MONEY PRICE CAUSALITY AND THE ROLE OF FINANCIAL CRISIS

Ghulam Mustifa
M.Phil. Economics, Lecturer in Govt Associate Degree College Daultala, Rawalpindi
gmustafa933@gmail.com

Zaheer Abbas
PhD, Assistant Professor of Economics, GIFT Business School, Faculty of Business and Commerce, GIFT University, Gujranwala
zaheer.abbas@gift.edu.pk

Waseem Shahid Malik
PhD, Professor, State Bank Memorial Chair at Economics Department at University of Peshawar, KPK, Pakistan

ABSTRACT
Quantity Theory of Money is subject to many critiques. One major critique is that it does not provide causal relation between money and prices. It generates a direct and proportional relationship between money and prices. If we causally link money and prices, then it could be argued that monetary growth is not always inflationary. To test this argument, we have selected quarterly data of the U.S economy over the period of 1991 to 2011. We have divided the time series into -periods i.e., normal times [1991 to 2005] and crisis period (2006 to 2011). Over these sub-samples, the study applied different econometric techniques like Ordinary Least Square (OLS), Autoregressive Distributive Lag Model (ARDL) and Johansen co-integration as per the requirements. In the normal time period, money growth and CPI inflation were not related, but it was directly related to HPI inflation. However, it was inversely related to both inflations in crisis times. Quantity theory relates money with the general price level of the economy. The joint price index of consumer goods and asset prices is the better proxy of a general price index. Finally, monetary growth is directly related to joint inflation in normal times and inversely related to crisis periods. Hence monetary growth is not always inflationary; it could be deflationary under some specific circumstances.

Key Words: Quantity Theory of Money, Inflation, Time Series Data, Co-integration, Price Index.

INTRODUCTION
Inflation represents continuous growth in the level of the prices of products & services (Blanchard 2000, Barro 1997 and Bernanke 1995). With the passage of time, the economic and social costs of inflation have become known to the policymakers, which can very well be positive and negative, so they largely recommend a stable price level for the economy. The reason for the choice of a stable price level is that a rise in the price level raises uncertainty that harms investment and savings and encourages hoarding. Public opinion surveys indicate that; the general public considers that uncertainty embodied in inflation acts as a nightmare for economic growth. (De Gregorio 1993, Fisher 1993 and Barro, 1995). Economists generally consider hyperinflation or high inflation rates as a monetary phenomenon (Barro and Vittorio 1994). Though changes in money supply and aggregate prices have a strong correlation, the direction of causality between them, however, has been a cause of controversy. The current study starts with the oldest and widely accepted Quantity Theory of Money (Fisher 1911) which relates inflation directly to the quantity of money. Fisher (1911) put forwarded his hypothesis as, “Other things remaining unchanged, as the quantity of money in circulation increases, the price level also increases in direct proportion and the value of money decreases and vice versa.” Many economists have criticized the different aspects or assumptions of QTM. We mainly point out only two of them. Firstly, the theory states that “As the quantity of money in circulation increases”, but it does not explain how the quantity of money expands or how it evolves. Secondly, the theory argues that the general price level increases in direct proportion with the expansion of the quantity of money, but it does not provide any causal link
The data generation process of a quantity of money is explained through the “Money Multiplier Approach” by other advocates of Quantity theory i.e., Friedman and Schwarts (1963). They argue that the process of money creation begins from deposits to the creation of loans, and the stock of money depends upon the money multiplier and the monetary base. Whereas the “Neoclassical loan-able funds” theory (Krugman 2009, Mankiw 1995 and Patinkin 1958) argues that savings are the real and only resource that a bank could use for the creation of additional bank credit. Thus, this theory also favours the view that “bank deposits create the loans”. Contrary to this, Post Keynesian economists argue that the process of money creation runs in a chain that starts from credit to money to economic activity (Palley 2001). The main and important point is that credit is placed at the beginning of this chain. When the demand for credit rises the bank must have additional recourses to ensure liquidity. They believe that the central bank must have to increase its monetary base to ensure the liquidity of commercial banks. It implies that the central bank responds and accommodates the credit demand. So, their endogenous money theory has challenged the Monetarist and Neo-classical’s explanation regarding the stock of money supply determination (Palley 2008).

Fontana (2003) and Holtemoller (2002) argue that both monetary base and money stock in an economy are endogenously determined by the optimizing behavior of private agents (firms and households) and commercial banks like households and firms determine both the money stock and the monetary base endogenously.

There are many economists who have related debt with economic condition especially the crisis. The basic theme of all the “credit driven business cycle theories” is that; debt bubbles or debt inflation are the prerequisite of crisis and debt deflation. Fisher (1933) argues that when too much debt accumulates in the economy, a pessimistic event may start the cycle of deflation and bankruptcy resulting in reduction in velocity of currency and then again deflation. This spiral further enhances if counter policy of reflation has not adopted. And in the end leads economy to depression.

Minsky (1992) identified three types of borrowers i.e. Hedge, Speculative and Ponzi borrowers. He argues that when the magnitude of hedge borrowing is large then system will be stable. In contrast, larger share of Ponzi and Speculative borrowing will lead to more volatile financial system. Wolfson (2002) argues that disruptions in financial system lead to fall in investment and ultimately profit level and nominal income then finally the deflation. Bernanke (1995) describes that a larger decline in the level of price and nominal incomes leads toward raising the real debt burden, which converts in debtor insolvency, and hence aggregate demand reduces ultimately price level decrease further and debt deflation spiral develops. According to his view a small decrease in the price level leads to simply reallocation of wealth from debtors to creditor without creating any harm for the economy.

Existing literature reveals that there are many economists who have worked on the forms of money endogeneity. Accompanied by this, many studies have been conducted on the topic “credit and crisis”. But, still there exists a research gap i.e., what is the relationship between money and general price level in the period of crisis. And our hypothesis is that money and prices have a positive relationship in a normal times period and a negative in crisis time periods. The current study will fill this research gap by studying the economy of the United States of America, especially during the period of the financial crisis that occurred in the first decade of the twenty-first century. In this research, the economy of the U.S.A is selected because it was the origin of financial crisis. The second objective of the study is to test, whether the Quantity Theory of Money holds in crisis periods.

The study comprises four sections and they are organized in the following manner. Material & Methods (Model specification and econometrics technique used for the estimation) are described in 2nd section. Empirical results have been presented and analyzed in 3rd section. And lastly, 4th section contains concluding remarks.

**MATERIAL AND METHODS**

This section comprises of three sub-sections. First sub-section deals with model specification. Data and variables construction are provided in the second sub-section. Last section describes the econometric techniques.
Model Specification
The purpose of this study is to investigate the impact of financial crisis upon the relationship between price level and stock of money in an economy. This will be done in two steps i.e. by finding the relationship between price level and money supply in both normal time period and in crisis time. And then result of both periods will be compared. For the relationship between price level and stock of money research starts from equation of exchange, as Steven and Waterman (2015) argue that Paul Samuelson considered equation of exchange as an identity that always remains the true. That is amount of money used in exchange must be equal to nominal income. Equation of exchange assumes neither velocity of money is constant nor it states that price level has direct and proportional relationship with money.

\[ M \times V = P \times Y \]  
(2.1)

In quantity theory of money, Fisher argues that there exist proportional relationship between money and prices. If we assume constant velocity as fisher did, then equation of exchange in log form will be as follows:

\[ \ln(M) + \ln(\bar{V}) = \ln(P) + \ln(Y) \]  
(2.2)

By applying time derivative

\[ \ddot{m} = \ddot{p} + \ddot{y} \]  
(2.3)

The dot over the variables represents the time rate of change and the lower case represents the logarithm of the variables. Variable v (velocity) has vanished because we have assumed it as a constant and proportionate change in the constant is always zero. It is usually assumed that, velocity decline the crisis, but it is not true in the case of financial crisis. Rearranging the above equation gives;

\[ \ddot{p} = \ddot{m} - \ddot{y} \]  
(2.4)

So, inflation rate should be equal to growth rate of money stock that is in excess of growth rate of real output. In general, inflation is positively related with money and inversely related to output growth. There are many other variables that can be helpful in explaining the inflation rate, but in this study they are not included as we are focusing on the variables of equation of exchange. That is used in the Fisher’s theory i.e. “Quantity Theory of Money”.

There are a lot of studies that have used same variables to explain the money price causality. Ramachandran (2004) used the annual data from 1952-2001 to find the causality between money price and output. And concluded that there exists bidirectional relationship between money and price but real output does neither Granger cases money nor the price in the case of India. Nelson & Pinga (2001) inspected the relationship between stock of money and general price levels using these same variables for twenty-six countries. They concluded that money (M2 & M1) and prices do not have causal relation in case of Malaysia. On the other hand, money endogeneity and bi-directional causation between general price level and money supply was the frequent evidence. Kumar, Hatekar and Sharma (2010) employed a technique known as bi-variate methodology. They concluded that, in the short run, output and money have trade off whereas in the long run money only affects general price level and output is independent of the stock of money. They also tested Granger causality between the variables and concluded that money supply is exogenous as it is neither Granger caused by prices nor by the output. In the light of existing rich literature econometric model for our study is as follows:

\[ \text{Inf}_t = \alpha_0 + \alpha_1 \text{GM}2_{t+1} + \alpha_2 \text{GGDP}_t + \mu_t \]  
(2.5)

Where,
\[ \text{Inf}_t \] represents the inflation rate in time period t;
\[ \text{GM}2 \] represents the growth rate of stock of money in the economy, M2 is used as measure of Stock of money;
\[ \text{GGDP} \] represents the growth rate of economy’s output in time period t, which is calculated as growth of Gross Domestic Product.

In this study, we divided the complete time series into two subsets i.e. crisis time period and normal times period. Then given model will be estimated in both subsets of times independently. It is expected that in normal time period \( \alpha_1 \) will be positive. Positive coefficient reveals direct relationship i.e., increase in money growth will lead to higher inflation. On the other hand, our hypothesis is that in
crisis time period this ($\alpha_t$) coefficient will be opposite to normal time i.e., it will be negative. This will be exactly opposite to the result that the quantity theory predicts.

**Data and Variables Description**

To test the validity of Quantity Theory of Money, study have divided the complete time series into two subsets and test the hypothesis in both data sets independently. The division of the data may result in less number of observations and ultimately result in low degree of freedom. To overcome this problem, we have used quarterly data. The U.S.A economy data set of 21 years (i.e. 64 quarters) starting from 1991 till 2011 is collected from two sources:

A) International Financial Statistic (IFS)
B) Federal Housing Finance Agency

Data on Real Gross Domestic Product (GDP), Broad Money (M2) and Consumer Price Index (CPI as a proxy for price level) is downloaded from the IFS. Whereas data on housing price index (HPI) is gained from Federal housing finance agency of United States. Reason for selecting data set from 1991 is that data on HPI is not available earlier than this. M2 and HPI were already seasonally adjusted whereas remaining variables are adjusted for the seasonality by using X-13 using E-views 9. The natural logarithm is applied to convert the coefficients into elasticity. A dummy variable is used to capture the impact of dot com bubble. CPI is used a proxy for the price level. In contrast some studies have used GDP deflator as a proxy for inflation (see for instance, Jariyapan 2012). Every variable is used in three different ways

I. At level
II. Quarterly growth = ($X_t - X_{t-4}$)*400
III. Annualized growth = ($X_t - X_{t-4}$)*100

**Integration of housing price into a price index**

“Quantity Theory of Money” relates money with general price level prevailing in the economy. Many studies argue that Consumer Price Index is a good measure of cost of living but not the general price level. Bryan, Stephen G. and Roisin (2002) argue that the omission of asset prices while estimating inflation from CPI causes an annual bias of 0.25% points. They identified three types of assets i.e., bond equities and housing. They concluded that the omission of housing prices causes the largest measurement inaccuracy.

Klein and Alchian (1973) argue that monetary policy should be formulated on the basis of extended measures of inflation. They argue that asset prices should also be included in measuring inflation. A theoretical basis for the claim that asset prices can be used to help measure inflation has been provided by Shibuya (1992) while Shiratsuka (1999), and Goodhart and Hofmann (2000) have done empirical work.

There arise another problem regarding the integration of housing prices i.e. how to merge the HPI (Housing price index) and CPI (Consumer price index). Here, the study will use the same technique as the BLS (Bureau of Labor statistic) does. BLS estimate CPI in two steps; in the first step they calculate price index of each good and in second step they merge them using the concept of weighted average (BLS handbook, 2007). While integrating, a weight of 0.2 is assigned to HPI as done by Bryan, Stephen G. and Roisin (2002) in case of U.S.A.

**Econometric Modeling**

The hypothesis of this study is that the relationship between the stock of money in the economy and its general price level is different in different economic scenarios i.e., crisis and normal times period. As the hypothesis is connected with different economic conditions that prevail in different time periods, we are taking time series data on the variables of this study. The majority of macroeconomic time series continuously increase and they have integrated processes, for example, gross domestic product, consumer price index and stock of money in the economy. The problem due to this trend is that it makes the variables non-stationary. So, in first step, study will apply the unit root test like Phillips Perron (PP) and Augmented Dickey-Fuller (ADF) tests to check the problem of non-stationary. Further, econometrics literature has different tests of integrations. Mainly are three i.e., Engle & Granger’s approach to test co-integration (1981), Johansen Co-integration Test (1988), Autoregressive Distributed Lag Models (ARDL) (2001). Every estimation technique has its own prerequisite conditions, under
which they provide efficient estimates. For example, OLS is efficient when series are stationary and classical assumptions are fulfilled. Johansen approach could be applied when all the variables have same order of integration or simply I (1), whereas ARDL has not such prerequisite conditions. It could work efficiently no matter all variables have same co-integration order or they have mixed order i.e. mixture of I (0) I (1) variables (Peseran et al 2001). It also considers optimal number of lags using any criteria i.e., AIC, SBC and Adjusted $R^2$. It provides robust estimates even in small sample as it allocates different lag length to different variables. Moreover, with the help of ECM, this technique is capable of incorporating short run adjustment information leading toward long run equilibrium without dropping or misplacing long run information. Unlike the Johansen approach, this technique clearly distinguishes between the independent and dependent series, and also the long run and short run parameters (Aug 2010). Finally ARDL will be unable to find relationship when one or more variables have 2nd order of integration i.e. I (2).

Same as Johansen approach; firstly, it is test whether variables are co integrated i.e. have long run relationship or not. In present approach, it is test using the Bounds test. The equation of this test will be as follows:

$$\Delta \text{INF}_t = \alpha + \sum_{i=1}^{p} a_i \Delta \text{INF}_{t-i} + \sum_{i=1}^{p} b_i \Delta \text{GDP}_{t-i} + \sum_{i=1}^{p} c_i \Delta \text{GM2}_{t-i} + \gamma \text{DUMMY} + \beta_1 \text{INF}_{t-1} + \beta_2 \text{GDP}_{t-1} + \beta_3 \text{GM2}_{t-1} + \nu_t$$

(2.6)

For testing the long run relationship hypothesis will be;

$H_0$: $\beta_1=\beta_2=\beta_3=0$ i.e. variables are not co-integrated or they have no long-run relationship.

$H_1$: at least one is non zero.

This hypothesis is tested using F-statistic. If null hypothesis is rejected then $\beta_i$ will be the long run relationship coefficients. Whereas $a_i$, $b_i$, $c_i$ are the short run adjustment coefficients. $\alpha$ shows the drift term. Lastly $\nu_t$ is the error term and it is supposed to be “Gaussian White Noise Term”, If this assumption does not hold then estimates are not be efficient.

RESULTS AND DISCUSSION

In this section, the econometric tests and techniques are applied to check the validity of the hypothesis empirically. The stationarity of given variables is checked firstly, and then study have applied econometric techniques according to the data generating process of given time series.

Stationary tests

Order of integration is crucial while applying econometric techniques especially in time series data. We have applied Augmented Dickey Fuller and Phillips Perron unit root tests to check the order of integration of given variables. The results of these tests are presented in table 3.1.

| Variables | ADF | Phillips Perron |
|-----------|-----|-----------------|
| CPI       | 0.364 (0.980) | -1.975 (0.606) | 0.348 (0.979) | -2.642 (0.263) |
| $\Delta$CPI | -10.536 (0.000)*** | -10.499 (0.000)*** | -10.221 (0.000)*** | -11.158 (0.000)*** |
| HPI       | -1.543 (0.507) | -2.288 (0.435) | -1.340 (0.607) | -0.996 (0.938) |
| $\Delta$HPI | -2.741 (0.074)* | -3.263 (0.079)* | -3.197 (0.028)** | -3.654 (0.043)** |
| M2        | 1.961 (0.999) | -3.015 (0.149) | 02.170 (0.999) | -2.902 (0.190) |
| $\Delta$M2 | -5.923 (0.000)*** | -6.516 (0.000)*** | -5.934 (0.000)*** | -6.566 (0.000)*** |
| GDP       | -1.829 (0.334) | -0.628 (0.974) | -2.473 (0.156) | -1.370 (0.863) |
| $\Delta$GDP | -6.480 (0.000)*** | -6.741 (0.000)*** | -6.653 (0.000)*** | -6.976 (0.000)*** |
Both of these Tests regarding the data generating process of given variables reveal that variables like CPI (Consumer Price Index), HPI (Housing Price Index), M2 (Broad money), GDP (Real Gross Domestic Product) and JOINT (combination of CPI and HPI) is explained in section 2.2 are non-stationary at level but their quarterly growth rates are stationary. Annualized growth rates of these variables are stationary at level except the Joint inflation, it is integrated of order one.

Econometric Techniques for long-run relationship
The econometric model of this study is described in third chapter. In this model, inflation is the dependent variable and money and GDP growths are explanatory variables. In this study, we have three different measures of inflation i.e. CPI inflation, HPI inflation and Joint inflation. First of all, we have considered quarterly growth of CPI as the dependent variable. In this case, quarterly growths of all three variables (CPI, M2 & GDP) are stationary at level, so the simple Least Square technique is applied. While applying OLS, the problem of Autocorrelation is observed, thus GLS is applied.

Table No. 2: GLS results in case of quarterly CPI inflation
Dependent variable: Inflation (quarterly growth rate of CPI)

| Estimation | Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------|----------|-------------|------------|-------------|-------|
| Time period 1991 to 2005 | C | 2.683181 | 0.817780 | 3.281055 | 0.0018 |
| | GM2Q | -0.029927 | 0.063690 | -0.469888 | 0.6403 |
| | GGDPA | 0.012190 | 0.110703 | 0.110110 | 0.9127 |
| | AR(1) | 0.160725 | 0.110703 | 1.483237 | 0.0000 |
| Diagnostics | Adj. R² = 0.0658 | D-W stats = 1.964 |
| | Heteroskedasticity ARCH test (prob.) = 0.3642 |
| | Jarque Bera normality test (prob.) = 0.989 |
| Time period 2006 to 2011 | C | 3.545954 | 2.227920 | 1.591599 | 0.1280 |
| | GM2Q | -0.402216 | 0.222447 | -1.808147 | 0.0864 |
| | GGDPA | 0.400398 | 0.245007 | 1.634229 | 0.1187 |
| | AR(1) | 0.160725 | 0.110703 | 1.483237 | 0.0000 |
| Diagnostics | R² = 0.366 | D-W stats = 1.711 |
| | Heteroskedasticity ARCH test (prob.) = 0.594 |
| | Jarque Bera normality test (prob.) = 0.4269 |

In a normal time’s period, monetary growth is not associated with CPI inflation. Whereas increased money is being spent somewhere else i.e. real estate sector. These results are not quite surprising. The U.S.A faced high inflations in the 1970s 1980s. In early 1980, inflation reached 18%. Paul Volcker, chairman of the federal Reserve started to formulate the monetary policy with the objective of inflation targeting (William 2015).

In the crisis times period, monetary growth is inversely related with inflation as was our hypothesis. Majority of credit money is spent on durable goods assets and investments. Following figure shows the relationship between house prices and credit money (measured by M2-M0).
When money starts being invested in a specific industry or sector, a bubble starts blowing. This bubble grows larger as the sector attracts more money. When it reaches its maximum level it bursts. The bursting of bubble may lead economy toward crisis. Same happened in U.S. economy in the real estate sector. Crisis in housing industry resulted in lot of bankruptcies and even bank panic. That resulted in reduction of wealth of public and demand deficiency. That ultimately led to deflation.

Following table shows the relation between money growth and asset price inflation.

**Table No. 3 GLS results in case of quarterly HPI inflation**

| Time period 1991 to 2005 | Estimation | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------------|------------|-------------|------------|-------------|-------|
| C                        | 4.156873   | 1.424258    | 2.918624   | 0.0051      |
| GM2Q                     | 0.147186   | 0.061035    | 2.411520   | 0.0193      |
| GGDPQ                    | 0.034040   | 0.065364    | 0.520777   | 0.6047      |
| AR(1)                    | 0.900175   | 0.062362    | 14.43457   | 0.0000      |
| SIGMASQ                  | 1.528828   | 0.299715    | 5.100943   | 0.0000      |

| Diagnostics              |
|--------------------------|
| Adj. R² = 0.785          |
| D-W stats = 2.495        |
| Heteroskedasticity ARCH test (prob.) = 0.4159 |
| Jarque Bera normality test (prob.) = 0.2469 |

| Time period 2006 to 2009 | Estimation | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------------|------------|-------------|------------|-------------|-------|
| C                        | 5.597517   | 3.142620    | 1.781163   | 0.1052      |
| GM2Q                     | -0.792171  | 0.330524    | -2.396713  | 0.0375      |
| GGDPQ                    | -0.680458  | 0.357756    | -1.902018  | 0.0863      |
 Positive coefficient of money clearly reveals that money was continuously being injected in housing industry during normal time period especially after 2000, as a result, housing industry observed a rapid increase in its prices. Whereas in crisis time, fall in asset prices resulted in bankruptcies.

On the basis of above results, one cannot conclude that “Quantity Theory of Money” is unable to explain money price relation under financial crisis. Theory relates money with general price level prevailing in the economy. So now onward study uses general price level that is obtained by integrating CPI and HPI with a weight of .8 for CPI. Firstly, we have considered all variables in level. As all of the variables are integrated of order one, so Johansen co-integration approach is applied to obtain long run relationship coefficients. Secondly, study considered quarterly growth rates of the variables and all of these are stationary at level, so research have applied OLS technique. Finally, considered their annualized growth rates. As growth rate of GDP and M2 are stationary at level and Joint inflation is integrated of order one, so we have applied ARDL (Auto-Regressive Distributive lag) technique for long run results.

Table No.4 Results of Johansen technique

| Co-integration rank test | Time period 1991 to 2005 | Trace test for rank | Max Eigen value test for rank |
|-------------------------|--------------------------|---------------------|-------------------------------|
|                         |                          | No. of CE’s | Statistic | Critical value | Probability |
|                         |                          | None*       | 48.03     | 29.79          | 0.000        |
|                         |                          | At most 1   | 11.19     | 15.49          | 0.199        |
|                         |                          | At most 2   | 2.44      | 3.81           | 0.118        |
|                         |                          | Using 5% level test indicates one co-integration equation |
| Normalized Co-integration coefficients |                          | Variables | Coefficient | Standard errors |
|                         |                          | M2        | 0.060  | 0.021          |
|                         |                          | GDP      | 0.675  | 0.065          |

| Co-integration rank test | Time period 2006 to 2011 | Trace test for rank | Max Eigen value test for rank |
|-------------------------|---------------------------|---------------------|-------------------------------|
|                         |                          | No. of CE’s | Statistic | Critical value | Probability |
|                         |                          | None*       | 30.53     | 29.79          | 0.041        |
|                         |                          | At most 1   | 13.98     | 15.49          | 0.083        |
|                         |                          | At most 2   | 3.19      | 3.84           | 0.074        |
|                         |                          | Using 5% level test indicates one Co-integration equation |
|                         |                          | Variables | Coefficient | Standard errors |
|                         |                          | M2        | 22.55    | 21.13          |
|                         |                          | GDP      | 10.79    | 14.26          |
|                         |                          | at most 2 | 3.19     | 3.84           | 0.074        |
Using 5% level test indicates one Co-integration equation

| Normalized Co-integration coefficients | Variables | Coefficients | Standard errors |
|---------------------------------------|-----------|--------------|----------------|
|                                       | M2        | -0.229       | 0.027          |
|                                       | GDP       | 0.756        | 0.068          |

In the Johansen technique, the existing long-run relationship is tested using the rank test. Both trace and max Eigenvalue test confirms the existence of a long-run relationship in normal and crisis time period. And the long-run relationship is positive and negative in normal and crisis time periods respectively.

**Table No. 5 GLS results in case of quarterly joint inflation**

Dependent variable: joint price inflation (quarterly growth rate of joint price level)

| Time period 1991 to 2005 | Estimation | Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---------------------------|------------|----------|--------------|------------|-------------|-------|
|                           |            | C        | 3.181993     | 0.642758   | 4.950527    | 0.0000|
|                           |            | GM2Q     | 0.070047     | 0.053611   | 1.306585    | 0.1969|
|                           |            | GGDQP    | -0.009827    | 0.061523   | -0.159727   | 0.8737|
|                           |            | AR(1)    | 0.577004     | 0.107476   | 5.368670    | 0.0000|
|                           |            | SIGMASQ  | 1.108961     | 0.211702   | 5.238317    | 0.0000|

**Diagnostics**

Adj. R² = 0.347  
D-W stats = 2.011  
Heteroskedasticity ARCH test (prob.) = 0.0624  
Jarque Bera normality test (prob.) = 0.169

| Time period 2006 to 2011 | Estimation | Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------------|------------|----------|--------------|------------|-------------|-------|
|                           |            | C        | -0.349297    | 1.262008   | -0.276779   | 0.7849|
|                           |            | GM2Q     | -0.220962    | 0.113500   | -1.946792   | 0.0700|
|                           |            | GGDQP    | 0.638046     | 0.168216   | 3.793009    | 0.0012|
|                           |            | AR(1)    | 0.181224     | 0.346523   | 0.522979    | 0.6070|
|                           |            | SIGMASQ  | 5.083680     | 2.039940   | 2.492073    | 0.0221|

**Diagnostics**

Adj. R² = 0.718  
D-W stats = 2.028  
Heteroskedasticity ARCH test (prob.) = 0.6037  
Jarque Bera normality test (prob.) = 0.547

**Table No. 6 ARDL results in case of annualized joint inflation**

Dependent variable: joint price inflation (annualized growth rate of joint price level)

| Time period 1991 to 2005 | Estimation | Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------------|------------|----------|--------------|------------|-------------|-------|
|                           |            | GM2A     | 0.343147     | 0.135341   | 2.535419    | 0.0151|
|                           |            | GGDP     | 0.641321     | 0.337827   | 1.898372    | 0.0647|
|                           |            | DUMMY    | -1.625412    | 0.668011   | -2.433210   | 0.0194|
|                           |            | C        | -1.029451    | 2.151557   | -0.478468   | 0.6349|
|                           |            | Co-inteq | JINFA - (0.3431*GM2A+0.6413*GGDPA-1.6254*DUMMY -1.0295) |

**Diagnostics**

Adj. R² = 0.948  
ECM = -0.160 (0.0138)  
Bond test stat = 4.482 (significant at 10%)  
Serial correlation LM test (prob.) = 0.6201  
Heteroskedasticity ARCH test (prob.) = 0.7421  
Jarque Bera normality test (prob.) = 0.3227

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In ARDL technique, bound test is applied to test existence of co integration. Bound test confirms the existence of long run relationship in both time periods at 10% level of significance. ECM value is also negative and significant. Other diagnostic test confirms the health of the model. And finally, CUSUM test shows the coefficients of the models are stable.

Results from all three techniques Johansen technique, GLS and ARDL confirm our hypothesis that monetary growth is inflationary in normal time period, whereas in crisis time period debt deflation channel is strong and overlaps the inflationary impact of paper money. Even the negative and significant coefficient of dummy variable shows that dot com crisis has also deflationary impacts. Diagnostic test of these techniques confirms the health of models.

CONCLUSION AND POLICY IMPLICATIONS
“Quantity Theory of Money” argues that money supplied and general price level are directly and proportionally related. Whereas Keynesian and monetarist schools of thought argue that quantity of money and price level have direct relationship but it is not proportional. They argue that money has some impact on output due to frictions in economic system. Commonality in all schools of thoughts is
that they all consider money growth as inflationary; some considers it as proportional; while other less than proportional. Contrary to these, our hypothesis is that money is not always inflationary; and relationship predicted by Quantity Theory does not hold in every circumstances. Stock of money is endogenously determined by the bank credit. If large debt accumulates in the economy and if it collapses due to any reason then this increased money supply (due to increase in loan) leads to deflation instead of inflation. To test this hypothesis, we have selected the event of global financial crisis and the economy of United States of America. We have selected the quarterly data from 1991 to 2011 for the series of inflation (calculated from Consumer Price Index, Housing Price index HPI and combination of both CPI and HPI), stock of money (measured by M2) and GDP. We have divided the total time series in two sub samples i.e. normal time period (1991 to 2005) and crisis time period (2006 to 2011). In this study, we made up a model in which inflation is dependent variable and independent variables are money and GDP growth. First of all, we have estimated this model for the normal time period and it turned out to be insignificant i.e. monetary growth has no relationship with CPI inflation. Some studies (William 2015), Surico and Sargent (2011)) reveal that when monetary policy is conducted in such a way that it targets the CPI; then the relationship, between money and inflation is predicted in the Quantity Theory, collapses. Now the question arises if increased money is not being used in the goods market, then where it is being used. It is being invested in the real estate market as does the regression indicates in which HPI inflation is dependent. Secondly, the regressions in crisis time period justify our hypothesis that money is not always inflationary. It could be deflationary when money increases due to loans and these loans collapse, as was the case in global financial crisis.

Quantity Theory in its basic form (i.e., transitional version) states that; nominal value of all the transactions (including old and newly produced goods as well as financial assets) in the economy must be equal to the total amount of money. So, the use of just CPI inflation to test this theory is not correct, as it contains only specific consumption goods but not the assets prices. Some studies {Shibuya (1992), Shiratsuka (1999), and Goodhart and Hofmann (2000)} states that, CPI is a good measure of cost of living but not the general price level and these studies indicates that assets prices should be included for the better measure of inflation. In the case of USA, housing sector is the dominant in determining the asset price inflation (Bryan, Stephen G. and Roisin 2002). So in this study, we have measured inflation from the weighted average of CPI and HPI where weight for housing is 20%, and estimated the relationship between monetary growth and inflation again. The results clearly support our hypothesis i.e., in normal time period monetary growth is inflationary and in crisis period it is deflationary. In other words, Quantity Theory fails to explain relationship in crisis time period.

**Directions for further research**

According to the basic version of Quantity Theory; nominal value of all the transactions (including old and newly produced goods as well as financial assets) in the economy must be equal to total amount of money. While testing the theory, researchers take one complete side by taking the broad measure of money and assuming velocity constant. Whereas on other side, they take only newly produced goods (i.e. GDP) completely ignoring the transactions of old goods and assets. And for the measure of inflation, they take CPI which encompasses limited goods prices. If the researchers take better measures of inflation (by encompassing the prices of each and every commodity) and total quantity of transactions (T), it may be possible that Quantity Theory may produce good results.

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