Money Supply, Investment and Economic Growth: A Causality Test for India

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Abstract

The paper aims to determine the empirical relationship between Money Supply, Investment (Gross Capital Formation) and Gross Domestic Output at current and constant price of India. Since the major variable in the monetary mechanism is the Money Supply which ultimately affects the Income and Expenditure (Gross Domestic Product).

The attempt is made to test the causality between the macroeconomic variables like the Gross Domestic Product and Money Supply of India on one hand and on the other hand the causality between Gross Capital Formation and Money Supply of India at Current Price and Constant Price between the time period of 1970-71 and 2007-08.

For this purpose Augmented Dickey-Fuller (ADF) Test, Phillips-Perron (PP) Test, Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test, Johansen Cointegration Test and Granger's Causality tests are undertaken. The results show that increase in the Gross Capital Formation causes increase in Money Supply at Current Price and Constant Price.

Key Words

Money Supply, Capital Formation, Gross Domestic Product, Stationarity Test, Cointegration Test, Causality Test.

Citation: Saji Kumar (2012). Money supply, investment and economic growth: A causality test for India, *Ganpat University Journal of Applied Research In Social Sciences & Humanities, 1* (1), 1-15.

1 Introduction

An attempt has been made in this paper to examine three causal relationships propounded in the economic theory. The three main focuses of the paper are (i) a causal relationship between money supply and economic growth (ii) a causal relationship between money supply and capital formation (iii) a causal relationship between capital formation and economic growth. For testing the above mentioned causality, the annual economic data on the three variables in the Indian economy was considered. The effort is to check whether there is a tendency of the monetary policy to follow the monetarist's rule. In a developing economy like India, the institutions and markets suffer from imperfection and inadequate marketlinkages that can constrain the effectiveness of the money supply transmission mechanism in achieving the policy objectives. The employed testing procedure is based on the Engle-Granger methodology described in Enders (1995). The paper is structured in various sections like the theoretical framework, literature review, data sources and the relevant data transformation for testing. The hypotheses are constructed for testing, followed by the methodology. The last section presents the results summary and conclusion.

2 Theoretical Framework

Monetary policy plays an important role in boosting the economic growth of any country provided money supply is exogenously determined in the economy. In short run the money supply does influence the real variables. In the long run the level of economic activity in nominal terms is almost completely determined by the stock of money. The monetarist notes that there is remarkable close positive correlation and conclude that the money supply is obviously the critical causal factor in determining the output. The General theoretical agreement notes the differences between monetarist and neo-Keynesians with respect to the key variables in the transmission mechanism.

The monetarist emphasise that the economic agents respond to discrepancies between desired and actual money balances by changing their rate of spending and thereby affecting the expenditures on the entire array of consumer and capital goods. The modern transmission mechanism says changes in real money supply bring about changes in portfolio adjustments. This leads to change in asset prices and interest rates. The aggregate demand adjusts to the change in interest rates leading to changes in adjustments in the level of output. According to the Monetarist money play an active role in determining the level of aggregate demand and thereby the output and income. In case of Keynes the changes in motives and expenditures causes changes in money supply and there do not exist a predictable relationship between money supply and output of economy.

3 Literature Review

A variety of money expenditures-income studies are offered as empirical support. Sims (1972) applied test of causality to U.S. data and found unidirectional causality from money supply to income. However in case of Canadian economy the empirical results of a similar Sims' procedure (Barth& Bannett, 1974) showed bidirectional causality between money and income. However in another empirical work (Williams et al., 1976) in case of UK, found unidirectional causality from income to money. A similar finding by Brillembourg and Khan (1979) in case of US established unidirectional causality between money to income and prices. Further a study of six industrialized countries by Dyreyes et al. (1980) empirically proved bi-directional causality between money and income for U.S. and unidirectional causality running from money to income in case of UK and Canada.

However in case of an empirical re-examination of Sim's results by John (1981) found that neither the causal relationship from money to income nor reverse causality from income to money exists. Christos et. al. (2006) found the time series of Greek real GDP and real money supply having long run equilibrium. Daniela and Mihail (2010) with reference to Romania, empirical tested the long run close relationship and link between evolution of money supply and gross domestic product. Ahmed et.al. (2011), found empirical evidences from Sudan, that there is no causality between real GDP and money supply. Another empirical work by Gefang (2012), with reference to US obtained strong support for nonlinear Granger causality from money to output, although there is also some evidence for models indicating that money is not Granger causal or long-run causal to output. The empirical examination of relationship and link between money supply and income remains inconclusive for the South Asian Countries. With reference to India, Joshi and Joshi (1985) pointed out bi-directional causality between money and income.

Bengali et. al. (1999) empirically found the evidence of bi-directional causality between money and income and uni-directional causality from money to prices in Pakistan. In a paper by Mishra et. al. (2010) on a developing country like India indicates the existence of bi-directional causality between money supply and output. Mahmoud et.al. (2010) in a study of capital formation in industrialized nations, found that changes in GNP, followed by long term interest rate and money supply, have a greater impact on capital formation than cost of funds as represented by short-term interest rates. With reference to SAARC countries, Mudabber (2003), the causality tests suggest that money do cause output in Bangladesh but not in India and Pakistan. In another empirical study on India, Inder and Lagesh (2011) found no short run and long run causality between real output and money and unidirectional causality running from price and real interest rate to real output.

4 Data Description and Test Hypothesis

The source of data is the National Accounts Statistics of India – EPW Research Foundation 2002, The National income Statistics 2010 – The CMIE publications, and The Economic Survey of India 2010.

Table 1: Data Description

Time Series of	Denotation	Units	Data Span
Money Supply (Current Price)	MSSCRNT	₹ Crore	1970-71 to 2007-08
Money Supply (Constant Price, Base Year 1999=00)*	MSSCST	₹ Crore	1970-71 to 2007-08
Gross Capital Formation (Current Price)	GDCRNT	₹ Crore	1970-71 to 2007-08
Gross Capital Formation (Constant Price, Base Year 1999=00)	GDCONT	₹ Crore	1970-71 to 2007-08
Gross Domestic Product at Market Price (Current Price)	GDCRNT	₹ Crore	1970-71 to 2007-08
Gross Domestic Product at Market Price (Constant Price, Base year 1999=00)	GDCONT	₹ Crore	1970-71 to 2007-08

*Money supply at current price was deflated by WPI series which was adjusted to a common base year (1999=00).

Hypothesis H1: There is bidirectional causality between Money Supply and Gross Capital Formation at current and constant price.

Hypothesis H2: There is bidirectional causality between Money Supply and GDP at current price and constant price.

Hypothesis H3: There is bidirectional causality between Gross Capital Formation and GDP at current price and constant price.

5 Methodology

In order to test the above mentioned hypothesis, the methodology suggested by Engle and Granger (1987) have been used. In testing I proceed as follows.

1. It is essential to test for stationarity of each series used in this study first. A series of data is said to be stationary when the data are fixed on repeated sampling, that is, the estimated values are distributed around the true mean. Such a time series will tend to return to its mean (called mean reversion) and fluctuations around this mean (measured by its variance) will have broadly constant amplitude. The standard The Augmented Dickey–Fuller (ADF) Test has been used for this purpose. The test was performed for the unit roots in the cases when there is only intercept and then with intercept and trend present in the regression, and finally without intercept and trend. The ADF test was run on the original series, first differenced series and second differenced series of MSSCRNT, MSSCST, GDCRNT, GDCONT, GDCRNT, and GDCONT.

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \qquad + \epsilon t \qquad \ldots\ldots\ldots (1)$$

The ADF Test requires to take the first differences of Yt, $(Y_t - Y_{t-1}) = \Delta Y_t$ and regress them on lagged values of ΔY_t , and Y_{t-1} and see if the estimated slope coefficient in this regression ($=\hat{}\delta$) is zero or not. If it is zero, it is concluded that Y_t *is* nonstationary. But if it is negative, it is said that Y_t is stationary. Where *t* is the time or trend variable and *εt* is a pure white noise error term. If the null hypothesis is rejected, it means that Yt is a stationary time series. The MacKinnon (1996) one sided p-values are taken to reject/accept the null hypothesis.

2. Further in order to test for stationarity the Phillips–Perron (PP) Unit Root Tests has been used. The Phillips-Perron (PP) unit root tests differ from the ADF tests mainly in how they deal with serial correlation and heteroskedasticity in the errors. In particular, where the ADF tests use a parametric autoregression to approximate the ARMA structure of the errors in the test regression, the PP tests ignore any serial correlation in the test regression. The test regression for the PP tests is

$$\Delta yt = \beta 0Dt + \pi yt-1 + ut \quad \text{..... (2)}$$

where ut is I(0) and may be heteroskedastic. The PP tests correct for any serial correlation and heteroskedasticity in the errors ut of the test regression by directly modifying the test statistics tπ=0 and T^π. The MacKinnon (1996) one sided p-values are taken to reject/accept the null hypothesis.

3. Finally to make the stationarity test more conclusive the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test has been applied. The test is carried out in a manner that ensures that the null is accepted unless there is strong evidence against it. According to the KPSS test, a time series is expressed as the sum of a deterministic trend, a random walk and a stationary error, and the test is the Lagrange Multiplier test of the hypothesis that the random walk has a zero variance. The KPSS test is the most commonly used stationarity test). The test is derived by starting with the model:

$$yt = \beta 0Dt + \mu t + ut \quad \text{..... (3)}$$

$$\mu t = \mu t-1 + \varepsilon t,\ \varepsilon t \sim W\ N(0, \sigma^2\varepsilon) \quad \text{..... (4)}$$

where Dt contains deterministic components (constant or constant plus time trend), ut is I(0) and may be heteroskedastic. Notice that μt is a pure random walk with innovation variance $\sigma^2\varepsilon$. The null hypothesis that yt is I(0) is formulated as H0 : σ2ε = 0, which implies that μt is a constant. The values given by Kwiatkowski, Phillips, Schmidt and Shin (1992, Table 4) are taken to reject/accept the null hypothesis.

4. Further to estimate the long-run relationships, i.e., to run the regression on the equations on Money Supply and Capital formation at constant price, Money supply

and Gross Capital formation at current price, Gross Capital Formation and GDP at constant price, Gross Capital Formation and GDP at current price, Money supply and GDP at Constant price, Money Supply and GDP at current price. A cointegration between two variables means that both variables have to move together over the long-run and they cannot move "too far" away from each other. In contrast, a lack of integration implies that such variables have no long-run link and cannot "drift together" through time, in principle; they can wander arbitrarily far away from each other (Dickey, Johansen and Thornton, 1991).

$$\Delta e_t = \beta_1 + \beta_2 t + \delta e_{t-1} + \qquad + \epsilon t \qquad \ldots\ldots\ldots (5)$$

To test whether the residuals are stationary, the standard ADF Test has been applied. The software E-views provides the default lag length of 11 in the test and it is sufficient to get rid of auto-correlation problem in the annual data series being used here. The Johansen Cointegration Test for the above mentioned variables are done with Trend assumption of No deterministic trend, No deterministic trend (restricted constant), Linear deterministic trend and Linear Deterministic trend (restricted). The hypothesized No of cointegrating equations (CE) is at None and At most 1. The Eigen values, Max-Eigen Statistic and Trace statistic at 5% Critical Value and 1% Critical Value are used to accept or reject the hypothesis of no cointegration. In the Johansen testing there are two test statistics; the trace statistics and the maximum eigen value statistic. The trace statistic tests the null hypothesis: "there are at most *r* cointegrating relations" against the alternative of "*m* cointegrating relations" (i.e., the series are stationary), $r = 0, 1, \ldots, m-1$. The maximum eigen value statistic test the null hypothesis: "there are *r* coinegrating relations" against the alternative: "there are $r+1$ cointegrating relations".

5. Finally, to examine the relationship between the variables mentioned abpve the simple Granger causality test is used. Basically, the above mentioned hypothesis are tested. This is done by a simple F-test and the p values. A time series *X* is said to Granger-cause *Y* if it can be shown, usually through a series of t-tests and F-tests on lagged values of *X* (and with lagged values of *Y* also included), that those *X* values provide statistically significant information about future values of *Y.*

$$(X)t = \alpha + \qquad _{t-i} + \qquad _{t-j} + \mu_{1t} \qquad \ldots\ldots\ldots (6)$$

$$(Y)t = \theta + \qquad _{t-i} + \qquad _{t-j} + \mu_{2t} \qquad \ldots\ldots\ldots (7)$$

Where, it is assumed that the disturbances *u1t* and *u2t* are uncorrelated. In passing, it is noted that as there are two variables, the bilateral causality is to be dealt with. In this case there is Granger causality, thus and.

6 Results Summary and Conclusion

It is crucial to determine in an empirical analysis that whether the time series are stationary. Further it is important to determine for the three variables, Money Supply, Capital formation and GDP at current and constant prices, how many (*d*) times the time series has to be differenced to make it stationary and so that it is integrated of order d.

Table 2: ADF Unit Root Test for Stationarity (Constant Prices, Base Year 1999=00)

Variables	Level			First Difference			Second Difference		
	Constant	Constant Linear Trend	None	Constant	Constant Linear Trend	None	Constant	Constant Linear Trend	None
GCFCONT	7.46	4.46	8.66	0.30	-1.55	0.34	-11.5**	-11.6**	-11.4**
MSSCST	3.67	2.91	4.33	1.54	1.02	2.02	-9.46**	-9.51**	-9.25**
GCFCRNT	9.44	9.18	9.68	5.44	3.09	5.79	-8.14**	-2.96	-7.77**
MSSCRNT	3.06	6.90	2.75	5.20	3.50	5.92	1.33	-0.64	1.59
GDCONT	13.02	5.93	3.39	0.93	-2.39	2.04	-9.12**	-9.45**	-8.61**
GDCRNT	4.07	5.01	3.76	4.25	0.43	4.69	-4.88**	-9.45**	1.45

MacKinnon (1996) one-sided p-values. ** 1% level of significance and *5% level of significance.

For stationarity, ADF, PP and KPSS unit root tests are undertaken with a constant, a constant and linear trend and none, in the test regression. The results from the ADF test (Table 2) and Phillips-Perron Test (Table 3) shows the times series of the above mentioned variables are stationary at second order difference. In case of KPSS Test (Table 4) the time series are stationary at original level (i.e. column 1 of Table 4) only.

Table 3: Phillips-Perron Test for Stationarity (Constant Prices, Base Year 1999=00)

Variables	Level			First Difference			Second Difference		
	Constant	Constant Linear Trend	None	Constant	Constant Linear Trend	None	Constant	Constant Linear Trend	None
GCFCONT	9.18	19.40	7.81	2.11	-3.99*	-1.17	-13.57**	-32.40**	-12.09**
MSSCST	2.05	-0.34	3.39	-6.70**	-8.10**	-6.16**	-18.68**	-18.37**	-15.03**
GCFCRNT	12.32	11.45	16.09	1.21	-0.48	2.35	-8.01**	-9.12**	-7.59**
MSSCRNT	6.50	2.36	7.67	-4.66**	-5.93**	-4.21**	-12.75**	-17.93**	-12.83**
GDCONT	11.12	5.93	11.71	0.25	-2.37	1.61	-9.16**	-10.01**	-8.51**
GDCRNT	14.61	6.76	19.75	2.69	0.17	4.01	-5.00**	-5.82**	-4.50**

MacKinnon (1996) one-sided p-values. ** 1% level of significance and *5% level of significance.

The test regression employed automatic lag length selection using a Schwarz Information Criterion (SIC) and a maximum lag length of 9. E-Views report the critical values at the 1%, 5% and 10% levels. It is noticed here that the statistic value is greater than the critical values and therefore, null hypothesis is not rejected at conventional test sizes. In case of KPSS and PP unit root test frequency zero spectrum default method was used.

For the kernel estimators, EViews provides the option of using Newey-West (1994) data-based automatic bandwidth parameter methods.

Table 4: KPSS Test for Stationarity (Constant Prices, Base Year 1999=00)

Variables	Level		First Difference		Second Difference	
	Constant	Constant Linear Trend	Constant	Constant Linear Trend	Constant	Constant Linear Trend
GCFCONT	0.65*	0.19*	0.56*	0.18*	0.50*	0.24*
MSSCST	0.71*	0.20*	0.62*	0.10	0.02	0.02
GCFCRNT	0.69*	0.20*	0.58*	0.16*	0.28	0.13
MSSCRNT	0.67*	0.20*	0.54*	0.16*	0.07	0.03
GDCONT	0.70*	0.22*	0.72*	0.16*	0.23	0.10
GDCRNT	0.65*	0.22**	0.72*	0.18*	0.41	0.09

*Kwiatkowski-Phillips-Schmidt-Shin (1992). ** 1% level of significance, *5% level of significance.

Further the attempt was to test the cointegration (long run relationship) between the time series using Johansen's Trace and Maximum Eigen value tests. The results are shown in Table 5 to Table 12. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship among the variables. The cointegrating equations may have intercepts and deterministic trends. The Table 5 and Table 6 shows the results with no deterministic trends and the cointegrating equations do not have intercepts. The Table 7 and Table 8 shows results with no deterministic trend and the cointegrating equations have intercepts. The Table 9 and Table 10 have linear trends but the cointegrating equations have only intercepts. In Table 11 and Table 12, the exhibit shows the results of cointegrating equations having linear trends. By default, EViews have computed the critical values for the test using MacKinnon-Haug-Michelis (1999) *p-values.*

The Table 5 and Table 6 shows that the cointegration between Money supply and Gross Capital Formation, Gross Capital formation and GDP at current and constant prices, the trace statistic and Max-Eigenvalue Test results indicates two way cointegrating equations. But with regard to Money Supply and GDP at current and constant the trace statistic and Max-Eigenvalue Test results evidences only one way cointegration. The Table 7 and Table 8, shows that between money supply and Gross Capital Formation at constant and current price, the trace statistic and Max-Eigenvalue Test results indicates two way cointegration. The results further show that there is one way cointegration between Gross Capital Formation and GDP at current and constant price, Money supply and GDP at constant price. However there is no cointegration between Money supply and GDP at current price. In Table 9 and Table 10, the trace statistic and Max-Eigenvalue Test results indicates once again that there is no cointegraion between money supply and GDP at current price. In Table 11 and Table 12, the results show that there is no cointegration

between Gross Capital formation and GDP, Money Supply and GDP, at current and constant price.

Since there is no two way cointegration between Money supply and GDP at current and constant price, other variables Money supply and Gross Capital formation, Gross Capital formation and GDP at current and constant price were considered to be tested for bi-directional causality using Engle Granger Causality Test. The result is exhibited in the Table 13, which depicts that there is unidirectional causality running from Gross Capital Formation to Money Supply at current and constant price. There is also unidirectional causality running from Gross capital formation and GDP at constant price.

It can be concluded that by employing the Engle-Granger methodology, it was found that there is no causality between Money supply and Gross Capital formation and neither between Money supply and GDP. The monetarist view do not hold true for India. It is the Keynesian view that the aggregate expenditures in the form Gross Capital Formation affects the level of GDP and further the Money Supply passively adjusts to increase the investment expenditures at current and constant price.

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Appendix

Table 5: Johansen Cointegration Test (Trend Assumption: No Deterministic Trend, No Intercept)

Variables	Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	5 % Critical Value	1 % Critical Value	Remarks
Money Supply & Gross Capital Formation at Constant Price	None **	0.412	25.569	12.53	16.31	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Trace test indicates 2 cointegrating equation(s) at the 5% level & 1 cointegrating equation at the 1% level
	At most 1 *	0.162	6.398	3.84	6.51	
Money Supply & Gross Capital Formation at Current Price	None **	0.387	27.039	12.53	16.31	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Trace test indicates 2 cointegrating equation(s) at both 5% & 1% levels
	At most 1 **	0.229	9.374	3.84	6.51	
Gross Capital Formation & GDP at Constant Price	None **	0.559	35.247	12.53	16.31	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Trace test indicates 2 cointegrating equation(s) at the 5% level & 1 cointegrating equation at the 1% level
	At most 1 *	0.146	5.710	3.84	6.51	
Gross Capital Formation & GDP at Current Price	None **	0.307	17.436	12.53	16.31	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Trace test indicates 2 cointegrating equation(s) at the 5% level
	At most 1 *	0.110	4.225	3.84	6.51	
Money Supply at Constant Price & GDP at Constant Price	None **	0.468	22.961	12.53	16.31	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Trace test indicates 1 cointegrating equation(s) at both 5% & 1% levels
	At most 1	0.005	0.201	3.84	6.51	
Money Supply at Current Price & GDP at Current Price	None *	0.298	13.113	12.53	16.31	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates 1 cointegrating equation(s) at the 5% level and no cointegration at the 1% level
	At most 1	0.010	0.364	3.84	6.51	

Note: UnrestrictedCointegration Rank Test.

Table 6: Johansen Cointegration Test (Trend Assumption: No Deterministic Trend, No Intercept)

Variables	Hypothesized No. of CE(s)	Eigen Value	Max-Eigen Statistic	5 % Critical Value	1 % Critical Value	Remarks
Money Supply & Gross Capital Formation at Constant Price	None **	0.412	19.171	11.44	15.69	*(**) denotes rejection of the hypothesis at 5% (1%) level. Max-eigenvalue test indicates 2 cointegrating equation(s) at 5% level & 1 cointegrating equation(s) at the 1% level
	At most 1 *	0.162	6.398	3.84	6.51	
Money Supply & Gross Capital Formation at Current Price	None **	0.387	17.665	11.44	15.69	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Max-eigenvalue test indicates 2 cointegrating equation(s) at both 5% and 1% levels
	At most 1 **	0.229	9.374	3.84	6.51	
Gross Capital Formation & GDP at Constant Price	None **	0.559	29.536	11.44	15.69	*(**) denotes rejection of the hypothesis at 5% (1%) level. Max-eigenvalue test indicates 2 cointegrating equation(s) at 5% level and 1 cointegrating equation(s) at the 1% level.
	At most 1 *	0.146	5.710	3.84	6.51	
Gross Capital Formation & GDP at Current Price	None *	0.307	13.211	11.44	15.69	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Max-eigenvalue test indicates 2 cointegrating equation(s) at the 5% level & no cointegration at the 1% level
	At most 1 *	0.110	4.225	3.84	6.51	
Money Supply at Constant Price & GDP at Constant Price	None **	0.468	22.760	11.44	15.69	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.005	0.201	3.84	6.51	
Money supply at Current Price and GDP at Current Price	None *	0.298	12.748	11.44	15.69	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level & no cointegration at the 1% level
	At most 1	0.010	0.364	3.84	6.51	

Note: UnrestrictedCointegration Rank Test.

Table 7: Johansen Cointegration Test [No Deterministic Trend (Restricted Constant), Intercept]

Variables	Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	5 % Critical Value	1 % Critical Value	Remarks
Money Supply & Gross Capital Formation Constant Price	None **	0.528	46.085	19.96	24.60	*(**) denotes rejection of the hypothesis at 5% (1%) level. Trace test indicates 2 cointegrating equation(s) at both 5% & 1% levels
	At most 1 **	0.410	19.021	9.24	12.97	
Money Supply & Gross Capital Formation Current Price	None **	0.415	31.745	19.96	24.60	*(**) denotes rejection of the hypothesis at 5%(1%) level. Trace test indicates 2 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level
	At most 1 *	0.291	12.405	9.24	12.97	
Gross Capital Formation & GDP at Constant Price	None **	0.565	36.626	19.96	24.60	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.168	6.649	9.24	12.97	
Gross Capital Formation & GDP at Current Price	None *	0.358	20.605	19.96	24.60	*(**) denotes rejection of the hypothesis at 5% (1%) level. Trace test indicates 1 cointegrating equation(s) at the 5% level and no cointegration at the 1% level
	At most 1	0.120	4.638	9.24	12.97	
Money Supply at Constant Price & GDP at Constant Price	None **	0.468	26.518	19.96	24.60	*(**) denotes rejection of the hypothesis at 5%(1%) level. Trace test indicates 1 cointegrating equation(s) at both 5% & 1% levels
	At most 1	0.098	3.737	9.24	12.97	
Money Supply at Current Price & GDP at Current Price	None	0.306	15.117	19.96	24.60	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Trace test indicates no cointegration at both 5% and 1% levels
	At most 1	0.051	1.919	9.24	12.97	

Note: Unrestricted Cointegration Rank Test.

Table 8: Johansen Cointegration Test [No Deterministic Trend (Restricted Constant), Intercept]

Variables	Hypothesized No. of CE(s)	Eigen Value	Max-Eigen Statistic	5 % Critical Value	1 % Critical Value	Remarks
Money Supply & Gross Capital Formation	None **	0.528	27.063	15.67	20.20	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates 2 cointegrating equation(s) at both 5% and 1% levels
	At most 1 **	0.410	19.021	9.24	12.97	
Money Supply & Gross Capital Formation Current Price	None *	0.415	19.339	15.67	20.20	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates 2 cointegrating equation(s) at the 5% level & no cointegration at the 1% level
	At most 1 *	0.291	12.405	9.24	12.97	
Gross Capital Formation & GDP at Constant Price	None **	0.565	29.977	15.67	20.20	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.168	6.649	9.24	12.97	
Gross Capital Formation & GDP at Current Price	None *	0.358	15.966	15.67	20.20	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level & no cointegration at the 1% level
	At most 1	0.120	4.638	9.24	12.97	
Money Supply at Constant Price & GDP at Constant Price	None **	0.468	22.780	15.67	20.20	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.098	3.737	9.24	12.97	
Money Supply at Current Price & GDP at Current Price	None	0.306	13.198	15.67	20.20	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates no cointegration at both 5% and 1% levels
	At most 1	0.051	1.919	9.24	12.97	

Note: Unrestricted Cointegration Rank Test.

Table 9: Johansen Cointegration Test
(Trend Assumption:Linear Deterministic Trend, Only Intercept)

Variables	Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	5 % Critical Value	1 % Critical Value	Remarks
Money Supply & Gross Capital Formation Constant Price	None **	0.528	42.816	15.41	20.04	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels
	At most 1**	0.354	15.753	3.76	6.65	
Money Supply & Gross Capital Formation Current Price	None **	0.403	30.778	15.41	20.04	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels
	At most 1**	0.287	12.178	3.76	6.65	
Gross Capital Formation & GDP at Constant Price	None **	0.497	25.800	15.41	20.04	*(**) denotes rejection of the hypothesis at the 5%(1%) level Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.028	1.037	3.76	6.65	
Gross Capital Formation & GDP at Current Price	None	0.279	14.278	15.41	20.04	*(**) denotes rejection of the hypothesis at the 5%(1%) level Trace test indicates no cointegration at both 5% and 1% levels
	At most 1	0.066	2.488	3.76	6.65	
Money Supply at Constant Price & GDP at Constant Price	None **	0.409	20.703	15.41	20.04	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.047	1.752	3.76	6.65	
Money Supply at Current Price & GDP at Current Price	None	0.254	10.561	15.41	20.04	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates no cointegration at both 5% and 1% levels
	At most 1	0.0001	0.004	3.76	6.65	

Note: Unrestricted Cointegration Rank Test.

Table 10: Johansen Cointegration Test (Trend Assumption: Linear Deterministic Trend, Only Intercept)

Variables	Hypothesized No. of CE(s)	Eigen Value	Max-Eigen Statistic	5 % Critical Value	1 % Critical Value	Remarks
Money Supply & Gross Capital Formation Constant Price	None **	0.528	27.062	14.07	18.63	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Max-eigenvalue test indicates 2 cointegrating equation(s) at both 5% and 1% levels
	At most 1 **	0.354	15.753	3.76	6.65	
Money Supply & Gross Capital Formation Current Price	None *	0.403	18.600	14.07	18.63	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Max-eigenvalue test indicates 2 cointegrating equation(s) at 5% level & no cointegration at the 1% level
	At most 1 **	0.287	12.178	3.76	6.65	
Gross Capital Formation & GDP at Constant Price	None **	0.497	24.763	14.07	18.63	*(**) denotes rejection of the hypothesis at the 5% (1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.028	1.037	3.76	6.65	
Gross Capital Formation & GDP at Current Price	None	0.279	11.789	14.07	18.63	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates no cointegration at both 5% and 1% levels
	At most 1	0.066	2.488	3.76	6.65	
Money Supply at Constant Price & GDP at Constant Price	None **	0.409	18.950	14.07	18.63	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.047	1.752	3.76	6.65	
Money Supply at Current Price & GDP at Current Price	None	0.254	10.556	14.07	18.63	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates no cointegration at both 5% and 1% levels
	At most 1	0.0001	0.0049	3.76	6.65	

Note: Unrestricted Cointegration Rank Test.

Table 11: Johansen Cointegration Test
[Trend Assumption: Linear Deterministic Trend (Restricted), Intercept and Trend]

Variables	Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	5 % Critical Value	1 % Critical Value	Remarks
Money Supply & Gross Capital Formation at Constant Price	None **	0.579	47.741	25.32	30.45	*(**) denotes rejection of the hypothesis at 5%(1%) level. Trace test indicates 2 cointegrating equation(s) at both 5% & 1% levels
	At most 1 **	0.368	16.554	12.25	16.26	
Money Supply & Gross Capital Formation at Current Price	None **	0.536	41.739	25.32	30.45	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates 2 cointegrating equation(s) at the 5% level & 1 cointegrating equation(s) at the 1% level
	At most 1 *	0.323	14.063	12.25	16.26	
Gross Capital Formation & GDP at Constant Price	None **	0.549	35.851	25.32	30.45	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates 1 co-integrating equation(s) at both 5% & 1% level
	At most 1	0.180	7.159	12.25	16.26	
Gross Capital Formation & GDP at Current Price	None	0.424	24.489	25.32	30.45	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates no cointegration at both 5% and 1% levels
	At most 1	0.120	4.626	12.25	16.26	
Money Supply at Constant Price & GDP at Constant Price	None *	0.409	27.588	25.32	30.45	*(**) denotes rejection of the hypothesis at 5% (1%) level. Trace test indicates 1 co-integrating equation(s) at the 5% level. Trace test indicates no cointegration at the 1% level
	At most 1	0.212	8.620	12.25	16.26	
Money Supply at Current Price & GDP at Current Price	None	0.264	16.464	25.32	30.45	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Trace test indicates no cointegration at both 5% and 1% levels
	At most 1	0.138	5.382	12.25	16.26	

Note: Unrestricted Cointegration Rank Test.

Table 12: Johansen Cointegration Test
[Trend Assumption: Linear Deterministic Trend (Restricted), Intercept and Trend]

Variables	Hypothesized No. of CE(s)	Eigen Value	Max-Eigen Statistic	5 % Critical Value	1 % Critical Value	Remarks
Money Supply & Gross Capital Formation at Current Price	None **	0.579	31.186	18.96	23.65	*(**) denotes rejection of the hypothesis at the 5%(1%) level Max- eigenvalue test indicates 2 cointegrating equation(s) at both 5% and 1% levels
	At most 1 **	0.368	16.554	12.25	16.26	
Money Supply & Gross Capital Formation at Constant Price	None **	0.536	27.676	18.96	23.65	*(**) denotes rejection of the hypothesis at the 5%(1%) level Max- eigenvalue test indicates 2 cointegrating equation(s) at the 5% level and 1 cointegrating equation(s) at the 1% level
	At most 1 *	0.323	14.063	12.25	16.26	
Gross Capital Formation & GDP at Constant Price	None **	0.549	28.691	18.96	23.65	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max- eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
	At most 1	0.180	7.159	12.25	16.26	
Gross Capital Formation & GDP at Current Price	None *	0.424	19.862	18.96	23.65	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level & no cointegration at the 1% level
	At most 1	0.120	4.626	12.25	16.26	
Money Supply at Constant Price & GDP at Constant Price	None *	0.409	18.968	18.96	23.65	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates 1 cointegrating equation(s) at the 5% level & no cointegration at the 1% level
	At most 1	0.212	8.620	12.25	16.26	
Money Supply at Current Price & GDP at Current Price	None	0.264	11.082	18.96	23.65	*(**) denotes rejection of the hypothesis at the 5%(1%) level. Max-eigenvalue test indicates no cointegration at both 5% and 1% levels
	At most 1	0.138	5.382	12.25	16.26	

Note: Unrestricted Cointegration Rank Test.

Table 13: Granger's Test of Causality

Sr. No.	Null Hypothesis:	Observations	F-Statistic	Probability
1	MSSCST does not Granger Cause GCFCONT	36	1.17208	0.32307
2	GCFCONT does not Granger Cause MSSCST	36	25.5473	0.00000028
3	MSSCRNT does not Granger Cause GCFCRNT	36	2.09789	0.13980
4	GCFCRNT does not Granger Cause MSSCRNT	36	27.8174	0.00000012
5	GDCONT does not Granger Cause GCFCONT	36	0.95330	0.39648
6	GCFCONT does not Granger Cause GDCONT	36	4.75902	0.01576
7	GDCRNT does not Granger Cause GCFCRNT	36	1.40767	0.25992
8	GCFCRNT does not Granger Cause GDCRNT	36	2.36037	0.11113