

COINTEGRATION AND CAUSAL RELATIONSHIP BETWEEN MONEY SUPPLY (M3), WHOLESALE PRICE INDEX (WPI) AND CONSUMER PRICE INDEX (COMBINED) DURING PRE AND PEAK PANDEMIC IN INDIA: AN EMPIRICAL STUDY

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ABSTRACT

The present study investigates the relationship between Money Supply (M3), WPI and CPI (c) and also the impact of the time series on each other. Any change in money supply will impact the demand and thus the price rise. The study is based on secondary sources of information (monthly data) taken from RBI database from the period of 2018-19 to 2021-22. The findings of the study show that the sample data does not have normal distribution. The time series data are not stationary and at the same time they do not cointegrate each other. The researcher in this paper has tried to investigate the variables and their interdependence. The Granger causality test show unidirectional relationship between Money supply and CPI (c). The sample data related to period of study have been taken considering pre-pandemic and peak pandemic phase in Indian context.

Keywords: Money Supply (M3), CPI, WPI, Cointegration, Normal Distribution.

INTRODUCTION

The money supply in the economy largely is held for impacting the demand side price rise in the economy. Any change in money supply either helps in increasing demand or decreasing demand thus further increasing or decreasing the price. The Price change in India is measured through WPI and CPI. The Researcher in this paper has tried to study the variables, their stationarity, cointegration and causal relationships taking data during pre-pandemic phase and peak pandemic so as to see certain unusual results due to various discretionary measures taken both by RBI and the Government during pandemic.

LITERATURE REVIEW

Sedigheh Roshan (2014) has studied the relation between inflation and money supply growth in Iran. The paper analyzed the relation between M1 and M2 forms of money supply and prices in Iran. Cointegration and causality techniques have been used in order to test the validity of relationship. The period of study has been taken from 1988 to 2010. The findings of the results show that the variables taken for the study are not cointegrated. However, there is a two-way relationship between money supply and price level which justifies the theoretical understanding that during high inflation, inflation does impact money supply growth.

Masih & Masih (1994) in their paper have examined the causality between money and prices in context of India. The findings of the study suggest that money supply was the leading variable and price as a variable lagged in Indian context during the period of study.

Tuncer Gocmen (2016) has studied the causal relationship between money and inflation during a high inflation period in the context of Turkey. Cointegration and error correction models are applied in order to test the validity of relationship. The findings suggest that money supply impact price level in the bivariate model. The increase in money supply leads to inflation which further leads to money supply. However, the causality from money supply to inflation is stronger than inflation to money supply. In order to get robust result, the researcher has taken nominal interest rates and exchange rates also were added to the model.

Mallick et al. (2020) in their research papers have focused on short run and long run causal relationship between WPI and CPI in India during 1994 to 2015. The researchers have used linear and nonlinear cointegration relationship. The findings of the study showed nonlinear cointegration between WPI and CPI. The results showed rising per capita income and other macroeconomic variables to reasons behind inflation after 1995. The granger causality does not reveal causality from WPI to CPI, but causality is seen from CPI to WPI which suggest the presence of demand-pull inflation in India.

Manikandan et al. (2018) have studied the relationship between money, output and price level in India through cointegration and vector error correction model. The sample data has been taken from 1951-52 to 2012-13. The findings indicate long run unidirectional causalities from money supply to output and money supply to general price level. However, in the short run money supply and price level shows two-way relationship while unidirectional causality is seen in context of output and price level.

Batchu & Radha (2015) have investigated the relationship between stock exchange returns and exchange rates and their impact on each other. The sample data has been collected from 2005 to 2015. The results indicate the sample data to be non-normal distribution, time series to be stationary. The presence of cointegration between the variables suggest long term relationship. However, the granger causality test show one way relation between stock returns to exchange rates.

Objectives of the Study

1. To investigate the causal relationship between Money Supply (M3), WPI and CPI (c).
2. To test the validity of Fisher's equation of $MV=PY$.

H₀: There is no cointegration between Money supply, WPI and CPI (c)

H₁: There is a cointegration between Money supply, WPI and CPI (c)

H₂: There is granger non causality between Money supply and CPI (c).

H₃: There is a granger causality between Money supply and CPI (c).

H₄: There is granger non causality between Money supply and WPI.

H₅: There is a granger causality between Money supply and WPI.

RESEARCH METHODOLOGY

The research design selected for the study is descriptive and correlational. The study describes the level of money supply, WPI and CPI the way it exists. The design is correlational as it tries to study the relationship between different variables such as WPI, Money supply and CPI. The secondary data (monthly basis) has been collected from RBI data base from 2018-19 to 2021-

22. The absolute values of the data have been converted into log form. The various statistical tools used are Augmented Dickey Fuller Test to check the stationarity, Johansen Cointegration test and pairwise granger causality test Atrkar Roshan (2014) Table 1.

EMPIRICAL RESULTS AND ANALYSIS

	LWPI	L Money Supply (M3)	L CPI Combined
Mean	4.831107	16.65507	5.014717
Median	4.804021	16.66695	5.013298
Maximum	4.976044	16.81796	5.116196
Minimum	4.764735	16.47710	4.920711
Std. Deviation	0.060651	0.105005	0.062031
Skewness	1.179428	-0.065284	0.104288
Kurtosis	3.087254	1.690712	1.663860
Jarque Bera	10.91147	3.390431	3.581350
Probability	0.004272	0.183560	0.166848

H_0 : The series has normal distribution

H_1 : The series does not have normal distribution.

The test of normality is the Jarque-Bera test, which test whether the series is normally distributed or not. A small probability value leads to the rejection of the null hypothesis of a normal distribution. Samples from a normal distribution have an expected skewness of 0 and an expected excess kurtosis of 0 (which is the same as a kurtosis of 3). The test statistic of the Jarque-Bera test is always a positive number and if it's far from zero, it indicates that the sample data do not have a normal distribution. From the above table, it can be seen that the sample data do not have normal distribution Table 2.

Unit Root Test to Assess Stationarity of the Series

Null hypothesis: Log CPI has a unit root

Null Hypothesis: Log WPI has a unit root

Null Hypothesis: Log M3 (Money supply) has a unit root Table 2

Augmented Dickey Fuller test statistic	Log CPI		Log WPI		Log Money Supply	
	T-Statistic	Probability	T-Statistic	Probability	T-Statistic	Probability
	-0.198164	0.9313	0.925278	0.9950	-0.926532	0.7709
Test Critical Values:						
1% level	-3.581152		-3.584743		-3.581152	
5% level	-2.966622		-2.928142		-2.926622	
10% level	-2.601424		-2.602225		-2.601424	

**MacKinnon (1996) one sided p-values

The ADF statistic can be rejected by comparing Test Statistic with the critical values if test statistic is less than the critical values or the value of P is less than the level of significance. In all

the three cases, there is no evidence of rejection of null hypothesis. Hence the variables such as Money supply, CPI combined, WPI has a unit root i.e. the time series is not stationary Table 3.

Correlation Test

Table 3
THIS CAN BE CONSIDERED AS THE FIRST INDICATION OF THE EXISTENCE OF INTERDEPENDENCY AMONG THE TIME SERIES.

	Log M3 (Money Supply)	Log WPI	Log CPI (Combined)
LM3	1	0.8212	0.9836
LWPI	0.8212	1	0.8488
LCPI	0.9836	0.8488	1

From the above table, it can be seen that there exists strong relation between Money supply and WPI, Money supply and CPI (C) and WPI and CPI (C).

Co-Integration Test

After testing for stationarity, Johansen’s cointegration test is applied to find out the long run cointegration relationship between money supply, WPI and CPI.

H₀: There is no cointegration.

H₁: There is a cointegration.

Results of Cointegration test of Money supply, WPI and CPI Table 4.

Table 4
UNRESTRICTED COINTEGRATION TEST (TRACE)

Hypothesized No. of CE (s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability
None	0.261888	19.60163	29.79707	0.4503
At most 1	0.086399	5.936945	15.49471	0.7030
At most 2	0.040718	1.870669	3.841465	0.1714

Trace test indicates 1 cointegrating equation (s) at 0.05 level, * denotes rejection of the hypothesis at the 0.05 level, **Mackinnon Haug Michelis (1999) p-values Table 5.

Table 5
UNRESTRICTED COINTEGRATION TEST (MAX. EIGENVALUE)

Hypothesized No. of CE (s)	Eigenvalue	Max. Eigen Statistic	0.05 Critical Value	Probability
None	0.261888	13.66469	21.13162	0.3932
At most 1	0.086399	4.066276	14.26460	0.8523
At most 2	0.040718	1.870669	3.841465	0.1714

Max-eigenvalue test indicates 1 cointegrating equation at the 0.05 level, *denotes rejection of the hypothesis at the 0.05 level, ** Mackinnon Haug Michelis (199) p-values.

The result of trace test and maximum eigenvalue test are presented in above table. The null hypothesis will be rejected if the value of probability is less than or equal to 0.05. If the trace value and maximum eigen value are higher than the 0.05 critical value, then in that case also the null hypothesis is rejected. Thus, it can be clearly seen in the table that the trace value and the max. eigen statistic are less than 0.05 critical value, thus the null hypothesis cannot be rejected. Hence it can be concluded that there is no significant cointegration amongst the series. The results

clearly show that there does not exist a stationary, long-term relationship between money supply, WPI and CPI (combined). The absence of a cointegrating relationship between the variables forced the researcher to proceed with causality analysis Göçmen (2016) Table 6.

Pair Wise Granger Causality Test

The GC Test is a statistical proposition test determining whether one time series is helpful in forecasting another. The researcher has performed pair wise Granger causality test in order to predict one variable with the help of another.

Null Hypothesis	Observation	F-Statistic	Probability
Log WPI does not granger cause log Money supply Log Money supply does not granger cause log WPI	45	0.49295 2.53834	0.6145 0.0917
Log CPI (c) does not granger cause log money supply Log Money supply does not granger cause log CPI (C)	45	2.33662 3.89503	0.1097 0.0285
Log CPI (c) does not granger cause log WPI Log WPI does not granger cause log CPI (c)	45	1.59823 0.18270	0.2149 0.8337

The Results of the table show that the P value in all the cases is more than 0.05. Hence there is no base for rejection of null hypothesis. This means that WPI does not granger cause money supply as well as CPI (c). Similarly, CPI (c) does not granger cause money supply and WPI. Money supply does not granger cause WPI. However, the value of P (0.02) is less than 0.05 which suggests that the null hypothesis is rejected and hence can be concluded that Money supply does granger cause CPI (combined). This justifies the validity of Fisher's equation of $MV = PY$.

CONCLUSION

The researcher has explored the relationship between money supply, WPI and CPI (combined). The results of the test show that the sample data is not normally distributed, time series data are non-stationary. The researcher found positive and significant relation between money supply, WPI and CPI (combined). However, there was no cointegration between money supply, WPI and CPI (c). The results of the Granger causality test only show unidirectional causality wherein money supply does granger cause in CPI (C). However, the limitation of this study is its time period wherein the results may not be robust. Commenting on validity of fisher's equation in a such a short period and that too in context of one economy may be the other limitation. In this research control variables have not been considered in the model which could have increased the robustness of the results.

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