rate, and real effective exchange rate. There is positive and substantial effect of real effective rate of exchange on real money demand just in the long run while very low impact of foreign rate of interest both in the short run and long run periods. Moinuddin (2007), Omer and Saqib (2008) get totally opposite results that demand function for money is unstable in Pakistan and thus targeting of monetary aggregate is not appropriate. In view of these studies another option is inflation targeting for the State Bank of Pakistan (SBP).

There is always negative effect of interest rate on demand for money that is volatility of rate of interest brings instability in velocity of money. Therefore Omer (2009) attempts to find out the stability of money velocity in Pakistan for the period of 1975-2006. It is concluded that there is stable relationship of all velocities of M0, M1, and M2 with their determinants and that there is no influence of the volatility of interest rate on the velocities of base money and broad money. The small sample size is the negative point of Omer's analysis due to which robustness tests can't be applied to its results.

Previous studies ignored the impact of financial liberalization carried out in Pakistan since late 1980s on demand for money, therefore Khan and Hye (2013) analyzes the impact of financial liberalization by adopting time trend for financial liberalization. They conclude from their study that there is no impact of financial liberalization on the stability of money demand in Pakistan and the rate of real deposits and GDP has significant impact on M2 monetary aggregates.

The effect of exchange rate on demand for money was not considered by any study in Pakistan, therefore by applying ARDL approach, Anwar and Asghar (2012) conclude that in Pakistan there is a long run relationship of demand for money with real income, rate of inflation and exchange rate. Demand for broad money (M2) has a stable relationship with its determining factors in the

long run. It is suggested to monetary authority of Pakistan that it should focus only on the long run stabilization policy because variables in the short run may not have any significant effects on the preparation and application of monetary policy. Mall (2013) and Naseer (2013) reviewed the same study for Pakistan by including interest rate and concluded that demand for money function is stable in Pakistan and has positive relation with real income and foreign exchange rate but negative relationship with interest rate on deposits both in the short run and long run. Naseer also specify physical assets as attractive substitutes for monetary assets in the long run as well as in the short run for domestic assets holders.

Faridi and Akhtar (2013) examine the determinants of money demand in Pakistan by considering real variables and find positive impact of these variables such as total population, real GDP, and financial innovations on real money demand whereas exchange and deposit rates have negative relation with real money demand. Prior studies deliver contradictory description about stability of money demand because of insufficient specifications and inaccurate estimation, therefore Haider et al. (2013) consider monetary aggregates as nominal anchor and tried to explore demand for money function for Pakistan. The results showed a stable demand function for money in Pakistan, when properly specified.

2.5 SUMMARY

The literature review indicates that according to different theories of money, money demand depends upon income and interest rate and future uncertainties. A number of studies have been conducted on demand for money on different countries including Pakistan. Different studies use different specifications, monetary aggregates and estimation techniques. It is clear from literature that in most of the developed countries such as USA, Korea, Barbados, Malaysia, Singapore and Japan there is positive and stable relation between monetary and economic uncertainties with

money demand function. However there are some contradictions about this relationship in the short run and long run. According to some studies like [Choi & Oh, (2003), Oskooee & Xi (2014), Oskooee et al. (2014), and Oskooee and Bahmani (2014)] the relation of monetary and economic uncertainties with money demand is positive in some countries[5] both in the short run and long run.

While according to a group of other studies [Bruggemann and Nautz, (1997), Oskooee and Bohl (2000), Mensah (2004), Jackman (2010), Oskooee and Xi (2014), Jackman (2010), Oskooee and Xi (2014), Kiptui (2014), Kones (2014)] the uncertainty variables are negatively related to money demand in some other countries[6] in the long run. Therefore this study is inclined to examine the relationship of monetary and other economic uncertainties with money demand for Pakistan both in the short run and long run. In developing countries including Pakistan some literature is available on the stability of money demand and the results are the same as for developed countries (stable money demand). However there is contradiction about the stability of money demand function for Pakistan in the previous studies. According to a cluster of researchers [Sarwar et al. (2010), Azim et al. (2010), Qayyum (2005), Khan and Sajjid (2005), Omer (2009), Anwar and Asghar (2012), Mall (2013) and Naseer (2013)] money demand function is stable for Pakistan. Whereas [Moinuddin (2007), Omer and Saqib (2008)] explored unstable money demand function for Pakistan. Therefore this study will re-examine the money demand function for Pakistan in the presence of uncertainty variables.

[5] US, Singapore, China, Philippines and Kenya

[6] Germany, Canada, Barbados, Indonesia and India

CHAPTER # 3

3 MODEL SPECIFICATION and DATA DISCRIPTION

3.1 INTRODUCTION

This chapter comprises of two main parts. Specification of the model and estimation technique used in the analysis is discussed in the first part of the chapter. Second part of the chapter provides explanation and construction of variables included in the model and sources of data for all these variables.

3.2 MODEL SPECIFICATION

Real or nominal GDP, price level, interest rate and exchange rate are considering as main components of money demand in every country. Money demand function for Pakistan has no exception. A number of studies estimated money demand function in Pakistan by applying different techniques and got diverse results. This study is re-estimating the money demand function by including two more variables that are monetary and economic uncertainties to its determinants. These two variables were ignored by all the previous studies in case of Pakistan. Directing the monetary policy the central bank of Pakistan is applying M2 monetary aggregate because it is considered as stable in the long run. Therefore we identify the demand for money function which relates the demand for broad money M2 to real GDP (income), NEX, price level, interest rate (r) and two measures of uncertainty (monetary and economic).

To achieve the main goals, this study attempts to develop an econometric model based on current literature and economic theory. The main goal of the study is to examine the relationship of money demand with monetary and economic uncertainties. Modeling the affiliation of variables we follow the study of Oskooee and Bahmani (2014). The leading model of money demand for Pakistan is presenting in equation (1) bellow as:

$$LnM_t = \beta_\circ + \beta_1 LY_t + \beta_2 LP_t + \beta_3 r_t + \beta_4 LEX_t + \beta_5 V_t + \beta_6 EU_t + \varepsilon_t \quad (1)$$

Where

$\beta_\circ$ is intercept

$\beta_1, \beta_2, \ldots, \beta_6$ are coefficients

LnM is log of real money balance M_2

LY is log of real GDP

LP is log of CPI

LEX is log of nominal effective exchange rate

r is rate of interest

V is volatility of nominal money stock

EU is measure of economic uncertainty

ε_t is the error term and the subscript 't' shows time period

This 1st equation is the money demand function for Pakistan after including two measures of uncertainty which represents the relationship of independent variables with dependent variable M_2. Following the literature, the signs of β_1 and β_2 in the equation are anticipated to be positive, while the sign of β_3 is anticipated to be negative. The sign of β_4 could be positive or negative depending on the value of exchange rate. Increase in exchange rate reflects devaluation of home currency or appreciation of foreign currency. Thus with the rise in exchange rate the value of overseas possessions in the form of home currency increases (that is rise in assets) which is anticipated to give rise to money demand. Therefore estimation of β_4 is anticipated to be positive. Such a positive impact of nominal effective exchange rate (NEX) on money demand is known as dominant wealth effect. However if there is an expectation of further depreciation, it may lead to increase in demand for foreign currency or decrease in demand for domestic currency. Thus estimate of β_4 can also be negative and this negative effect is known as substitution effect of NEX. β_5 and β_6 could take any sign. If a measure of uncertainty persuades people to be more careful and to hold more liquid assets, value of coefficients will be positive. However, if any measure of uncertainty (monetary or economic) creates substitution effect so that people move away from holding cash towards less volatile assets then the values of β_5 and β_6 can be negative.

In order to properly test the long run coefficient estimates of equation (1) for stability, we should include the short run dynamic adjustment mechanism. The procedure basically amounts to specify equation (1) in an Error Correction Model format. Thus, following the ARDL bound testing approach of Pesaran et al. (2001) we have the following equation

$$\Delta LnM_t = \alpha_\circ + \sum_{i=1}^{n} \alpha_1 \Delta LM_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta LY_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta LP_{t-i} + \sum_{i=0}^{n} \alpha_4 \Delta LEX_{t-i} + \sum_{i=0}^{n} \alpha_5 \Delta r_{t-i} + \sum_{i=0}^{n} \alpha_6 \Delta V_{t-i} + \sum_{i=0}^{n} \alpha_7 \Delta EU_{t-i} + \rho_\circ LM_{t-1} + \rho_1 LY_{t-1} + \rho_2 LP_{t-1} + \rho_3 LEX_{t-1} + \rho_4 r_{t-1} + \rho_5 V_{t-1} + \rho_6 EU_{t-1} + \varepsilon_t \quad (2)$$

Where

$\alpha_\circ$ is intercept

α's and ρ's are coefficients

Δ shows 1st difference of variables

t- 1 represents 1st lag of variables

t- i shows lag length of variables

i = 0, 1, 2, 3

Hypothesis

$H_\circ: \rho_1 = \rho_2 =, \ldots, = \rho_6 = 0$ (No co-integration)

$H_1: \rho_1 \neq \rho_2 \neq, \ldots, \neq \rho_6 \neq 0$ (Co-integration)

This 2nd equation is the error correction representation of ARDL model. This is a bit different from the standard error correction model in the sense that all variables from equation (1) are included in equation (2) in their lagged level form instead of including lagged error term. This specification is mostly favored by Pesaran et al. (2001) because by estimating equation (2) the short run and long run effects of variables can be found in one step estimation. As we are

interested in analyzing the short run and long run effects of variables therefore this error correction representation of ARDL model is the most appropriate model to apply by the study. The estimates of the coefficients α_1, α_2, ...α_7, reflects the short run effects, while ρ_1, ρ_2, ..., ρ_6 normalized by ρ_0 reflects the long run effects. However, in order to make estimates of the long run coefficients meaningful, there is need to check cointegration among the variables.

To establish cointegration Pesaran et al. (2001) propose a nonstandard F test (also called bound test), which has new critical values for joint significance of lagged level variables. They provide the upper bound and lower bound critical values. For the existence of cointegration among variables, the calculated F statistics should be greater than the upper-bound critical value. However if the test statistics lie bellow the lower bound then the null hypothesis of no co-integration is accepted. If test statistic lies between the upper and lower bounds the results are considered as inconclusive. After applying F test, equation (1) is estimated to get the residuals which are further uses as error correction term. Equation (2) is then re-estimated by replacing the variables representing long run relationship (lagged level variables) with the lagged error correction term. The estimated value of error correction term shows the adjustment of variables towards equilibrium only if it is negative and significant, which also provides evidence for cointegration of variables.

The short run and corresponding long run affiliation between variables are estimated by applying a number of econometric techniques available in the literature over the preceding three decades. The most popular techniques used in the literature are two-step estimator by Engle and Granger (1987), the multivariate methodologies of Johansen (1988) and Johansen and Juselius (1990), the fully adjusted OLS procedures of Hansen and Phillips (1990) and the full information maximum

likelihood practices of Johansen (1995). There are some limitations of the above approaches. One major limitation of these techniques is that at least two variables must be I(1).

Therefore the present study uses "the bound testing approach to cointegration" as a major approach within the framework of autoregressive distributed lag (ARDL). There are some main advantages of ARDL approach over other cointegration approaches. The first advantage is, when the variables are integrated of order I(0) and I(1) then ARDL is the most appropriate approach. Secondly, it is useful even in case of small sample size. Thirdly, unlike the VAR models of cointegration it is applicable to different variables having different lags.

3.3 UNIT ROOT TEST

Unit root test is the first step for checking the time series properties of the variables. There is some motive behind every test performed in an econometric work. There are also two motives behind unit root test applied at a first place in every study. The first motive, which is important for setting up an econometric model and for obtaining precise results, is checking the order of integration. The second motive of applying unit root test in different studies is that according to economic theory some variables should be integrated, a random walk process or a stochastic process. These properties of variables can be explored only by applying very comprehensive tests in combination with unit root tests to variables. This shows that theory also motivates unit root tests before the construction of an econometric model [Sjo (2008)].

Unit root tests are carried out in most of the studies to categorize variables into stationary and non-stationary. To check the stationarity of variables different unit root tests are available in the literature. These tests include DF test (1979), ADF test (1981), Ng-Perron test (1995), Philips-perron test (1988), and Kwaitkowaski-Phillips-Schmidt-Shin (KPSS) test (1992) etc. This study

applies Augmented Dickey Fuller (ADF) unit root test proposed by Said and Dickey (1984) to check the order of integration of variables.

The reason that we focus on ADF test in our study is that it is simple, standard, commonly used and has no evenly better alternative [Sjo (2008)]. Once we classify our variables as integrated, stationary or deterministic trend stationary then we can set up a model where statistical supposition will be meaningful and can estimate short run and long run effects in our model. The regression equations for ADF test are;

$$\Delta y_t = \alpha + \rho y_{t-1} + \gamma \sum_{i=1}^{n} \Delta y_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta y_t = \alpha + \beta_t + \rho y_{t-1} + \gamma \sum_{i=1}^{n} \Delta y_{t-1} + \varepsilon_t \quad (4)$$

Where

y_t is time series to be tested for unit roots

α is constant term

β_t is time trend term

ρ is the parameter of interest

$\gamma \sum_{i=1}^{n} \Delta y_{t-1}$ is auto regressive term included in models to ensure the

residual (ε_t) is serially correlated

ε_t is white noise error term

The hypotheses are:

$H_0: \rho = 0$ Unit root (non-stationary)

$H_1: \rho \neq 0$ No unit root (stationary)

If a variable has unit root (null hypothesis will be accepted), otherwise alternative hypothesis will be accepted.

A traditionally estimated money demand function that is stable over time is of intense help to the policy makers in forecasting money stock. It is, therefore, essential to examine the stability of the estimated function. It is required to check the stability of money demand after adding monetary uncertainty and economic uncertainty as new determinants of money demand. Cumulative sum (CUSUM) and cumulative sum squared (CUSUMSQ) tests are applied to the residuals of the error-correction model to test the stability of the long run money demand function.

3.4 DATA AND VARIABLES

To estimate the money demand function specified in the preceding section, data on the following variables are required: real monetary aggregate M2, Y (real GDP), price level, interest rate (r), nominal effective exchange rate (NEER), monetary uncertainty (V) and economic uncertainty index (EUI). To reduce the variability of data and to make our calculations simple some of the variables (real GDP, CPI, NEER and M2) are converted into logarithmic form. We use annual data from 1970 to 2014. Data are collected from Economic Survey of Pakistan, annual reports of State Bank of Pakistan and International Financial Statistics (IFS). Detail of variables is given bellow:

- Demand for real monetary aggregate (M2): data is not directly available from any source therefore first data of nominal M2 is taken from economic survey of Pakistan and then it is deflated by GDP deflator to obtain real M2.
- Real GDP (Y): data on GDP at constant market prices is also taken from the same source

- Log of CPI (LP): CPI data is also obtained from economic survey of Pakistan
- Nominal effective exchange rate (EX): it is defined as the value of dollar in terms of rupee. The increasing trend in data shows depreciation of domestic currency or appreciation of dollar over time. Its data is taken from International Financial Statistics (IFS).
- Interest rate (r): it is defined as govt bond yields. Its data also taken from IFS.
- Economic uncertainty index (EUI): It is the index of five variables which are; govt expenditures, exports, imports, foreign remittances and foreign direct investment (FDI). The data on all the five variables are taken from economic surveys of Pakistan and then converted to percentage of GDP. All the variables are taken in the first difference form due to stationarity. Data on uncertainty of variables are not available; therefore, it is proxied by volatility. Data on volatility of variables is also not available therefore; it is generated by calculating standard deviation of all variables. For measuring standard deviation of these variables we took the data from 1966 to 2014. Then standard deviation for each five observations is calculated through rolling method, due to which the first four observations dropped out from the data. Thus we got a series of standard deviation for each variable from 1970 to 2014. After calculating standard deviation for all variables, economic uncertainty index is constructed with help of the following formula.

$$EUI = \sum_{i}^{n} \gamma_i \left(\frac{(V_i - \overline{V_i})}{\delta_v}\right)$$

Where

V_i is the volatility of variable 'i'

$\overline{V_i}$ is the average volatility

δ_v is the standard deviation of volatility

γ_i is the weight attached to each factor

Actual weights are calculated by principal component analysis for variables which are reported below:

Govt Expenditure= 0.24 Exports= 0.33 Imports= 0.36

Remittances= 0.02 FDI= 0.05

After getting the index series we converted them into Z-score values, so that every observation represents 1% point of the index. The Z-score formula is given bellow

$$Z = 100\left(\frac{EUI_i - EUI_{min}}{EUI_{max} - EUI_{min}}\right)$$

Where

EUI_i represents observations of the economic uncertainty index series

EUI_{min} is minimum value of the series of economic uncertainty index

EUI_{max} is maximum value of the series of economic uncertainty index

- Monetary volatility (V): It is estimated by applying GARCH (1,1) technique on monthly data of nominal M2. Monthly data of nominal M2 is taken from State Bank of Pakistan.

The volatility calculated from monthly data of M2 is then converted into annual volatility by taking the average of every 12 monthly observations. The annual volatility series is then converted into monetary uncertainty index by Z-score formula as explained above. GARCH (1, 1) technique is presented below.

3.4.1 GARCH MODEL

GARCH is the abbreviation of Generalized Autoregressive Conditional Heteroskedasticity which is the extension of ARCH model and is developed by Engle (1982). GARCH model has the capability to measure volatility which does not remain constant over time but varies with time. Uncertainty of variables can't be measured directly; therefore it is proxied by volatility. Data on monetary volatility is not available, therefore, by following Oskooee et al (2010) it is created through GARCH technique. GARCH works with variables like X whose variance changes with time. It assumes that X is a random variable which is drawn from a conditional density function f(Xt|Xt−1). There is a standard assumption that X is a variable having constant variance and depends on its past value. A primary assumption of first order auto regressive process for GARCH model is that, $X_t = \beta_\circ + \beta_1 X_{t-1} + \varepsilon_t$ where ε_t has the properties of white noise (Mean=0 and Variance=σ^2). The unconditional mean of X_t is also zero whereas the conditional mean of X_t is $\beta_\circ + \beta_1 X_{t-1}$. To estimate the variance of X it is necessary to first calculate the conditional variance of error term ε_t which varies over time.

GARCH model depends on the variance ($\sigma_t{}^2$) and error term (ε_t) at time t, therefore the basic equation of GARCH model can be written as

$$\sigma_t{}^2 = \alpha_\circ + \alpha_1 \varepsilon_{t-1}^2 + \cdots \alpha_q \varepsilon_{t-q}^2 + \beta_1 \sigma_{t-1}^2 + \cdots \beta_p \sigma_{t-p}^2 \qquad (5)$$

Where

q is the lag length of ARCH effect

p is the lag length of GARCH term

There are two pre-conditions for measuring volatility through GARCH technique. First is the presence of clustering volatility in time series data which is checked by looking at the graph[7] of the data. Second, there should be ARCH effect in the data.

3.4.2 ARCH EFFECT

Auto regressive conditional heteroskedasticity (ARCH) is a necessary condition for applying GARCH model. ARCH effect is estimated under the null hypothesis

$H_0: \alpha_1 = \alpha_2 = \cdots = \alpha_q = 0$

This hypothesis is based on equation (5) which can be tested with the help of p value. If $p<0.05$ then we reject the null hypothesis, otherwise we can't reject our null hypothesis. The acceptance of null hypothesis means that there is no Arch effect and rejection of null hypothesis means that there are one or more than one non zero coefficients in the regression which shows Arch effect in the data series. After the fulfillment of these two conditions (clustering volatility and Arch effect) we are able to apply GARCH model to get the volatility series for monetary aggregate M_2.

3.5 DEFINITION AND IMPORTANCE OF VARIABLES

There are a number of variables which can influence demand for money in Pakistan. The reason for considering the above variables[8] as determinants of money demand is there importance, which is described billow.

[7] See clustering volatility graph in appendix at page #58

3.5.1 MONEY STOCK

Money stocks are divided into two categories that is narrow money (M1) and broad money (M2). M1 consists of the most liquid factors of supply of money. It contains those assets and cash which can be converted into currency very quickly, thus it provides the function of money as a mean of exchange. M2 is a broader definition of money than M1, it consists of M1, saving deposits, time deposits, money market mutual funds and overnight repurchase contracts and deposit accounts at money market. The use of money stock in different empirical studies varies from study to study. The use of M1 or M2 is decided on the basis of goals of the studies and also on the other variables including in the studies. A large number of studies[9] estimated the demand for M2 money balances, because it is considered as more capable of bringing the full effect of interest rates. In case of Pakistan M2 is considered as more stable in the long run, therefore this study is also taking M2 while estimating money demand function for Pakistan.

3.5.2 REAL INCOME (GDP)

It is defined as a measure of total economic activity of a nation. It is used in the money demand as a measure of transactions associated to economic activity. GDP is used by all most all studies on money demand and it is clear from these studies that GDP is very important determinant of money demand function because it improves its performance. Thus a number of studies performed for developing countries including Pakistan incorporate real GDP as a component of money demand function. Some of these studies are [Akhtar (1974), Qayyum

[8] Real GDP, price level, interest rate, exchange rate, monetary uncertainty and economic uncertainty

[9] Qayyum (2001,2005), Anwar and Asghar (2012), Khan and Zabir (2005), Bahmani and Kutan (2010), Khan (1980), Dritsakis (2011) etc

(2001, 2005), Anwar and Asghar (2012), Dritsakis (2011), Khan and Hye (2011), Kundu and Mollah (2014), Naseer (2013), Oskooee (2001), Owoye (2007)].

3.5.3 PRICE LEVEL

One of the main objectives of monetary policy in developing countries is to control inflation in the economy so as to avoid its negative influence on the economy. Inflation is defined as a continue increase in price level, and price level has a direct relationship with money demand. If rise in money supply is not equal to demand for money it causes price level to increase. Thus price level is also taken in money demand function by several studies [Kundu and Mollah (2014), Mall (2013), Akhtar (1974), Dutton (1979), and Ibrahim (1998, 2001)].

3.5.4 NOMINAL EFFECTIVE EXCHANGE RATE

Exchange rate is also known as foreign opportunity cost of holding money, thus in an open economy it is important to analyze the impact of exchange rate on demand for holding money. The nominal effective exchange rate has influence on money demand function in developing countries. The significance of nominal effective exchange rate in demand for money function is emphasized by the studies of [Dritsakis (2011), Faridi and Akhtar (2013), Mall (2013), Oskooee and Bahmani (2014), Oskooee and Wang (2012), Kiptui (2014)].

3.5.5 INTEREST RATE

Interest rate is the opportunity cost of money holding and it can be defined as the difference between the rate of returns on assets other than money and the personal rate on money. It is pointed out by the good performance of interest rate in different studies that different types of interest rates are relevant to money demand function. Interest rate in the form of call money rate, govt bond yield and Treasury bill rate is incorporated by different researchers to the money

demand function. There is extensive evidence from the studies both for developed and developing economies that demand for money is negatively related to interest rate i.e. [Khan (1980), Owoye (2007), Oskooee and Wang (2012), Oskooee and Bohl (2000), Oskooee and Bahmani (2014)] etc.

3.5.6 MONETARY AND ECONOMIC UNCERTAINTY

Uncertainty is defined as a situation of imperfect information, where it is not possible to precisely explain the existing situation, a future effect or more than one possible effect. Both measures of uncertainty have important role in determination of money demand. Importance of both variables is also clear from the studies of [Choi and Oh (2003), Jackman (2010) Economic, Mensah (2004) eco, Oskooee and Bahmani (2014), Oskooee and Wang (2012), Kiptui (2014)]

CHAPTER #4

4 RESULTS AND INTERPRETATION

4.1 INTRODUCTION

The objectives of the study are to investigate the relationship of money demand with its determinants including monetary and economic uncertainties and to check the stability of money demand function in Pakistan. In order to investigate the determinants of money demand, unrestricted error correction model (ECM) is employed. To check stability, QUSUM and QUSUMS tests are applied. Before estimating the model it is necessary to check time series properties of the variables. Therefore the chapter is divided into three parts. The first part discusses the results of a unit root test. The second part interprets and explains the results of ARDL model. The findings of diagnostic tests applied to the estimated money demand function are discussed in third part.

4.2 THE RESULTS OF THE UNIT ROOT TEST

One of the preconditions of ARDL model is that, none of the variables should be I(2), therefore it is necessary to check the stationarity of all variables. Thus Augmented Dickey Fuller (ADF) test is applied to all variables both at level and first difference, for checking time series properties of variables such as stationarity or non-stationarity.

Table 1

Results of ADF Test

Null hypothesis; there is unit root in the data

Level variables	lags	t-statistics	Difference variables	Lags	t-statistics
LM2	0	-0.2567	DLM2	0	-5.3597***
LY	0	-1.2106	DLY	0	-4.7118***
LP	1	-1.1902	DLP	0	-3.3595**
NER	0	-2.0640	DNER	0	-5.0113***
R	1	-3.2916**	DR	1	-5.7099***
VLM2	0	-1.9770	DVLM2	0	-4.6227***
EUI	0	-1.6036	DEUI	0	-5.6549***

Note: ** and *** represents significant at 5% and 1% level of significance respectively

Values in the brackets represent lag lengths which are automatically selected in eviews by SIC

The results of Augmented Dickey Fuller test for stationarity are reported in table 1. The results make it clear that all variables except interest rate have unit root at level but don't have unit root at their first difference. This indicates that all variables included in the study are stationary at their first difference but interest rate variable is stationary at level. We can also say that interest rate is I(0) while all other variables are I(1). The results also indicate that no one of the variables is I(2). Thus it provides the validation of ARDL bound testing approach to be used for examining the determinants of money demand for Pakistan. Therefore we proceed towards the second part of the chapter which consists of results of ARDL model.

4.3 COINTEGRATION ANALYSIS: ARDL APPROACH

To determine the short run and long run relationship between real money demand (M2), real GDP, price level, interest rate, nominal effective exchange rate, monetary uncertainty and economic uncertainty ARDL model is estimated. The first step in application of ARDL is the determination of optimal lag selection for each variable. Akaike Information Criteria (AIC) and Schwarz Criteria (SC) are utilized for the purpose. First we impose 3 lags on all variables of first difference and just one lag on variables in level and estimate the equation. The insignificant lags are dropped out one by one till the value of SC stop to decline. In this way the appropriate ARDL model is selected where different variables have different optimal lag length. It is worth mentioned that coefficients of variables with first difference show the short run relationship while coefficients of variables at level represent the long run relationship. The short run coefficients are reported in table 2, while the long run coefficients are reported in table 3.

Table 2

Short-Run Coefficient Estimates

Dependent Variable DLM2

Lag Order				
Variables	0	1	2	3
DLM2	--	0.3859*** (3.91)	0.2192*** (3.16)	0.2813*** (3.98)
DLY	1.3318*** (4.65)	1.2532*** (3.69)	2.1676*** (6.42)	1.3014*** (4.53)
DLP	-0.836*** (6.04)	0.9120*** (6.47)	--	-0.2881 (1.36)
DLNER	-0.170*** (3.199)	--	--	0.4521*** (7.37)

DR	-0.002 (1.01)	0.0157*** (5.52)	0.0052* (2.03)	0.0179*** (8.38)
DVM2	-0.003** (2.53)	0.0022*** (3.19)	– –	0.0010 (1.79)
DEUI	-0.001** (2.24)	0.0005 (1.34)	0.0021*** (7.75)	0.0016*** (5.50)

Note: *,**and *** represents significant at 10%, 5% and 1% level of significance respectively
Figures in parenthesis represent t-statistics values

Table 3

Long run coefficient estimates

Dependent variable DLM2

Variables	Coefficients	t-statistics	p-value
C	8.5394	4.6569	0.0009
LY	0.3479	2.413	0.0365
LP	0.4479	5.204	0.0004
LNER	-0.2327	5.523	0.0003
R	-0.0173	3.903	0.0029
VLM2	0.0014	1.206	0.2557
EUI	-0.0019	3.398	0.0068
R-squared= 0.99 Adjusted R-squared= 0.97 F-statistic= 40.08 Prob(F-statistic)= 0.000 Durbin-Watson stat= 2.078			

It is clear from the table 2 that at least two coefficients of each variable are significant which means that monetary and economic uncertainties along with other variables have significant

impacts on demand for money in the short run. The findings of our study are in line with the results of Oskooee and Wang (2012) for China and Choi and Oh (2003) for USA.

The table 3 reports long run estimates of ARDL model. The coefficient of real GDP not only has a desired sign but is also significant. The positive sign of real GDP shows that money demand is positively related to real income. It is according to economic theory which states that with the rise in real income the demand for money increases. But here this relationship of real income and money demand is non proportional which is in line with the theory of post Keynesian economist Baumol (1952). This result of our study is consistent with the results of all most all studies conducted on money demand for Pakistan and other countries. Some of these studies are; Akhtar (1974), Choi and Oh (2003), Mensah (2004), Qayyum (2001 and 2005), Anwar and Asghar (2012), Naseer (2013), Oskooee and Bahmani (2014), Oskooee et.al (2014), Apergis (2015).

The price variable has also positive and significant coefficient. It supports the economic theory. Our results are in line with the study of Akhtar (1974) for Pakistan, Dutton (1979), and Ibrahim (1998, 2001) for Malaysia, which concluded that prices are positively related to money demand.

It is also clear from the results that nominal effective exchange rate has significantly negative impact on money demand for Pakistan. Its coefficient is highly significant at one percent level of significance but is less elastic. A one percent rise in exchange rate declines money demand by only 0.23%. The reason for the inverse relation between exchange rate and money demand may be that; a rise in exchange rate (ER) indicates a decrease in value of domestic currency due to which demand for holding domestic currency in the form of (M2) declines. People convert their holdings (in the form of money) into foreign assets due to expectations of further decline in the value of domestic currency. This is consistent with the results of Bahmani and Kutan, (2009) for

emerging economies, Ibrahim (2001) for Malaysia, Kones (2014) for Africa and Kiptui (2014) for Keyna. Our findings for exchange rate contradict the findings of Oskooee (2002) and Mall (2013) by the way of positive relationship between exchange rate and demand for money.

The coefficient of interest rate (government bond yield) is also negative and highly significant, which indicates inverse relationship of interest rate with demand for money. The reason for this inverse relationship may be that; whenever interest rate gets higher, the returns on saving deposits increases which in turn raises the opportunity cost of holding money. Therefore people prefer to hold alternatives to demand for money and hence demand for money decline. This is consistent with theory and also the results are in line with the findings of Mangla (1979), Inoue and Hamori (2008) and Kiptui (2014) for different countries. All these studies found that both interest rate and nominal exchange rate have significant but inverse relationship with money demand.

Monetary uncertainty has a positive coefficient which means that it has positive impact on money demand. However the relationship of monetary uncertainty with money demand is statistically insignificant for Pakistan. This result is consistent with the results of Oskooee and Wang (2014), Kones (2014) but inconsistent with Oskooee and Xi (2014), Oskooee and Bahmani (2014). The reason of insignificant coefficient of monetary uncertainty can be the less volatile behavior of M2 money supply in Pakistan. The less volatile behavior is predicted from very small values of our volatility series for money supply calculated through GARCH technique.

The coefficient of economic uncertainty is significantly negative. This indicates that economic uncertainty has a negative impact on money demand. As its coefficient value is very small that is

0.0019, which means that although its impact on money demand is negative but very small in case of Pakistan. The inverse relationship of economic uncertainty with demand for money is supported by the findings of Oskooee and Xi (2014) for Malaysia and Indonesia. However our results are in contrast with the results of Oskooee and Xi (2014) for India, Philippine and Singapore, Jackman (2010) for Barbados and Kones (2014) for Africa.

4.4 DIAGNOSTIC TESTS

The next step in ECM is to check cointegration among variables. To make the long run coefficients meaningful it is necessary to establish that the long run variables are co-integrated. In other words the long run investigation of variables is considered pertinent only when variables are co-integrated. The presence of co-integration can be established by applying test of co-integration that is bound test.

Table 4

Results of Diagnostic Tests

F-statistic	ECM_{t-1}	Adj R^2	LM	D.Watson	CUSUM	CUSUMSQ
25.9206	-0.5123 (3.68)	78.60	4.8465 (0.09)	1.6428	stable	stable

Bound test is applied on the lagged level variables for checking the long run relationship which is reported in table 4 by F-statistic. The ARDL bound test results shows that the value of F-statistic is 25.9206 which is much higher than upper bound critical value. Therefore the hypothesis that there is cointegration among variables is accepted. The critical values for F-

statistics are got from the table (unrestricted intercept and no trend) of Pesaran et.al (2001) which ranges from 2.45 to 3.61. Thus it is clear from the result of bound test that there is cointegration among the variables and that all the variables can move together towards equilibrium.

After diagnosing cointegration among variables the last step of unrestricted ECM is the estimation of error correction term. Therefore we run the regression of real demand for money on its determinants at level to get the error correction term. The lagged level variables are then replaced with the lagged level error correction term (EC_{t-1}). Then the equation is re-estimated and the value of error correction term is obtained which is -0.5123. The value of error correction term is negative and significant which indicates that there is cointegration among all variables. Thus it is proved both from F-statistics and Error Correction Term that real income, price level, interest rate (govt bond yield), exchange rate (nominal effective), monetary volatility and economic volatility are co-integrated.

Error Correction Term also shows the speed of adjustment towards the equilibrium. Thus it shows that after a change in independent variables the depended variable adjusts towards equilibrium in the long run at a high speed of 51 percent per year. This speed of adjustment is much higher than that of other studies conducted for Pakistan such as 10%, 27.6% and 25% in the studies of Qayyum (2005), Anwar and Asghar (2012) and Oskooee and Xi (2014) respectively. The speed of adjustment in our study is slightly smaller than the speed of adjustment estimated by Faridi and Akhtar (2013)] which is 53.8%.

Therefore after estimating the error correction model, we apply some diagnostic tests such as LM test and Durbin Watson statistics etc. The results of these tests are also reported in table 4. LM test is applied to check the serial-correlation in the data. The results of LM test show that the null

hypothesis of serial correlation is rejected as chi-square value is 0.09 which is much higher than 0.05 (5%). The critical value for LM test at five percent level is 9.48 and the value of LM statistics is 4.84 which is much smaller than the critical value. It means that there is no serial correlation in the residuals, which is desirable. The value of adjusted R-square shows explanatory power of the model that is about 78 percent. The Durbin Watson statistics is also reported in the table which is an indicator of the presence or absence of autocorrelation in the data; here its value is 1.64 (near to desirable value) which indicates that there is no autocorrelation in the residuals of error correction model (ECM) in our study.

One of the objectives of the study is to check the stability of money demand function for Pakistan. Therefore after estimating the money demand function, we check its stability with the help of CUSUM and CUSUMSQ tests proposed by Durbin et al (1975). The results of the test are shown in figure 1 and 2. The dotted straight lines in both figures signify the critical bounds at 5% level of significance. When the test line lies within the critical bounds it indicates stability of the model, otherwise the model is considered unstable.

The CUSUM test in figure 1 shows the stability of money demand function because the test line lies inside the critical bounds. The CUSUMSQ test in figure 2 also indicates the stability of money demand for Pakistan. These results are in line with the findings of Omar (2009), Qayyum (2005), Khan and Sajjid (2005), Khan and Hye (2013), Haider et al. (2013) but inconsistent with the results of Uddin (2007) and Kones (2014) for some African countries[10].

The outcomes from stability tests; CUSUM and CUSUMSQ and error correction model shows that our money demand function is more stable than that of Hussain (1994), Qayyum

[10] Burkino Faso, Burundi, Cameroon, Egypt, Gabon and Kenya

(2001,2005), Azim et.al (2010), Anwar and Asghar (2012) and Oskooee and Xi (2014) in Pakistan. However previous studies on real demand for money in Pakistan justify that the political instability, regional disparity of resources and income, weak policy reforms in fiscal expansions, crisis in the balance of payment situation, depreciation of domestic currency and other changes in the monetary policy face in Pakistan could be the cause of smaller instability in the money demand function (Mall, 2013).

Figure 1

Real Monetary Aggregate M2

CUSUM test to the residuals of equation 2

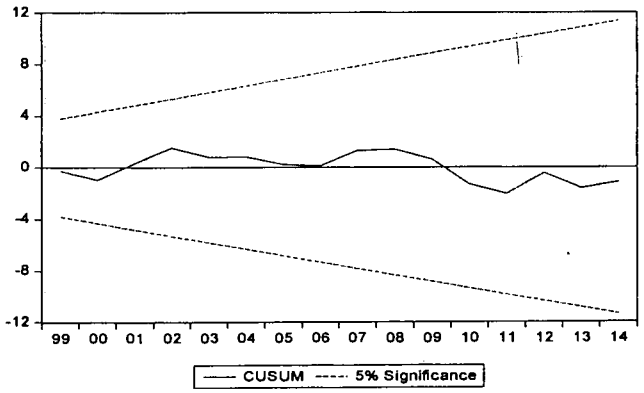
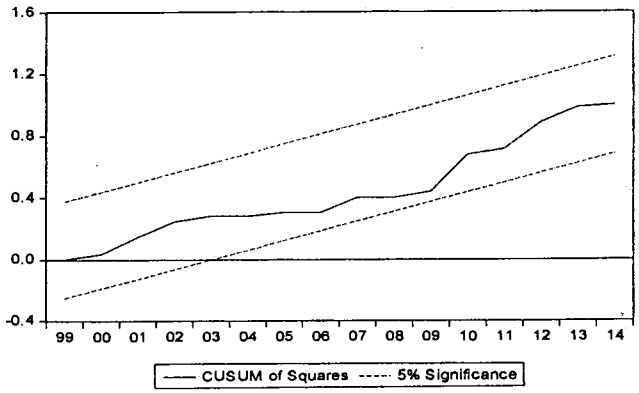


Figure 2

Real Monetary Aggregate M2

CUSUMSQ test to the residuals of equation 2 for Pakistan



CHAPTER # 5

5 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter presents brief summary and main findings of the study and also presents some points of recommendation to the policy makers.

5.2 SUMMARY

The monetary uncertainty could encourage people to spend less and hold more money [Friedman (1984)]. Later on the same argument was extended to economic uncertainty. Choi and Oh (2003) argued that economic uncertainty can also influence people's choice in distributing their wealth among different assets because economic uncertainty creates uncertainty about job predictions which could encourage people to hold additional money (currency) and lesser amount of other assets. Few studies tested these propositions for several developed economies by including monetary and economic uncertainty measures in the standard demand for money function for these countries. Asian countries and particularly Pakistan have got no attention at all and therefore we try to fill the gap in the literature by estimating money demand function for Pakistan together with monetary and economic uncertainties.

The aim of the study is to explore the dynamic demand for money function for Pakistan that could be employed to policy analysis. More specifically purpose of the study is to explore whether monetary and economic uncertainties affect the demand for money in Pakistan. Another aim of the study is to explore whether after including these measures of uncertainties money demand function remains stable or not. The model is estimated by taking time series data from

1970 to 2014. Since interest rate is level stationary variable, while other variables are non-stationary at level therefore the more appropriate method of estimation is ARDL bound testing approach of Pesaran et al. (2001). This test allow the variables to be stationary or non stationary and also accounts for integrating properties of all variables. The method also distinguishes the short-run effects from the long-run effects in one step estimation.

Conditional variance estimates of money supply obtained from the GARCH (1,1) model are proxied as monetary volatility. Whereas economic uncertainty is obtained by calculating an economic uncertainty index of exports, imports, govt expenditure, FDI and foreign remittances through their standard deviations. After applying bound test ECT is calculated to explore the speed of adjustment of variables towards equilibrium and autocorrelation is checked among variables through LM test. At the end of our estimation process two stability tests CUSUM and CUSUMSQ are also applied to check the stability of estimated money demand function for Pakistan.

5.3 CONCLUSIONS

It is concluded from the results of the study that economic uncertainty does in fact have a significant impact on money demand in Pakistan. Its impact on money demand is though negative but small both in the short run as well as in the long run. The negative impact of economic uncertainty justifies the substitution effect due to which people move away from holding cash towards less volatile assets. Whereas the impact of monetary uncertainty is significant only in the short run but insignificant in the long run. This shows that monetary uncertainty is effective just in the short run while in the long run it is not more volatile therefore it can't influence money demanded by the public. On the basis of these conclusions we accept our first null hypothesis (H_0^1) that "monetary uncertainty don't have significant impact on

demand for money" in Pakistan. Second null hypothesis (H_0^2) of the study is rejected therefore we accept an alternative hypothesis (H_2) that "economic uncertainty has significant impact on demand for money" in Pakistan.

All other variables included in the study such as interest rate, exchange rate, price level and real income have significant impacts on money demand. It is also concluded from the results of the study that both interest rate and exchange rate negatively affects demand for money in Pakistan. The negative impact of exchange rate provides the evidence in favor of substitution effect. Another finding of the study is that demand for money is positively affected by price level as well as real income. The intensity of real income affecting M2 is higher than price level and all other variables in the short run. While in the long run price level has stronger relationship with money demand than all other variables including income. Thus according to the findings of this study price level is a primary determinant of money demand in Pakistan. This indicates that a one percent raise in price level is accompanied by comparatively higher increase (more than one percent) in supply of money, to support a constant increase in money demand.

The speed of adjustment of the variables at which they returns towards the equilibrium level reveals that the real demand for money can adjust from its disequilibrium level in the previous year towards the equilibrium level in the current year at the speed of 51.23%. The stability tests CUSUM and CUSUMSQ make available a proof about the stability of the demand (M2) for money function for Pakistan. This indicates that after including measures of monetary and economic uncertainties in money demand function it remains stable. Therefore we reject our third null hypothesis (H_0^3) and accept the alternative hypothesis (H_3) that "demand for money function is stable in Pakistan". Based on the findings of the study, we can conclude that the measure of broad money M2 has a stable long run relationship with its determinants like real

income, price level, interest rate (govt bond yield), nominal effective exchange rate, monetary uncertainty and economic uncertainty.

Therefore we can safely conclude that the monetary policy based on broader measures of money (M2) plays a vital role in the stabilization of economic activity, particularly in case of prices and output in Pakistan.

5.4 RECOMMENDATIONS

There can be a number of reasons attributed to the above findings and a few policy implications, which are given below:

The evidence of an important implication derived from the study suggest that in addition to interest rate, exchange rate and price level, economic uncertainty is also an important determinant of the demand for money; therefore the policy maker should keep it in mind while using the policy tools for achieving policy objectives. The study also presents some general suggestions: firstly higher economic uncertainty declines the demand for money and when demand for money becomes lower than supply of money, inflation creates in the economy. Therefore it is necessary to keep uncertainty in control by controlling the factors responsible for creating uncertainty in the economy. Secondly keeping in view the short-run and long-run strong relationships of prices and real income with real money demand it is suggested to the state bank of Pakistan to be very careful while using any policy that influences real income or price level in the economy. Therefore this study also allows the policy makers to assess threats to the price stability in the long-run.

Thirdly to conduct a proper monetary policy it is necessary to raise supply of money at the time of increase in demand for money. This can be attain by verifying the

observing capacity of economy for augmented money supply by way of changes in real income, price level, interest rate, exchange rate and monetary and economic uncertainties. Therefore it is obligatory to analyze the demand side of money market.

Fourthly finding a stable demand for money function is essential for policy makers as it provides a useful framework to accurately predict the impact of macroeconomic variables for explaining, predicting, controlling and targeting inflation.

Fifthly in case of stable money demand, a monetary aggregate (M2) targeting monetary policy can have a very important position in stabilization of the economy. As the study justified the stability of money demand function for Pakistan; therefore for controlling inflation in the economy money supply targeting is more appropriate method. Sixthly the relative usefulness of economic policies (monetary and fiscal) can be improved. For example, in situation of lacking confidence in domestic currency if the state bank of Pakistan implements an expansionary monetary policy, its effectiveness may be compromised, leading to decline economic growth.

By taking the above points into consideration by policy makers while making an economic policy they can be succeeded in formulating a more appropriate policy for the economy. The suggestions for future research are that; this study can be extended by including permanent income and other variables by following Friedman's theory of money demand.

APPENDIX A

INTERPRETATION OF GARCH MODEL

Volatility is generally defined as an evaluation of risk. The variation over time in the variance of a variable is generally referred to as the existence of conditional heteroskedasticity in that variable. While measuring monetary volatility we take monthly data on M2 monetary aggregate for the period of 1970 to 2014.

Before applying garch model to monthly data of nominal M2 ADF test is applied to the data for checking whether the series is stationary or non-stationary. The results of ADF test are presented in the table 5.

Table 5

Results of unit root test for LM2

Log of M2		lag	t-statistics	p-value
At level	intercept	13	-0.5221	0.884
	Intercept+trend	13	-3.0521	0.119
At 1st difference	intercept	15	-5.5314	0.000
	Intercept+trend	15	-5.5547	0.000

The null hypothesis at level is; log of M2 (LM2) has a unit root. It can be accepted when p-value is greater than 5 percent; otherwise an alternative hypothesis of stationarity of variable will be accepted. Null hypothesis is accepted here both at intercept with and without trend in case of variable at level. Thus LM2 is non stationary at level. In case of 1st difference null hypothesis is; DLM2 has a unit root. This hypothesis is rejected (both at intercept and intercept+trend) because

the p-value is less than five percent. Thus log of M2 at first difference is stationary at 1 percent level. The lag value is determined automatically through Schwarz Criteria.

GARCH Model

The stationary variable (with first difference) is then used for calculating volatility by applying generalized autoregressive conditional heteroskedasticity (GARCH) technique. There are two basic conditions of GARCH model which are necessary to fulfill before applying GARCH that are:

i) Clustering volatility and

ii) ARCH effect

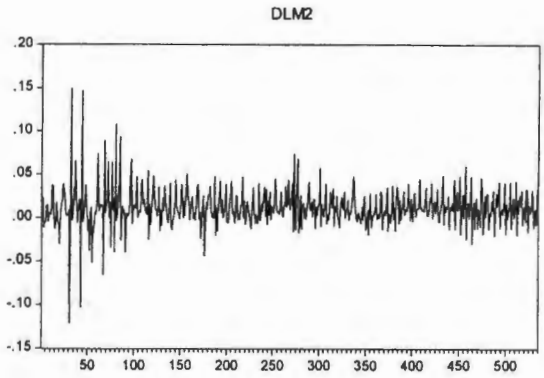
Clustering Volatility

Clustering volatility is defined as the time of big changes come after the time of big changes while the time of low changes come after the time of low changes. Figure 3 clearly shows unpredictability bunches in the data over time that is towering unpredictability come after towering unpredictability and little instability comes after small instability.

Figure 3 shows clustering volatility in the series of DLM2.

Figure 3

Clustering volatility



ARCH Effect

A heteroskedasticity test is applied for estimating arch effect in data series. The null hypothesis for this test is that "there is no arch effect". We reject this null hypothesis in our study because the probability of chi-square value is found as (0.000) less than five percent. Therefore an alternative hypothesis that there is arch effect in the series is accepted.

Table 6

Dependent variable is DLM2

	value	Prob-value
F-statistics	101.859	0.000
Obs R-squared	85.787	0.000

D.W statistics= 1.79

CORRELOGRAME

Before moving towards GARCH effect a correlograme of the data is obtained which is given in table 7. The table shows auto-correlograme function, partial correlograme function and Q-statistics for the monthly series of M2.

Table 7

Correlograme

Sample: 1 535
Included observations: 534

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
**|. |	**|. |	1	-0.294	-0.294	46.521	0.000
.|. |	*|. |	2	0.022	-0.071	46.771	0.000
.|. |	.|. |	3	0.037	0.025	47.508	0.000
.|* |	.|* |	4	0.130	0.165	56.566	0.000
.|. |	.|. |	5	-0.037	0.060	57.315	0.000
.|. |	.|. |	6	0.037	0.049	58.062	0.000
.|. |	.|. |	7	0.013	0.022	58.159	0.000
.|. |	.|. |	8	-0.027	-0.044	58.542	0.000
.|. |	.|. |	9	0.044	0.017	59.589	0.000
.|. |	.|. |	10	-0.023	-0.020	59.889	0.000
.|. |	*|. |	11	-0.065	-0.088	62.188	0.000
.|. |	.|. |	12	0.064	0.023	64.432	0.000
*|. |	*|. |	13	-0.091	-0.083	68.977	0.000
.|. |	.|. |	14	0.008	-0.028	69.015	0.000
.|. |	.|. |	15	-0.018	-0.012	69.197	0.000
.|. |	.|. |	16	-0.028	-0.042	69.640	0.000
.|. |	.|* |	17	0.055	0.078	71.305	0.000
*|. |	.|. |	18	-0.072	-0.033	74.180	0.000
.|. |	.|. |	19	0.009	-0.010	74.229	0.000
.|. |	.|. |	20	-0.045	-0.041	75.332	0.000
.|. |	.|. |	21	0.059	0.015	77.289	0.000
.|. |	.|. |	22	-0.065	-0.024	79.676	0.000
.|. |	.|. |	23	0.009	-0.014	79.717	0.000
.|. |	*|. |	24	-0.063	-0.084	81.939	0.000
.|. |	.|. |	25	0.040	0.004	82.843	0.000
.|. |	.|. |	26	0.004	0.017	82.853	0.000
.|. |	.|. |	27	0.004	0.031	82.860	0.000
.|. |	.|. |	28	0.016	0.058	83.001	0.000
*|. |	*|. |	29	-0.086	-0.099	87.237	0.000
.|. |	.|. |	30	0.035	-0.019	87.927	0.000
.|. |	.|. |	31	0.004	-0.015	87.935	0.000
.|* |	.|* |	32	0.109	0.133	94.687	0.000
*|. |	.|. |	33	-0.068	0.028	97.307	0.000
.|. |	.|. |	34	-0.018	-0.048	97.500	0.000
.|. |	.|. |	35	0.061	0.018	99.657	0.000
.|. |	.|. |	36	0.061	0.070	101.80	0.000

The short vertical lines represent the boundaries of 95% confidence interval for autocorrelation and partial correlation. The estimates of auto and partial correlation are presented in the columns

of AC and PAC. The small values of estimates of AC and PAC show that there is no problem of autocorrelation in the data, which is also clear from the graphs in the same table. So we can move towards GARCH effect.

GARCH effect

The estimation results of garch effect are given in the table 8 which indicates that the variable has a significant garch effect because it has zero p-value.

Table 8

GARCH effect

Dependent variable is DLM2

	Coefficient	Std-error	prob
C	1.55E-06	1.06E-06	0.1447
RESID(-1)2	0.0709	0.0081	0.0000
GARCH(-1)	0.9264	0.0069	0.0000

Durbin-Watson= 2.396

After all of the above estimations we are able to obtain GARCH variance series which is actually the volatility series of variable M2. We can further use that volatility series as a variable of monetary volatility in the estimation of our model.

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