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Causal Relationship between Money, Price and Income in Asian Countries (1964-2011)

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Abstract

Monetary and fiscal policies are used for macroeconomic stabilization and to achieve low level of inflation and high level of economic growth. To execute these policies direction of causality between money, price, and income should be known. It is in this connection that this study examined the direction of causality between money, price and income in Asian countries namely- Nepal, India, Sri Lanka, Myanmar and Korea using the annual time series data of the period 1964-2011. Bivariate Granger causality test was performed for both non-cointegrated and cointegrated variables using conventional Granger F test and ECM models respectively. Causal nexus between these variables, in some extent, differed from one structure of economy to another but in all countries money was causing price and income. Feedback effects were coming either from price or income or the both. Thus, this study reaches to the conclusion that money supply is an endogenous variable in all the countries, though the extent of endogeneity in term of price and income variables slightly differs from one to another. Thus conventional concept of purely exogenous money supply is invalid. Money causes the both price and income and is receiving the feedback effects either from price or income or the both.

General Background

The relationship between money, price and income has been discussed since classical school of macroeconomics to modern macroeconomic thoughts. Classical and neoclassical schools of thought innovated the quantity theory of money, which argue that money supply affects the general level of price. There is direct, positive and proportional relationship between money and price. Money has no any effects in real equilibrium profile of the economy. Thus, money is neutral, meaning that money affects the prices not the real income (Pierce & Tysome, 1985). But, Classical economists such as Smith, Ricardo and Mill did not endow money with neutrality (Frisch, 1983, p.226). O'Brien (1975) further argues that some classical economists like David Hume do not assume full employment and there was no any dichotomy. As increase in supply of money increases

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the nominal cash balance of economic agents which results in higher expenditure on goods and services and hence higher production and employment in the economy. Thus, money affects the real output but they assume money as an exogenous variable.

Keynesian school of thought argues that, if the economy is in less than full-employment level, money affects the both price and output. If the economy is in full employment level, then it has only the price effect (Pierce & Tysome, 1985). Earlier Keynesian also assumes that money supply is an exogenous variable. Monetarist school of thought leaded by Friedman argues that in the short run money affects the real output but in the long run output effects disappears and only the price effects appears (Froyen, 2005). All these three school of thoughts- Classical, Keynesian, and Monetarists did not discussed the feedback effects coming from price to money supply and income to money.

It is the post Keynesian school of thought who raises the arguments of endogeneity of money. It is recent development in monetary economics. The creation of money occurs within the monetary system of the economy but not by any exogenous forces. According to them money is determined by joint action of monetary authority, commercial banks, portfolio decision of non-bank public and the demand for bank loan (Palley, 1992, p.155). Hence, money is endogenous variable. The theory of endogenous money is the extension of Keynes ideas and thoughts and is considered as a part of Post Keynesian Economics (Nayan, 2010, p.10; Palley, 1997, p.133). Horizontalists, structuralist, liquidity preference approach and the circuit theory of money are the four branches of Post Keynesian Economics. All these school of thoughts though differs in the nature of direction of causality but they all agree that GDP causes the monetary aggregates and money is an endogenous variable. Further all these four branches agree that bank credit causes the monetary aggregates. General economic intuition suggests that increase in price causes the increase in the demand for money so the bank credit which in turn causes to increase the monetary aggregates. Thus the Post Keynesians are in favor of bidirectional causality between money, price and income.

New Classical School of Economics have innovated the ideas of "Rational Expectation". The rational economic agents very precisely predict the effects of monetary and fiscal policy and gear their economic activities in advance as if the final effect of policy is realized in the economy. So policy has no effect in real output and employment. Therefore, they developed the "policy ineffective proposition"- money does not affect the real output but increases the prices proportionally (Froyen, 2003).

The real business cycle school of economics, also known as second generation of new classical economists, states that real not monetary factors are responsible for the fluctuation in income and output. Thus in real business cycle model, the role of money is to determine the price level as in classical model. In this model, changes in quantity of money results in proportionate changes in prices but no changes in output and employments (Froyen, 2003).

Examining all these theories a general conclusion could be derived as -there is possibility of achieving the unidirectional and bidirectional causality between money,

price and income though the causal nexus differs from one school of thoughts to another. Thus, possibility of appearing causality in either of the direction could not be denied.

Price stability, exchange rate stability, favorable balance of payment, high but sustained economic growth, full employment etc. are the major macroeconomic goals. Two major tools of achieving such goals are monetary and fiscal policies. Major tool of monetary policy is the money supply. Effective implementation of these policies requires proper knowledge on direction of causality between money, price and income. The controversy and debate in different schools of thoughts regarding the direction of causality is another problem. Thus this study raises the following research questions.

(i) Is the money supply causing the general level of price? Or the general level of price is causing the money supply? Or the both?

(ii) Is the money supply causing the output or income in the economy? Or the output is causing the money supply? Or the both?

Objective: the general objective of this study is to examine causal relationship between money and price and income in Asian Countries. However its specific objectives are:

(i) To examine the causal relationship between money and price in Nepal, India, Sri Lanka, Myanmar and South Korea

(ii) To examine the causal relationship between money and income in Nepal, India, Sri Lanka, Myanmar and South Korea

Limitation: It only considers the Granger cointegration and Granger bivariate causality. Data for GDP in Myanmar was available only for the period1964-2004. So, except the GDP of Myanmar all other variables cover 1964-2011.

Review of Literature

Sims (1972) was the first to introduce testing of Granger causality into economics when he examined the relationship between money and income in U.S.A. for the period 1947 to 1969. He found unidirectional causality flowing form money to money income.

Holly and Longbottom (1982) tested the causality between stock of money and price level using the data for U.K. for the period 1964 to 1979. They approached the problem as an exercise in applied econometric and time series analysis. They explored the evidence that money causes price and price causes money. There was bi-directional causality. The hypothesis of proportional relationship between money and price was supported by their empirical work.

Thronton and Batten (1985) using the data for the period 1962 to 1982 made a study of U.S.A. They found bi-directional causality between money and income. This paper made extensive survey on the lag length selection criteria. In particular, they examined rule of thumb, arbitrary lag length selection and statistically determined lag structures. According to them a safest approach is to perform an extensive search of the lag space.

Jones and Sattar (1988) employing data for the period mid 1974 through 1985, conducted a study of the economy of Bangladesh. They examined the direction of causality between money growth, inflation and output growth using the monthly data series. They observed causality running from both narrow and broad money to price when a lag of twelve month is considered. However the result was sensitive to the selection of lag length. Similarly, they found causality running from inflation to both measure of money growth in the short run (12 months), however, the relationship disappeared in the long run. Hence, there was bi-directional causality between inflation and money growth.

Similarly they found that money exert short run and long run impact on real economic activities (output) i.e. growth rate of money causes growth rate of real output. They also found the causal evidence of feedback effect. So there was bi-directional causality between money and output. Their basic finding was that inflation in Bangladesh was not a purely monetary phenomenon. Growth rate of money supply had also casual impact over the real economic activities. So, money was not neutral.

Jones (1989) employed the Granger test to examine the causal relationship between growth rate of money Supply and Inflation for the U.S over the period 1959 to 1986. Statistical search and non-statistical adhoc method was utilized to determine the order of lags. The adhoc distributed lag method of lag length selection was found to perform somewhat better than the statistical search methods in correctly assessing the casual relationship between money growth and inflation. He used quarterly data series.

Gyanwaly (1991) made an extensive survey of causality between money price and income in selected Asian countries namely Nepal, India, Srilanka, Philippines, Thailand, Korea and Japan for the period 1960 to 1988 using the annual data series. So far the causality between money and price is concerned he found no casual relation between money and price in Nepal. He found bi-directional causality between money and price in India.

Hasan (1997) using the annual data for China spanning for the period 1952-89 performed the Granger Causality test between money stock and price. Causal relation was examined using the following three steps. First unit root test was performed to determine the order of integration. Granger test requires co-variance stationary time series data. Second, test of co integration was performed. Finally a direct test of Granger causality was made using F test. In his empirical work he found no evidence of co-integration.

NRB (2001) examined the money price relationship in Nepal using the quarterly data series for the period- the third quarter of 1975 through the second quarter of 1999. Simple regression technique was used in stationary data series. The regression result shows that money supply significantly affects the prices in Nepal. Narrow money (M_1.) had relatively strong relationship with price than that of broad money. Simple regression technique claims that Indian wholesale price index significantly affects the Nepalese prices. In Granger causality test, NRB found bidirectional causality between money and price in Nepal.

There are a few studies covering the issues of direction of causality between money, income and prices. But studies covering the case of Asian countries, spanning the period 1964-2011, using Granger causality approach from both cointegrated and non-cointegrated variables, is lacking. Further, empirical relationship may be unstable and it needs updated information. Thus this study makes an attempt to bridge such gaps. Conventional economic theory assumes that money supply is an exogenous variable but the recent economic thoughts are arguing in favor of endogeneity money supply. This study using the long run time series data of selected Asian countries examines the endogeneity /exogeneity of money supply on the basis of direction of causality. Hence its importance is obvious.

Methodology

Concept of Causality

Granger (1969) introduced concept of causality in econometrics. Causality may be of two types – unidirectional causality and bidirectional causality .It X_t causes the Y_t but Y_t does not cause X_t then we say there is unidirectional causality. If X_t causes Y_t and Y_t also causes X_t then we say there is bidirectional causality i.e. $X_t \rightarrow Y_t$ and $Yt \rightarrow X_t$. Another major concept is the feedback effect. Let, theoretically, Y_t is depending on X_t. If causality runs from Y_t to X_t than we say there is feedback effect.

Latter in 1987, in time series analysis, concept of cointegration was innovated. Engle and Granger (1987) state that if two variables are cointegrated, a causal relationship will exist at least in one direction. Thus the test of Granger causality can be split up into two parts. Test of Granger causality in cointegrated series and in non-cointegrated series.

Test of Causality in Non-Cointegrated Series

It is conventional test which is based on stationary data series. The testing procedure could be described as follows. In econometrics a useful measure of causality has been suggested by Granger (1969). The reduced from of Granger model could be outline as follows. For any bi-variate time series process (Xt, Yt) causality is tested by using ordinary least squares estimation method for the following restricted and unrestricted autoregressive equations.

$$y_t = a_o + [a_1L^1 + a_2L^2 + \ldots\ldots + a_kL^k]\, y_t + et \ldots\ldots\ldots\ldots (1)$$

$$y_t = b_o + [\, b_1L^1 + b_2L^2 + \ldots\ldots + b_kL^k]\, yt + [c_1L^1 + c_2L^2 + \ldots\ldots + c_nL^n]\, x_t + e't \ldots\ldots\ldots (2)$$

where,

ai, bi, cj, are the parameters. $i=1,2,\ldots\ldots k.$ $j = 1,2\ldots\ldots n.$

et, e't are white noise innovations.

L is lag-operator.

and,

$$x_t = (1-L)^{d1} \ln X_t \quad \text{.....(3)}$$

$$y_t = (1-L)^{d2} \ln Y_t \quad \text{.....(4)}$$

Here equation (3) and (4) are transformations. For the application of Granger test covariance stationary time series process is necessary. So the transformation (3) and (4) are used. A time series is stationary if it has constant finite mean, variance and auto covariance. d_1 and d_2 are the degrees of polynomial. Causal inference in the Granger model is made with the help of following F statistics:

$$F = \frac{\left(R_1^2 - R_0^2\right) / K_1 - K_o}{\left(1 - R_1^2\right) / N - K_1 - 1} \quad \text{.....(3)}$$

Where,

N = Number of observations in sample

K_o = Number of explanatory variables in equation (1)

K_1 = Number of explanatory variables in equation (2)

R_o^2 = Coefficient of determination of equation (1)

R_1^2 = Coefficient of determination of equation (2)

Causality running from X to Y is tested by using above computed F statistics at (K_1-K_0, N-K_1-1) degree of freedom. This test is equivalent to testing H0=c1=c2...cn=0 in equation (2). It is the case of unidirectional causality. The feedback effect or causality running from Y to X is tested just reversing the procedure.

Cointegration and Causality

if the series are co-integrated VAR cane be constructed either in term of level data that in I(1) variables or in the form of Error Correction Mechanism(ECM) models where the variables are I(0). Let us consider the following model.

(i) Causality from Cointegrated Series but from Level Data

$$Y_t = b_o + [b_1L^1 + b_2L^2 + \ldots + b_kL^k] Yt + [c_1L^1 + c_2L^2 + \ldots + c_nL^n] X_t + ut \ldots\ldots \quad (4)$$

$$X_t = a_o + [\beta_1L^1 + \beta_2L^2 + \ldots + \beta_kL^k] Xt + [\delta_1L^1 + \delta_2L^2 + \ldots + \delta_nL^n] Y_t + vt \ldots\ldots \quad (5)$$

Here Error terms are assumed to be white noise. Here, X Granger Causes the Y if Ho: c1 = c2=c3..... cn = 0 is rejected against the alternative H1: at least one cj $\neq$ 0, for all j = 1,2,3..... n (see equation 4). Similarly Y Granger causes the X (see equation 5), if H0 : $\delta_1 = \delta_2 = \ldots\ldots \delta_n = 0$ is rejected against the alternative H1: at least one $\delta j \neq 0$, for all j = 1,2,3.....n. (Oxley and Greasley, 1998).

(ii) Causality from ECM Models

Let us consider the following equations.

$$\Delta Y_t = b_o + [b_1L^1 + b_2L^2 + \ldots + b_kL^k] \Delta Yt + [c_1L^1 + c_2L^2 + \ldots + c_nL^n] \Delta X_t + \lambda ECM_{t-1} + ut \ldots \quad (6)$$

$$\Delta X_t = a_o + [\beta_1 L^1 + \beta_2 L^2 + \ldots + \beta_k L^k] \Delta Xt + [\delta_1 L^1 + \delta_2 L^2 + \ldots + \delta_n L^n] \Delta Y_t + \eta ECM_{t-1} + vt \ldots (7)$$

Here, ΔX Granger Causes the ΔY if Ho: $c1 = c2 = c3 \ldots\ldots cn = 0$ is rejected against the alternative H1: at least one $cj \neq 0$, for all $j = 1,2,3 \ldots n$ (see equation 6) or $\lambda \neq 0$. Similarly ΔY Granger causes the ΔX (see equation 5), if H0: $\delta_1 = \delta_2 = \ldots\ldots$ $\delta_n = 0$ is rejected against the alternative H1: at least one $\delta j \neq 0$, for all $j = 1, 2, 3 \ldots$ n. or $\eta \neq 0$ (Oxley and Greasley, 1998). Note that here ECM is error correction term. The hypothesis Ho: $c1 = c2 = c3\ldots\ldots cn = 0$ or H0: $\delta_1 = \delta_2 = \ldots\ldots \delta_n = 0$ are tested using Wald Statistics.

Note that, in this case, causality can be inferred from the significance of λ or η alone that the causal nexus is altered, i.e. causality run from past level to current rate of change without any lagged changed effects.

Lag Length Selection

Lag length selection technique can be classified in to three groups (a) Adhoc Method (b) Rule of Thumb Method (c) Statistical Method. Applying all the procedures has reached to the conclusion that Adhoc procedure performed better than any of the three statistical methods in correctly identifying the causality (Jones 1989, p. 821). According to Adhoc procedure lags are selected arbitrarily. For example (1,1) or (2,2) or (3,3) on annual time series data. Here, Adhoc procedure is followed.

Sources of Data

All the data (information) necessary to estimate the Granger Model, i.e. narrow money, broad money, consumer price index (CPI), and GDP are taken from *International Financial Statistics CDROM*(2012) published by International Monetary Fund (IMF). However, data for narrow money broad money and consumer price index are taken from NRB (2011) and GDP is taken from IFS CDROM (2012) for Nepal.

Sample

Five countries are taken as sample countries from ASIA and they are Nepal, India, Sri Lanka, Myanmar and Korea. Nepal is taken deliberately being our home country. Others are taken on the basis of availability of data from IFS for the period 1964 to 2011 as well as on the basis of structure of the economy. Thus study period is 1964 to 2011.

Definition of Variables

Definitions of variables used in this study are given below:

Price: (P): Consumer price indexes of all countries are taken as a proxy variable for general level of price.

Money Supply: Two measures of money supply are used in this work. They are narrow money (M1) and broad money (M2). For the case of Nepal narrow money includes currency held by non-bank public and demand deposit, it is denoted by M1. Board money consists of narrow money and time deposit held at commercial banks. It is national definition. For other sample countries narrow money is as defined in

International Financial Statistics and broad money is considered as money plus quasi money. This definition is officially agreed for all countries.

Income: Gross Domestic Product is taken as proxy for income or output variable.

Stationarity Test

Stationary data series are necessary for the application of Granger model. Two methods are used to test the stationarity of data series. One is the test statistics and the other is Graphical methods. In test statistics, Dickey- Fuller (DF) and Augmented Dickey- Fuller (ADF) test are used to examine the stationarity of data series. Staionarity test is prerequisite for both causality and cointegration.

Empirical Analysis

Unit Root Test

Table 1: Unit Root Test of Basic Variables: India and Sri Lanka

Variables	DF (c)	ADF at lags (c)		DF(c, t)	ADF at lags(c, t)	
		1	2		1	2
India						
lnM1	1.584	1.478	1.856	-2.580	-2.631	-2.471
lnM2	2.755	1.377	0.694	-4.32***	-4.00**	-4.27***
lnGDP	1.905	1.001	1.248	-2.371	-2.147	-2.389
lnP	-0.441	-0.322	-0.303	-2.209	-3.072	-2.203
DlnM1	-6.394***	-5.551***	-3.51**	-6.707***	-6.07***	-3.80**
DlnM2	-4.534***	-3.148**	-3.330**	-4.79***	-3.140*	-3.157*
DlnGDP	-5.101***	-4.213***	-2.86*	-5.222***	-4.474***	-3.194*
DlnP	-4.961***	-5.528***	-4.061***	-4.905***	-5.459***	-3.975**
Sri Lanka						
lnM1	0.641	0.150	-0.107	-2.254	-2.382	-1.575
lnM2	0.996	0.087	-0.518	-2.544	-2.790	-2.939
lnGDP	0.974	0.200	-1.128	-2.575	-2.476	-2.103
lnP	1.627	0.566	0.414	-3.73**	-3.279*	-2.975
DlnM1	-4.932***	-5.221***	-2.651*	-4.880***	-5.099***	-2.581
DlnM2	-3.818***	-3.064**	-2.619*	-3.776**	-2.933	-2.54
DlnGDP	-4.993***	-4.431***	-3.722***	-4.931***	-4.319***	-3.598**
DlnP	-4.587***	-4.037***	-3.786***	-4.604***	-3.970**	-3.691**

Note: *** Significant at one percent ** Significant at five percent * Significant at ten percent
(c) Including constant; (c, t) including constant and trend.

Source: Authors own calculation based on IFS data.

The unit root test is performed in the Table 1 which states that narrow money, broad money, GDP and consumer price index of India which are expressed in natural logarithms are non-stationary at level while they are stationary at first differences. Thus these variables are integrated of order one that is I (1). Similarly, in the case of Srilanka too, basic variables are non-stationary at level but stationary at first differences. Note that symbol ln stands for natural logarithms and D for first differences.

In Table 2, as in previous cases all the variables are expressed in natural logarithms. In the case of Nepal and Myanmar variables such as narrow money, broad money, GDP and consumer price index are non-stationary at level but stationary at their first differences. For the case of Korea, some type of complex result is observed. Dickey-Fuller statistics reported in the table gives the impression that they are stationary at level but as trend component is included they become non-stationary at the level form. A kind of paradoxical result is appearing.

Table 2: Unit Root Test of Basic Variables: Nepal, Myanmar and Korea

Variables	DF (c)	ADF at lags (c)		DF(c, t)	ADF at lags(c, t)	
		1	2		1	2
Nepal						
lnM1	*-0.179*	0.015	0.187	*-1.543*	-2.033	-0.904
lnM2	*0.008*	-0.207	-1.121	*-1.459*	-1.970	-1.895
lnGDP	*0.789*	*0.796*	1.190	*-2.101*	-2.121	-2.741
lnP	*-0.007*	-0.011	0.289	*-1.630*	-1.859	-1.957
DlnM1	*-5.557***	-4.904***	-3.386**	*-5.492***	-4.844***	-3.315*
DlnM2	*-5111***	-3.929***	-2.686*	*-5.032***	-3.871**	-2.634
DlnGDP	*-6.833***	-4.892***	-3.417**	*-6.895***	-5.113***	-3.428*
DlnP	*-5.967***	-4.989***	-3.631***	*-5.902***	-4.946***	-3.582**
Myanmar						
lnM1	*2.772*	2.614	1.501	*-1.847*	-1.701	-1.763
lnM2	*4.166*	2.968	1.831	*-1.974*	-1.604	-1.577
lnGDP	*5.381*	*2.123*	2.133	*0.015*	-0.423	-0.371
lnP	*2.227*	0.973	2.006	*-1.157*	-1.853	-1.765
DlnM1	*-6.264***	-3.019**	-2.492	*-7.654***	-3.775**	-3.221*
DlnM2	*-4.826***	-2.544	-2.186	*-6.498***	-3.564**	-3.169*
DlnGDP	*-3.133***	-2.494	-1.775	*-4.124***	-3.659**	-2.991
DlnP	*-3.650***	-4.075***	-2.803*	*-4.004***	-5.107***	-3.351*
Korea						
lnM1	-6.85***	-6.70***	-7.42***	-2.040	-2.112	-2.726
lnM2	-10.546***	-2.992**	-3.374***	-4.143**	-2.763	-2.402
lnGDP	*-8.60***	-4.835***	-3.147**	0.766	-0.835	-1.24
lnP	*-5.628***	-2.944**	-3.407**	-0.908	-1.550	-1.494
DlnM1	-3.834***	-3.005**	-2.170	-5.935***	-5.818***	-3.771**
DlnM2	*-2.129*	-2.620*	-2.453	*-3.068*	-3.782**	-3.272*
DlnGDP	*-1.750*	-0.965	-0.910	-5.187***	-2.984	-3.076
DlnP	*-2.614**	-2.678*	-1.986	*-3.716***	-4.174***	-3.357*

Note: *** Significant at one percent ** Significant at five percent * Significant at ten percent
(c) Including constant; (c, t) including constant and trend.

Source: Authors own calculation based on IFS data.

In the case of first differences result is quite consistent. Both the Dickey-Fuller statistics, one including constant and the other including constant and trend, states that

variables stationary at first differences. The graph shown in the appendix reconfirms that variables are non-stationary at level but stationary at their first differences.

Test of Cointegration by Granger Approach

A method of testing the causality for cointegrated series is different from non-cointegrated series. The test of Ganger cointegration is shown in table 3. This is two step procedures. At first regression equation is estimated and residual is derived. In the second step, residual is tested for stationarity. Cointegration test is reported in Table 3.

Table 3: Granger Cointegration Test from the Residuals

Dependent Variables	Independent variables	Residual	DF test for Residual	ADF Test for Residual at lags	
				1	2
Nepal					
lnP	lnM1	ehatpm1	-2.886	-2.812	-2.318
lnP	lnM2	ehatpm2	-2.426	-2.598	-2.527
lnGDP	lnM1	ehatym1	-3.830**	-4.272***	-3.05
lnGDP	lnM2	ehatym2	-2.727	-2.353	-2.411
India					
lnP	lnM1	ehatpm1	-2.345	-2.797	-1.732
lnP	lnM2	ehatpm2	-2.474	-3.253*	-2.329
lnGDP	lnM1	ehatym1	-2.761	-2.876	-2.209
lnGDP	lnM2	ehatym2	-1.806	-2.440	-2.062
Sri Lanka					
lnP	lnM1	ehatpm1	-2.135	-2.589	-1.824
lnP	lnM2	ehatpm2	-2.005	-2.425	-2.483
lnGDP	lnM1	ehatym1	-2.638	-3.515**	-2.164
lnGDP	lnM2	ehatym2	-2.633	-3.400*	-3.302*
Myanmar					
lnP	lnM1	ehatpm1	-4.848***	-4.136***	-3.819**
lnP	lnM2	ehatpm2	-3.185*	-3.516**	-2.938
lnGDP	lnM1	ehatym1	-5.277***	-3.279*	-3.622***
lnGDP	lnM2	ehatym2	-2.981	-2.118	-2.542
Korea					
lnP	lnM1	ehatpm1	-2.033	-2.667	-1.634
lnP	lnM2	ehatpm2	-1.303	-2.081	-1.364
lnGDP	lnM1	ehatym1	-3.663**	-3.025	-2.998
lnGDP	lnM2	ehatym2	-2.973	-2.690	-2.935

Note: *** Significant at one percent ** Significant at five percent * Significant at ten percent

Source: Authors own calculation based on IFS data.

Stationarity test of residual reported in Table 3 states that, in Nepal, M1 and GDP variables are cointegrated. They have the long run equilibrium relationship. In India, broad money and general level of price are cointegrated; such equilibrium relationship is observed only at 10 percent level of significance. Similarly, in Sri Lanka, GDP and M1, and GDP and M2 are co-integrated. Former is observed at five percent level of

significance while the latter relation is observed at ten percent level of significance. In Myanmar, three pairs of variables are cointegrated that is M1 and P, M2 and P, and M1 and GDP. The cointegrated relation between M1 and P is significant at one percent or better level of significance. The relation between M2 and P is significant at five percent or better level of significance but the relation between M1 and GDP is significance at one percent or belter level. In case of Korea, only the narrow money and GDP are found to be cointegrated at five percent level of significance.

Cointegrated Series and Granger Causality from Level Data

If the series are cointegrated, if we estimate the causality from level data, the estimators will be super consistent. So here causality test is performed in cointegrated level data.

Table 4: Cointegrated Series and Granger Causality at Level Data

Dependent Variables	Independent Variables	F at Lags			Remarks
		1,1	2,2	3,3	
Nepal					
lnGDP	lnM1	20.57***	12.90***	9.88***	M1→GDP
lnM1	lnGDP	0.13	0.41	0.96	No causality
India					
lnP	lnM2	6.98***	8.17***	3.44**	M2→P
lnM2	lnP	0.006	0.68	1.98	No causality
Sri Lanka					
lnGDP	lnM1	0.17	3.128**	3.04**	M1→GDP
lnM1	lnGDP	6.78***	6.009**	3.05**	GDP→M1
lnGDP	lnM2	**0.01**	3.38**	3.16**	M2→GDP
lnM2	lnGDP	7.39***	5.83***	5.50***	GDP→M2
Myanmar					
lnM1	lnP	8.52***	3.18**	2.23*	P→M1
lnP	lnM1	6.23***	10.29***	5.96***	M1→P
lnM2	lnP	1.34	0.05	0.50	No causality
lnP	lnM2	8.81***	13.12***	13.12**	M2→P
lnM1	lnGDP	15.11***	6.40***	4.04***	GDP→M1
lnGDP	lnM1	1.94	8.63***	8.35***	M1→GDP
Korea					
lnM1	lnGDP	0.07	1.68	1.13	No causality
lnGDP	lnM1	52.35***	7.18***	4.46***	GDP→M1

Note Significant at ten percent or better, **Significant at five percent or better
***Significant at one percent or better

Source: Authors own calculation based on IFS data.

Causality test performed at level data, shown in Table 4, states that unidirectional causality is flowing from narrow money to GDP in Nepal. Similarly unidirectional causality is flowing from broad money to prices in India. There is bidirectional causality between narrow money and GDP in Sri Lanka. Bidirectional causality is also observed in

broad money and GDP in Sri Lanka. Other results could similarly be explained from the table.

Cointegrated Series and Granger Causality from ECM Models

As discussed in methodology, in this section causality is tested from Error Correction Models (ECM). This method is applicable only for co-integrated variables.

Nepal

As the table 3 shows that narrow money and GDP are co-integrated. The causal relation between M1 and GDP can be inferred as follows.

$$\begin{array}{lll} \text{DlnGDP} = & 0.071 - 0.526\ EC_{t-1} + 0.260\text{DlnM1}_{t-1} + 0.076\ \text{DlnGDP}_{t-1} \\ \text{Pvalue} & (0.006)\ (0.004) \quad (0.14) \quad (0.58) \end{array}$$

Similarly,

$$\begin{array}{lll} \text{DlnM1} = & 0.115 - 0.135\ EC_{t-1} + 0.236\text{DlnM1}_{t-1} - 0.105\ \text{DlnGDP}_{t-1} \\ \text{Pvalue} & (0.00)\ (0.41) \quad (0.21) \quad (0.47) \end{array}$$

These estimated equation shows that unidirectional causality is flowing from narrow money to GDP. There is no any feedback effect from GDP to M1. To examine the causality running GDP to M1 other models were also estimated but the result was insignificant. Thus there is unidirectional causality flowing from narrow money to GDP. This finding is consistent with the finding of co-integrated level data.

India

Cointegration analysis from Granger approach shows that there is long run equilibrium relation between broad money and general level of prices. Utilizing this cointegrating relation, following error correction models are estimated.

$$\begin{array}{lll} \text{DlnP} = & 0.011 - 0.01\ EC_{t-1} + 0.357\text{DlnM2}_{t-1} + 0.431\ \text{DlnP}_{t-1} \\ \text{Pvalue} & (0.77)\ (0.00) \quad (0.12) \quad (0.00) \end{array}$$

Similarly,

$$\begin{array}{lll} \text{DlnM2} = & 0.06 - 0.01\ EC_{t-1} + 0.196\text{DlnP}_{t-1} + 0.125\text{DlnPt-2} - 0.164\ \text{DlnM2}_{t-1} + \\ & 0.043\text{DlnM2}_{t-2} \\ \text{Pvalue} & (0.01)\ (0.83) \quad (0.02) \quad (0.15) \quad (0.28) \quad (0.00) \end{array}$$

Wald $\chi^2 =$ 6.28(0.04) Wald F = 3.14(0.05)

These estimated error correction models show that there is bidirectional causality between broad money and general level of prices in India. Note that the methodology of finding causality from level data was un-capable in detecting the bidirectional causality.

Sri Lanka,

$$\text{DlnM1} = 0.106 + 0.274\ EC_{t-1} + 0.423\text{DlnM1}_{t-1} - 0.251\ \text{DlnGDP}_{t-1}$$

Pvalue (0.00) (0.00) (0.00) (0.16)

Similarly we get

$DlnGDP = 0.077 - 0.062\ EC_{t-1} + 0.301 DlnGDP_{t-1} + 0.208\ DlnM1_{t-1}$

Pvalue (0.00) (0.31) (0.02) (0.03) (0.05)

Wald $\chi^2 = 11.61(0.004)$ Wald F = 8.50(0.005).

These estimated error correction models shows that there is bidirectional causality between Narrow money and GDP in Sri Lanka.

The case of M2 and GDP

$DlnM2 = 0.09 + 0.383EC_{t-1} - 0.375DlnGDP_{t-1} - 0.10DlnGDP_{t-2} + 0.43DlnM2_{t-1} + 0.44DlnM2_{t-}$

Pvalue (0.00) (0.00) (-0.04) (-0.54) (0.00) (0.00)

Similarly we have

$DlnGDP = 0.08 - 0.036\ EC_{t-1} + 0.25DlnM2_{t-1} + 0.18\ DlnGDP_{t-1}$

Pvalue (0.00) (-0.62) (0.02) (0.22)

Wald $\chi^2 = 12.89(0.00)$ Wald F=6.44(0.00)

These estimated equations show that there is bidirectional causality between broad money and GDP.

Myanmar

$DlnP = 0.037 - 0.328\ EC_{t-1} + 0.181 DlnM1_{t-1} + 0.532\ DlnP_{t-1}$

Pvalue (0.09) (0.00) (0.04) (0.00)

Similarly,

$DlnM1 = 0.118 + 0.44\ EC_{t-1} + 0.126 DlnM1_{t-1} + 0.218\ DlnP_{t-1}$

Pvalue (0.00) (0.03) (0.44) (0.34)

Thus there is bidirectional causality between narrow money and prices.

Broad Money and Prices

$DlnP = 0.019 - 0.29\ EC_{t-1} + 0.269 DlnM2_{t-1} + 0.532\ DlnP_{t-1}$

Pvalue (0.40) (0.00) (0.01) (0.00)

Similarly,

$DlnM2 = 0.118 + 0.44\ EC_{t-1} + 0.126 DlnM1_{t-1} + 0.218\ DlnP_{t-1}$

Pvalue (0.00) (0.03) (0.44) (0.34)

The estimated error correction model states that there is bidirectional causality between broad money and prices. Variables are cointegrated so we performed Granger

causality test at level data using conventional F statistics and also we get bidirectional causality.

Narrow Money and GDP

$$\text{DlnM1} = 0.057 + 0.64\ EC_{t-1} + 0.092\text{DlnM1}_{t-1} + 0.537\ \text{DlnGDP}_{t-1}$$

Pvalue (0.16) (0.00) (0.62) (0.03)

Similarly,

$$\text{DlnGDP} = 0.062 + 0.009\ EC_{t-1} + 0.339\ \text{DlnGDP}_{t-1} + 0.367\text{DlnM1}_{t-1}$$

Pvalue (0.008) (0.94) (0.01) (0.00)

Wald χ^2 = 12.45(0.00) Wald F = 12.45(0.00)

Thus there is bidirectional causality between narrow money and GDP in Myanmar. [Variables are co-integrated so we performed Granger causality test at level data using conventional F statistics and also we get bidirectional causality].

Korea

Only M1 and GDP are cointegrated (in Granger sense) in Korea so following error correction model are estimated.

$$\text{DlnM1} = -0.028 + 0.405\ EC_{t-1} + 0.390\text{DlnM1}_{t-1} + 0.803\ \text{DlnGDP}_{t-1}$$

Pvalue (0.39) (0.00) (0.01) (0.00)

Similarly,

$$\text{DlnGDP} = 0.016 - 0.015\ EC_{t-1} + 0.611\ \text{DlnGDP}_{t-1} + 0.265\text{DlnM1}_{t-1}$$

Pvalue (0.28) (0.78) (0.00) (0.00)

Wald χ^2 = 16.05(0.00) Wald F = 16.05(0.00)

These estimated equations states that there is bidirectional causality between narrow money and GDP. Note that causality test from level data could not detect the bidirectional causality.

Comparison between Level Data and ECM Models in Cointegrated Relation

The finding and analysis done in Cointegrated series and level data and cointegrated series and ECM models reveal that detecting the causality from ECM model is more powerful than detecting the causality from Level data. Investigation from level data, in some cases, causality may be missed. For example in Nepal, same finding is observed from level variable and ECM models. However, In the case of India, ECM shows bidirectional causality but level shows unidirectional in M1 &GDP. Level could not predict the causality. In the case of Srilanka, finding is same. But in the case of Myanmar ECM shows bidirectional causality but level shows unidirectional causality in M2 and P. Level could not predict causality. In the case of Korea, ECM shows bidirectional causality between narrow money and GDP but the level data shows only unidirectional

causality. Conclusion is that causality test from ECM model is more powerful in detecting the causality than from Level data.

Causality from Non-cointegrated Variables

Conventional F test is used to examine the direction of causality for non-co-integrated variables. Result of the test is shown in Table 5.

Table 5: Direction of Granger Causality in Nepal, India, Sri Lanka, Myanmar and Korea.

Dependent Variables	Independent Variables	F at Lags			Remarks
		1,1	2,2	3,3	
Nepal					
DlnM1	DlnP	0.001	0.32	1.16	No causality
DlnP	DlnM1	4.43**	2.76*	1.73	M1→P
DlnM2	DlnP	0.004	1.52	1.03	No causality
DlnP	DlnM2	6.54**	3.36**	2.41*	M2→P
DlnGDP	DlnM2	7.34***	4.75***	3.35**	M2→GDP
DlnM2	DlnGDP	0.88	2.88*	1.55	GDP→M2
India					
DlnM1	DlnP	1.54	5.74***	3.75***	P→M1
DlnP	DlnM1	2.19	1.01	0.89	No causality
DlnGDP	DlnM1	2.84*	1.47	0.95	M1→GDP
DlnM1	DlnGDP	0.03	0.86	1.97	No causality
DlnGDP	DlnM2	1.56	1.89	1.58	No causality
DlnM2	DlnGDP	0.40	1.96	2.40*	GDP→M2
Sri Lanka					
DlnM1	DlnP	0.47	0.90	0.47	No causality
DlnP	DlnM1	3.63*	4.38**	4.22**	M1→P
DlnM2	DlnP	0.18	0.44	0.27	No causality
DlnP	DlnM2	11.80***	5.57***	3.68**	M2→P
Myanmar					
DlnGDP	DlnM2	16.75***	9.69***	11.54***	M2→GDP
DlnM2	DlnGDP	6.93**	1.23	1.34	GDP→M2
Korea					
DlnM1	DlnP	6.86***	4.76**	1.97	P→M1
DlnP	DlnM1	3.86**	8.94***	5.82***	M1→P
DlnM2	DlnP	3.26*	3.78**	2.54*	P→M2
DlnP	DlnM2	3.93**	5.09***	3.14**	M2→P
DlnGDP	DlnM2	11.86***	3.81**	3.27**	M2→GDP
DlnM2	DlnGDP	0.28	1.20	0.71	No causality

Note * Significant at ten percent or better, **Significant at five percent or better
***Significant at one percent or better;

Source: Authors own calculation based on IFS data.

The result shows that narrow money is causing the general level of prices in Nepal but the price is not causing the narrow money. Similarly broad money is also causing the price but the price is not causing the broad money. Thus monetarist proposition is valid for Nepal. Concerning the effect on GDP, there is bidirectional causality between broad money and GDP in Nepal. That is, in the short run, money is causing the GDP.

In India, price is causing the narrow money but narrow money is not causing the prices. Thus narrow money is an endogenous variable in term of prices. Similarly M1 is causing the GDP but the GDP is not causing the M1. Further there is unidirectional causality flowing from GDP to broad money (M2).

In Sri Lanka, narrow money is causing the price; broad money is causing the price but price is not causing the narrow money as well as the broad money. That is price in Srilanka is monetary phenomenon.

In Myanmar, bidirectional causality is found between broad money and GDP. Thus broad money in term of GDP is an endogenous variable. In Korea, in the short run, there is bidirectional causality between narrow money and prices, as well as, broad money and prices. Money price spiral is there. But in term of GDP, broad money is causing the GDP but GDP is not causing the broad money.

Overall Finding

Causality is examined using three approaches. The findings of these approaches are summarized below.

Table 6. Summary of Direction of Causality in all Countries

Direction of Causality	Nepal	India	Sri Lanka	Myanmar	Korea
M1→P	Yes	No	Yes	Yes	Yes
P→M1	No	Yes	No	Yes	Yes
M2→P	Yes	Yes	Yes	Yes	Yes
P→M2	No	Yes	No	Yes	Yes
M1→GDP	Yes	Yes	Yes	Yes	Yes
GDP→M1	No	No	Yes	Yes	Yes
M2→GDP	Yes	No	Yes	Yes	Yes
GDP→M2	Yes	Yes	Yes	Yes	No

Table 6 describes the direction of causality between money and price and money and income. The flow of causality can be read easily from the table. Except a few cases causality is flowing from the side of both money and price, and money and income.

Conclusion

The direction of causality between money, price and income in annual data series differs from one country to another. Thus, structure of the economy may determine the

flow of causality between the variables. In case of Nepal price is monetary phenomenon because both the definition of money- narrow and broad money unidirectionally causing general level of price. But the money supply in Nepal is not exogenous variables it depends upon income level of the economy. The bidirectional causality between broad money and GDP justify it. Again money supply in Nepal is not neutral because it is causing income and output of the economy at the cost high inflation. In the case of India, general level of price is causing the narrow money and there is bidirectional causality between broad money and prices. Again, GDP is causing the broad money so narrow and broad money supplies in India are endogenous variables. In Sri Lanka, price is monetary phenomenon but bidirectional causality between narrow money and income and broad money and income confirm that money supply is an endogenous variable. Very interesting finding is observed in Myanmar. Bidirectional causality is found in narrow money and price, broad money and price, narrow money and income, and broad money and income. In all cases there is bidirectional causality. Thus both the money supply definition in Myanmar are endogenous variable in term of piece and income. Similar result is observed in Korea_except that unidirectional causality flowing from broad money to GDP.

Observing these entire phenomenon, author reaches to the conclusion that money supply is an endogenous variable in all the countries, though the extent of endogeneity in term of price and income variables-slightly differs from one to another. Thus conventional concept of purely exogenous money supply is invalid. Money causes the both price and income with receiving the feedback effect. In methodological front, in detecting the causality in co-integrated series, ECM models are more powerful than the conventional F-test in level variables.

Policy Implication

Money supply is not only influenced by supply side variables which are within the control of central bank but it is also determined by demand side variables such as price and income. Therefore, the conventional concept of exogenous money supply is invalid. It is jointly determined by banks and general public. Thus, to keep the money supply in desirable range, policies should be designed from the supply side as well as the demand side for the studied countries.

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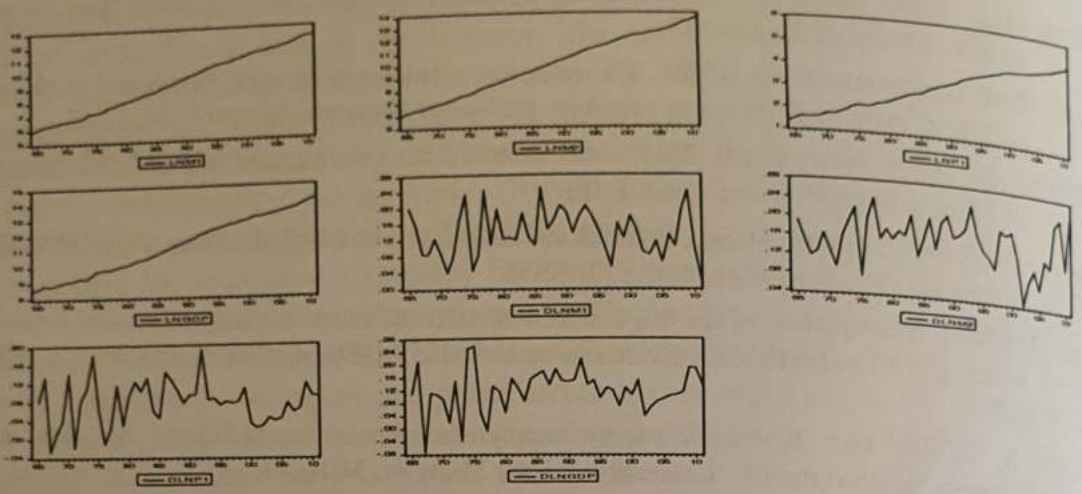
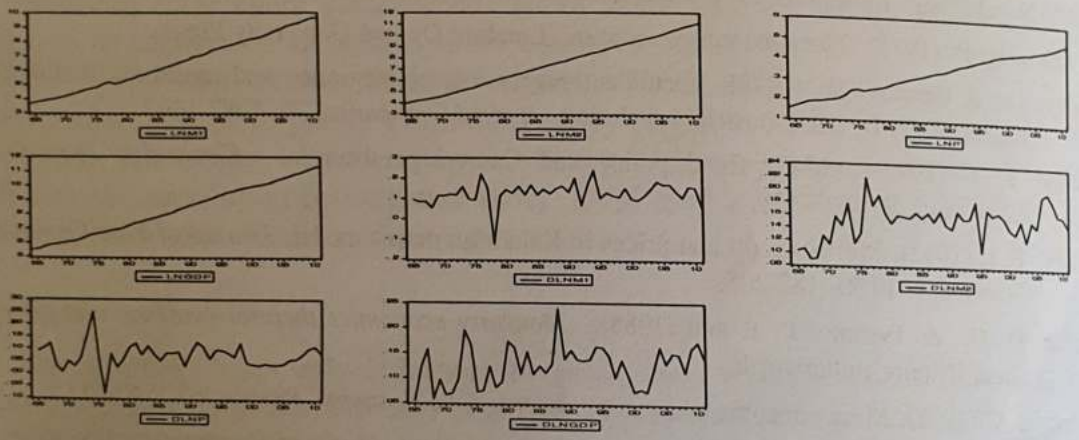
APPENDIX I

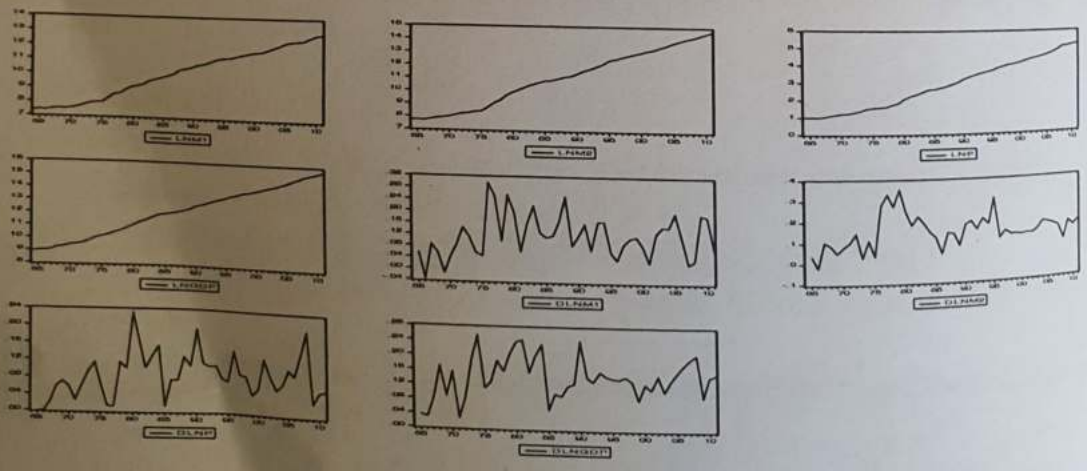
Basic Variables of Nepal



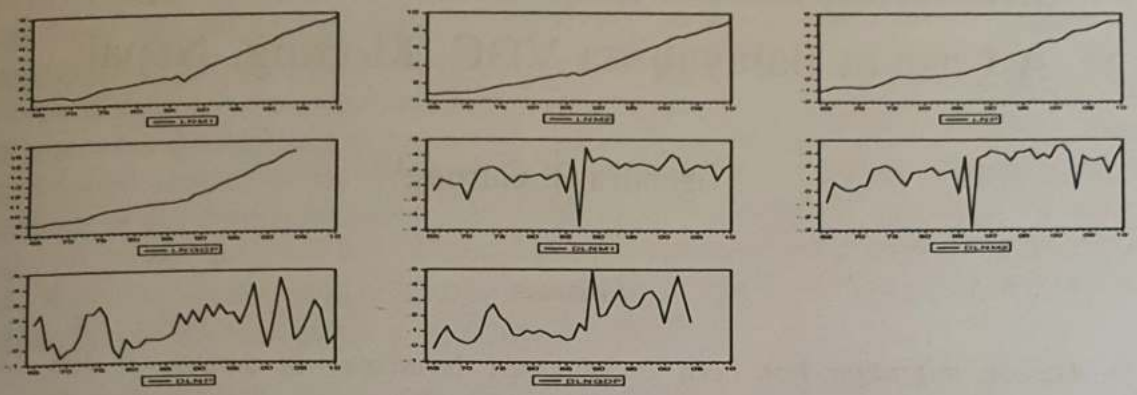
Basic Variables of India



Basic Variables of Srilanka



Basic Variables of Myanmar



Basic variables, Korea