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Quantity Theory of Money and Its Applicability: The Case of India

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ABSTRACT

This study examined quantity theory of money and the long run relationship and the direction of causality between money and price level of India. The Data for all the variables have been collected for the period of 1980-2016. We used Augmented Dickey Fuller (ADF) and Phillips-Perron (PP), VAR-VECM and Granger (1986) and Engle and Granger (1987) causality analysis. There is supporting evidence that there is bi-directional causality found from LWPI to LRGDP national output in India, where savings turns into consumption especially for imported commodities. With our findings, there is a very strong consistency with the theory and a quantity of money circulation in optimal balance of resources with validates our results. The present study, unidirectional causality running from money to inflation and money and RGDP has been found. So, expansionary monetary policy could accelerate economic activities in India at the expense of high price level. Results found that the (super) neutrality condition of money assuming unaffected real output level in the long-run following the permanent changes in the growth rate of money supply. Our estimation results revealed that changes in the growth rate of M1 and M2 money supplies lead to a significant increase in the real output growth rate.

Key Words : Quantity theory, M1 and M2, Inflation, RGDP, Interest Rate, VAR-VECM, India

INTRODUCTION

The quantity theory of money is one of the oldest surviving economic doctrines. Simply stated, it asserts that changes in the general level of general prices are determined primarily by changes in the quantity of money in circulation. The quantity theory of money formed the central core of 19th century classical monetary analysis, provided the dominant conceptual framework in contemporary financial events. Considering the adverse impacts of inflation on the economy, there is a consensus among the world's leading central banks that the price stability is the prime objective of monetary policy and the central banks are committed to maintain low inflation.

Money plays a very active and highly important part in the economic system by influencing the general level of prices. Its volume and velocity, whether the motivation comes from the state itself or from the general public, can lead to a rise or fall in the general price level. Since rising prices generally stimulate production, and falling prices check it, a general rise or fall in the price level is liable to affect, for better or for worse, the welfare of most sections of the community. Monetary

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conditions are inclined to stimulate or discourage consumption as well as production. Money, thus, is a potent factor that is liable to stimulate or hinder economic progress.

The Quantity Theory of Money (hereafter denoted QTM) is considered as one of the main building blocks in the construction of economic theory. The main implication of the QTM is that long run movements in the price level are determined primarily by long run movements in the excess of money over real output. However, conventional economic growth theories suggest that inflation negatively affects overall economic performance of any country. Several economic studies also reveal that high inflation distorts the decisions of private agents concerning investment, saving, production which in turn slower economic growth. There is also evidence that even moderate levels of inflation damage real growth. Considering various negative consequences of inflation on the economy, there is a consensus among world's leading economists that the price stability should be the prime objective of monetary policy and the central banks should be committed to maintain low inflation.

The quantity theory of money (QTM) constitutes one of the main corner-stones in the construction of economics theory. The relationship between the persistent changes in the price level and supply of money goes back to the earlier analysis by David Hume (1970) relating the prolonged increases in prices to the increases in nominal quantity of money. Its implications for income velocity of money and the assumptions used for the role of money in policy design process have still been highly controversial in contemporaneous macroeconomics. Resurrecting the interest upon the QTM Friedman (1956) in his classical article considers the quantity theory mainly a theory of the demand for money and emphasizes that the main contribution of the QTM to the economics theory is to put out the stability of the functional relations affecting the quantity of money demanded. Such an assumption in turn gives rise to that variations in the velocity of money can be foreseen by the economic agents in line with a stationary economic relationship for the various phases of business cycles. Considering these fundamental theoretical issues would restrict the attention on the theory to some main economic arguments and policy issues for the construction of functional relationships.

This study specifies and estimates a modem version of the quantity theory of money growth, real GDP growth, and inflation. It s traditional feature is that a country's long-run inflation rate increases with its money growth rate. The mode wrinkle is that inflation is mitigated by real GDP growth. It assumes that real GDP growth is governed by exogenous forces such as growth in human capital, physical capital formation, and technological progress. The model makes no attempt to explain GDP growth rates long-run neutrality proposed.

Review of literature:

Tan and Baharumshah (1999) examined the dynamic causal chain among money, real output, interest rate and inflation in Malaysia using monthly data from 1975 to 1995 and found that price does Granger causes M2 through short run channel.

Masih and Masih (1998) investigated the causality between money and prices in Thailand, Malaysia, Singapore and the Philippines from January 1961 to April 1990. They found a unidirectional causality running from money supply to prices.

Pinga and Nelson (2001) investigated the relationship between money supply and aggregate prices for 26 countries and found ambiguous results. They found no causal relationship between prices and money in Malaysia. They also found that aggregate prices cause money supply in Chile and Srilanka. However, they revealed that most countries exhibited mixed evidence of money supply endogeneity, with bidirectional causation between money supply and aggregate prices as a common result.

Jones and Uri (1987) examined the causality between money and prices in the US over the period 1959:Q1 to 1986:Q2. The results of the study showed bidirectional relationship between the measures of money growth and inflation.

Darrat (1986) examined the direction of causation between money and prices for Morocco, Tunisia and Libya over the period 1960:Q1 and 1980:Q2 and revealed a unidirectional causal relationship running from money to prices for all the concerning countries. Benbouziane and Benamar (2004) also found the same results for Morocco and Tunisia.

Ashra *et al.* (2004) examined the relationship between money, output and price level for India and found bidirectional causality between money and price level. Having used a large panel of low and high inflation countries, Gravwe and Polan (2005) found that the QTM prediction that an expansion of the money stock does not increase output in the long run was confirmed.

Herwarts and Reimers (2006) analyzed the dynamic relationship between money, real output and prices for an unbalanced panel of 110 economies. They revealed homogeneity between prices and money for high inflation countries. Their findings suggest that central banks can improve price stability by controlling monetary growth.

Research objectives:

The fundamental objectives of this paper, among other things, are:

1. To provide an empirical investigation on both the long–and short-run determinants of broad money demand in India.
2. To evaluate the stability of broad money demand in India during the period under study
3. To provide recommendations that would help improve monetary management in the country.

METHODOLOGY

As explained in the introduction, this paper examines the long run relationship and the direction of causality between money and price level of India. The measure of Real GDP (RGDP) can be considered as an indicator of economic development. However, Inflation (INF), Interest Rate (INT) and Money Supply (M1 and M3) have also been considered in this study as the measurement of the Quantity Theory of Money.

The Data for all the variables have been collected from World Development Indicators managed by the World Bank. Our data set spans over the period of 1980-2016. Expansion of data set is not possible due to unavailability of data. Also since the relationship is dynamic one, so inclusion of very old data can produce us with wrong outcomes. Small sample size might be problematic in finding the long run relationship. Eviews 9.0 has been used as statistical software packages for all the tests run in this study. All the econometrics results are available on request.

Model specifications:

Existence of unit root has been tested to check the stationarity of the variables. Macro variables are well known for their non stationarity. Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) have been performed to find the existence of unit root. In time series analysis, non stationary data may lead to spurious regression unless there exists at least one cointegrating relationship. The Johansen procedure is applied to test for cointegration. Granger (1986) and Engle and Granger (1987) indicate that even though economic time series may be non-stationary in their level forms, there may exist some linear combination of these variables that converge to a long run relationship over time, which also requires the existence of Granger causality in at least one direction in an economic sense as one variable can help forecast the others. Following Johansen (1988) and Johansen and Juselius (1990), let us briefly assume a Zt vector of non-stationary n endogenous variables and model this vector as an unrestricted vector autoregression (VAR) involving up to k-lags of Z_t:

$$Zt = P_1Z_{t-1} + P_2Z_{t-2} + ...+ P_kZ_{t-k} + e_t \qquad ......(1)$$

where et follows an i.i.d. process N(0, σ2) and z is (nx1) and the ∏i an (nxn) matrix of parameters. Above Eq. can be rewritten leading us to a vector error correction (VEC) model of the form:

$$\Delta zt = \Gamma 1\Delta Z_{t-1} + \Gamma 2\Delta Z_{t-2} + ... + \Gamma_{k-1}\Delta Z_{t-k+1} + \Pi_{t-k} + \varepsilon_t \qquad ......(2)$$

where

$$\Gamma i - I + \Pi_1 + ... + \Pi i \ (i = 1, 2, ..., k-1) \text{ and } \Pi - I - \Pi 1 - \Pi 2 -....... - \Pi k ......(3)$$

Eq. 3 can be arrived by subtracting zt-1 from both sides of Eq. 3 and collecting terms on zt-1 and then adding -(Π1 -1)Xt-1 + (Π1 - 1)Xt-1. Repeating this process and collecting of terms would yield This specification of the system of variables carries on the knowledge of both the short- and long-run adjustment to changes in Zt, via the estimates of Γi and P.. Following Harris (1995), P = αβ' where a measures the speed of adjustment coefficient of particular variables to a disturbance in the long-run equilibrium relationship and can be interpreted as a matrix of error correction terms, while b is a matrix of long-run coefficients such that β'zt-k embedded in Eq. up to (n-1) cointegrating relations in the multivariate model which ensure that zt converge to their long-run steady-state solutions. Note that all terms in Eq. which involve ΔZ_{t-i} are I(0) while πzt-k must also be stationary for et ~ I(0) to be white noise of an $N(0, \sigma^2)$ process. Gonzalo (1994) reveals that this method performs better than other estimation methods even when the errors are non-normal distributed or when the dynamics are unknown and the model is over-parameterized by including additional lags in the error correction model.

We now construct two unrestricted VAR models:

β'Zt : (m1, p, y) ~ I(0)

β'Zt : (m2, p, y) ~ I(0)

For the lag length of unrestricted VARs, we consider various information criterions to select appropriate model between different lag specifications, Considering the maximum lag of 5 for the unrestricted VAR models of quarterly frequency data and using the model with M1 monetary variable, LR, AIC, FPE and HQ criterions suggest to use 3 lag orders, while SC information criterion suggests 1 lag order. For the model with M2 monetary variable, LR, AIC, FPE and HQ criterions suggest to use 4 lag orders, while SC information criterion again suggests 1 lag order. Thus we choose the lag length of unrestricted VAR model with M1 monetary variable as 3 and with M2 monetary variable as 4. Researcher must express that including any dummy or dummy-type variable will be able to affect the underlying distribution of test statistics so that the critical values for these tests are different depending on the number of dummies included (Harris, 1995). As a next step, we estimate the long run co-integrating relationships by using two likelihood test statistics known as maximum eigenvalue for the null hypothesis of r versus the alternative of r+1 co-integrating relations and trace for the null hypothesis of r co-integrating relations against the alternative of n co-integrating relations, for r = 0, 1,..., n-1 where n is the number of endogenous variables.

RESULTS AND DISCUSSION

Empirical analysis:

The present study, the widely-used augmented Dickey-Fuller test (Dickey and Fuller, 1979) is applied to the Turkish data for testing the univariate non-stationary characteristics of the variables under the null hypothesis.

Table 1 : Results of Unit Root Test

Variables	ADF		PP	
	Level	First difference	Level	First difference
LRGDP	-0.994263	-6.298435***	-1.007384	-6.619652***
LM1	1.842803	-3.758384***	-1.793398	-3.758384***
LM3	-2.165878	-3.509181***	-1.611685	-3.684960***
LIR	-1.268477	-4.705358***	-1.268477	-4.871485***
LWPI	-3.600894*	-6.699033***	-3.600894*	-6.836198***

Notes: ADF:Augmented Dickey–Fuller PP: Phillips–Perron
The t-statistics refer to the MacKinnon (1996) one-sided p values table
*** Significant at the 1% level : -3.626784 ** Significant at the 5% level:-2.945842
* Significant at the 10% level: -2.611531

Above level and first difference are the test statistics with allowance for only constant and constant and trend terms in the unit root tests, respectively. The numbers in parentheses are the lags used for the ADF stationary test and augmented up to a maximum of 5 lags. The choice of the optimum lag for the ADF test was decided on the basis of minimizing the Schwarz information criterion. 'D' denotes the first difference operator. Unit root test results indicate that the null hypothesis of non-stationarity cannot be rejected for all the variables in the level form both assuming only constant and constant and trend in the test equation. However, for the first differences the null hypothesis of a unit root is strongly rejected. Thus all the series are integrated of order 1, *i.e.*, I(1), which have an invertible ARMA representation after applying to first differencing.

Lag selection procedure:

Before preceding unit root, co-integration and vector error correction test, we investigated the most appropriate lag selections through applying VAR lag order selection criteria. Likelihood Ratio (LR), Final prediction Error (FPE), Log likelihood (LogL), Akaike information, Schwars information and Hannan – Quinn information criteria have been separately calculated. lag level have been commonly selected for a group of statistics. Following the lag order selection test savings/investment relationship with economic growth have been analyzed in India. Vector auto-regression model is estimated from 1980-81 to 2016-17.

Table 2 : Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	48.20510	NA	4.62e-08	-2.700319	-2.471297	-2.624405
1	244.6829	319.2765	1.05e-12	-13.41768	-12.04356	-12.96220
2	264.2239	25.64756	1.67e-12	-13.07650	-10.55726	-12.24144
3	293.6531	29.42914	1.79e-12	-13.35332	-9.688978	-12.13869
4	337.3488	30.04084	1.25e-12	-14.52180	-9.712357	-12.92761
5	441.4490	39.03756*	6.05e-14*	-19.46556*	-13.51101*	-17.49180*

* indicates lag order selected by the criterion LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Co-integration Tests:

In this analysis, the hypothesis of existence of any long-run equilibrium relationship between M1, M3, Interest rate, inflation and real economic growth function is tested by using Johansen co-integration method natural log for Indian economy during 1980-81-2016-17. The Johansen method applies the maximum likelihood estimations to determine the presence of co-integrating vectors in non-stationary time series. The trace test and Eigen value test determine the number of co-integrating vectors. This implies stationary long-run equilibrium relationships between the variables. Table [money supply] shows the trace and the maximum Eigen value tests using Savings and Investment According to these tests, for both monetary variable case the result have one co-integrating vector both statistically and economically significant at 5% significance level.

Table 3 : Result of the Co-integration Test based on Johnson Juselius method

Johansen Test for Cointegration (Trace Test)					
Hypothesized No. of CE(s)	Trace Statistics	0.01 Critical Value	0.05 Critical Value	Prob.**	Conclusion
None *	0.717963	102.0040	69.81889	0.0000	One
At most 1 *	0.523643	58.96970	47.85613	0.0032	Cointegration
At most 2 *	0.484074	33.75568	29.79707	0.0166	Relationship
At most 3	0.256232	11.25477	15.49471	0.1963	
At most 4	0.034391	1.189889	3.841466	0.2754	
Johansen Test for Cointegration (Maximum Eigenvalue Test)					
None *	0.717963	43.03432	33.87687	0.0031	One
At most 1	0.523643	25.21401	27.58434	0.0976	Cointegration
At most 2 *	0.484074	22.50091	21.13162	0.0319	Relationship
At most 3	0.256232	10.06489	14.26460	0.2077	
At most 4	0.034391	1.189889	3.841466	0.2754	

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Above Table 3 describes the results of the co-integration test. There are two test statistics for co-integration, the Trace test and Maximum Eigen value test. The Trace-Statistic value is shown to be greater than the critical values at both 1% and 5% levels. Therefore, we reject the null hypothesis of no co-integrated equation among the variables. Thus, we conclude that there is at most one co-integrated equation among the variables. The results of Maximum Eigen value test statistics also express same here. Finally, we can say that there is a long run relationship between real gross domestic product (RGDP), M1, M3, Interest rate and inflation

Vector error correction tests:

The results of the Vector error correction Estimates are presented below:

Table 4 : Results of Vector Error Correction Model

Cointegrating Eq:	CointEq1				
LRGDP(-1)	1.000000				
LM1(-1)	1.452407				
	(0.21644)				
	[6.71053]				
LM3(-1)	-2.070549				
	(0.19158)				
	[-10.8077]				
LIR(-1)	-0.279554				
	(0.04387)				
	[-6.37172]				
LWPI(-1)	0.888449				
	(0.03800)				
	[23.3780]				
C	-0.813928				
Error Correction:	D(LRGDP)	D(LM1)	D(LM3)	D(LIR)	D(LWPI)
CointEq1	-3.222443	-0.904008	-0.256551	0.218681	3.239814
	(0.82229)	(0.24892)	(0.11314)	(0.71982)	(0.77003)
	[-3.91886]	[-3.63165]	[-2.26756]	[0.30380]	[4.20737]

Note: Standard errors in ( ) and t-statistics in [ ]

Table 5 : Regression System Equation

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-3.222443	0.822292	-3.918856	0.0007
C(2)	5.305568	1.458006	3.638921	0.0014
C(3)	4.883843	1.620577	3.013644	0.0064
C(4)	3.777929	1.045074	3.614988	0.0015
C(5)	2.321533	0.893397	2.598545	0.0164
C(6)	-8.702704	2.504644	-3.474628	0.0022
C(7)	-3.929601	2.025138	-1.940411	0.0653
C(8)	-0.682355	0.308275	-2.213459	0.0375
C(9)	-0.547534	0.271460	-2.016995	0.0561
C(10)	5.373208	1.477225	3.637367	0.0015
C(11)	4.939180	1.619695	3.049450	0.0059
C(12)	-0.045283	0.297591	-0.152165	0.8804
R-squared	0.495512	Mean dependent var		0.123462
Adjusted R-squared	0.243268	S.D. dependent var		0.202864
S.E. of regression	0.176472	Akaike info criterion		-0.360740
Sum squared resid	0.685135	Schwarz criterion		0.177975
Log likelihood	18.13258	Hannan-Quinn criter.		-0.177023
F-statistic	1.964416	Durbin-Watson stat		1.661985
Prob(F-statistic)	0.085606			

Vector error correction analysis:

The results for long run vector error correction estimation revealed that every 1 per cent increase in output, causes 322 all variable but in long-run dynamic vector error correction estimation revealed 530 percent increase in M3 and 483 percent interest rate in India and the F-statistics for saving rate is found to be significant (1.9644) and also it is inelastic. The error term shows that 322 percent disturbance have been eliminated between long-run and short-run estimations.

The coefficients of the variables are statistically significant and have positive impact. The coefficient sign is found to be negative as expected. This further indicates that improvement in economic growth over the years has necessitated an increase

Generally, the results obtained from the estimated equation revealed that the model is well-behaved and the explanatory variables explain well over 12 per cent of the variations in the dependent variable. This is adjudged by the value of the coefficient of determination (R2 *i.e.*, 49 %).

Granger causality tests:

Table 6 : Granger Causality Tests

Null Hypothesis:	Lag	F-Statistic	Prob.
LM1 does not Granger Cause LRGDP	2	5.56903*	Unidirectional
LRGDP does not Granger Cause LM1		1.13030	Causality
LM3 does not Granger Cause LRGDP	2	9.34010*	Unidirectional
LRGDP does not Granger Cause LM3		0.78389	Causality
LIR does not Granger Cause LRGDP	2	1.12874	No Causality
LRGDP does not Granger Cause LIR		1.57208	
LWPI does not Granger Cause LRGDP	2	11.8743*	Bi-directional
LRGDP does not Granger Cause LWPI		3.64018*	Causality
LM3 does not Granger Cause LM1	2	5.92531*	Unidirectional
LM1 does not Granger Cause LM3		0.00302	Causality
LIR does not Granger Cause LM1	2	0.61175	Unidirectional
LM1 does not Granger Cause LIR		3.13566*	Causality
LWPI does not Granger Cause LM1	2	0.99605	No Causality
LM1 does not Granger Cause LWPI		0.45557	
LIR does not Granger Cause LM3	2	0.36067	No Causality
LM3 does not Granger Cause LIR		1.60159	
LWPI does not Granger Cause LM3	2	0.49257	No Causality
LM3 does not Granger Cause LWPI		1.51377	
LWPI does not Granger Cause LIR	2	0.27024*	Unidirectional
LIR does not Granger Cause LWPI		2.84728	Causality

The Granger causality test has been done with specific lag period and the results are reported in Table 6. Lag length has been chosen by using Schwarz Information Criterion (SIC). Granger-causality test statistics with 2 lags reveals that at least one variable helps to predict another variable. Above table summarizes the Granger-causality results for the two variables VAR. It shows the p - values associated with the F-statistics for testing whether the relevant sets of coefficients are zero. Inflation should reduces that helps to predict real output of at the 5% significance level (the p-value is 0.0271 or 1%). Therefore, we can draw a conclusion that there is a bi-directional causal relationship from economic growth towards inflation in India. Quantity of money concerned national output promoted by investment and there is a uni-directional causal relationship with monetary variables in India.

There is supporting evidence that there is bi-directional causality found from LWPI to LRGDP national output in India, where savings turns into consumption especially for imported commodities. With our findings, there is a very strong consistency with the theory and a quantity of money circulation in optimal balance of resources with validates our results.

Conclusion:

This study has empirically examined the monetarists' view that money supply has been the key determinant of inflation in India. I have employed annual data and applied cointegration using the Johansen approach and application of Granger causality approach to study the money prices interaction. This study finds convincing evidence in support of the quantity theory of money using time series data from the Indian economy for the period 1980-2016. Empirical results suggest that prices and money move together in the long run which goes in line with previous research in other developing countries.

The study reveals that the money supply growth has been an important contributor to the rise in inflation in India during the study period. The results suggest that inflation in India is a monetary phenomenon. This may occur because of the implementation of weak monetary policy adopted by central bank of India to achieve the high priority growth objectives. So, monetary policy should be conducted with proper care. It has been argued that the policies triggered to output growth through money supply only have short run effect on real output but generate inflation. The present study, unidirectional causality running from money to inflation and money and RGDP has been found. So, expansionary monetary policy could accelerate economic activities in India at the expense of high price level.

My findings have important policy implications. For example, under a floating exchange rate system, monetary policy can be conducted to achieve price stability through monetary targeting if money growth is considered the primary, if not the sole determinant of long term inflation. Monetary targeting may therefore be considered an option at least for a transitional period, given that under the present market-based exchange rate system, the Reserve Bank of India has gained an effective control over the monetary base and that there exists both a stable money demand function and a situation of monetary stability as envisaged by monetary economists for a monetary rule (Friedman, 1960, Laidler, 1986). Additionally, the formulation of monetary policy must consider development in the real and financial sector and treat them as constraints on the policy (Gordon, 1985). But further research should be done especially investigating the validity of long run fisher effect in Indian economy.

However, we cannot find both money supply variables as weakly exogenous in the long-run variable space. This requires that money should be taken endogenous for the long-run evoluation of prices and real income, thus money cannot be considered the only forcing variable in the multivariate co-integrating system. For the design of monetary policy, a possible explanation can be brought out such that monetary authority seems to follow an accommodative monetary policy inside the period given the endogenous characteristics of the monetary variables. These all would weaken the discretionary policy role of money in the conduct of future stabilization policies. Finally we examined briefly the (super) neutrality condition of money assuming unaffected real output level in the long-run following the permanent changes in the growth rate of money supply. Our estimation results revealed that changes in the growth rate of M1 and M2 money supplies lead to a significant increase in the real output growth rate.

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