The Divisia Monetary Indices as Leading Indicators of Inflation

M. Ramachandran, Rajib Das and Binod B. Bhoi

This study constructed three alternative measures of Divisia monetary aggregates corresponding to two official measures of monetary aggregates, M2 and M3, and one liquidity measure, L1 and evaluated their role as indicators of inflation *vis-à-vis* their simple sum counterparts. The empirical results obtained from correlation analysis, fit of the nearest neighbourhood regression as well as the vector error correction model unambiguously established the superiority of Divisia monetary aggregates over their simple sum counterparts as predictor of both headline and core inflation. The results were further corroborated by evidence from forecast error variance decomposition which showed the growth rates of Divisia monetary aggregates as exogeneous sequence and the impulse response functions which showed stronger response of inflation to shocks in growth rates of Divisia monetary aggregates. Hence, the study suggests that the Reserve Bank of India (RBI) can closely observe the growth rates of Divisia monetary aggregates to have a better understanding of future inflationary pressure built-up within its multiple indicator approach. This, however, does not mean that the RBI can dispense the use of official measures of monetary aggregates. Simple sum aggregate can serve as an accounting stock.

I. Introduction

The monetary policy framework has undergone significant changes in most economies in response to the trade and financial liberalisation since the 1980s. Although price stability and sustainable output growth remains the final objectives of monetary policy, in view of they being not directly under the control of Central banks, monetary authorities typically set 'intermediate target/s', which bear a stable relationship with the overall objectives of monetary policy (Friedman, 1990). The selection of intermediate target/s is also conditional upon the channels of monetary policy transmission that operate in the economy.

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Although credit targeting was prevalent traditionally, such as in the US, the concept of a formal intermediate target emerged with the monetarist emphasis on money targeting in the 1960s. In the 1970s, the evidence of a stable relationship between money, output and prices, prompted Central banks to give more weight to money growth in their policy discussions, in an environment of worsening inflation (Volcker, 1978). In addition to supply (oil price) shocks, the high inflation in the 1970s was attributed to the accommodative monetary policies pursued in many countries to offset the adverse output and employment effects of the shock. In this backdrop, a commitment to rule was thought necessary to anchor inflation expectations (Kydland and Prescott, 1977 and Barro and Gordon, 1983). A number of Central banks, starting with Switzerland and including Germany, Japan, the UK and the USA, adopted monetary targets in the mid-1970s.

The assumption about stability of the money demand function was central to the monetary targeting framework. However, the sophistication in the financial markets that reduced the need for financial intermediation by the banking system during the 1980s, in turn, began to impart volatility to the behaviour of monetary aggregates and the velocity of money, especially in market-based economies. As a result, Central banks in advanced economies began to de-emphasise the role of monetary aggregates and moved towards signalling monetary policy stance through setting of interest rates under exchange rate flexibility or a tight exchange rate target regime. In contrast, monetary targeting continued in some form in some bank-based economies in continental Europe such as France, Germany and Switzerland where it was possible to test for money demand stability with some redefinition of monetary aggregates.

By the early 1990s, beginning with New Zealand, a number of advanced and emerging market economies (EMEs) have adopted 'inflation targeting' as an alternative monetary policy framework. Recognising the uncertainty and complexity involved in forecasting the final objective (i.e., inflation), a more eclectic approach is followed by inflation targeting Central banks, where a large set of variables/models are used to draw inferences about future inflation. In its pursuit of price stability objectives, however, the European Central Bank (ECB) bases its policy decisions on the 'two pillars' strategy comprising 'economic analysis' and 'monetary analysis' even today. According to the ECB, the monetary analysis mainly serves as a means of cross-checking, from a medium to long-term perspective, the short to medium-term indications for monetary policy coming from the economic analysis. In some EMEs such as Russia (Korhonen and Mehrotra, 2007) and China (Laurens and Maino, 2007), monetary aggregates continued to play a central role in their policy formulation. Thus, in many economies, despite transition and larger flexibility to monetary policy frameworks, the emphasis on money growth to contain inflation remained till date. The role of money and credit has further come to the limelight in policy debates as economists and policy makers have begun to draw lessons from the recent global financial crisis. It is argued that monitoring money and credit may help policymakers interpret asset market developments and draw implications from them for the economic and financial outlook (Goodhart, 2007).

In India, intermediate targets have evolved over time with changes in the overall operating environment of monetary policy and financial liberalisation of the Indian economy. The Reserve Bank of India (RBI) had no formal intermediate target till the middle of 1980s. As inflation was largely thought to be structural and inflation volatility was mainly on account of agricultural failures, there was greater reliance on selective credit controls to influence production outlays, on the one hand and to limit possibilities of speculation, on the other. Bank credit—aggregate as well as sectoral—came to serve as a proximate target of monetary policy after the adoption of credit planning from 1967-68 (Jalan, 2002).

During the early 1960s, although the analytics of money supply was being governed by the expansion in credit, the RBI began to pay greater attention to the movements in monetary aggregates (RBI, 2005). This accent on monetary aggregates was supported by several empirical studies which provided evidence of a stable money demand function in the Indian economy (Vasudevan, 1977; Jadhav, 1994; and Ramachandran, 2004). During the 1970s, the sharp increases in money supply in the face of deceleration in output growth was viewed as adding to the demand pressures in the economy, which coupled with the adverse impact of the supply shocks led to spikes in inflation. By the early 1980s, there was a broad agreement on the primary causes of inflation. It was argued that while fluctuations in agricultural prices and oil price shocks did affect prices, continuous inflation of the kind witnessed in India since the early 1960s could not occur unless it was sustained by the continuous excessive monetary expansion generated by the large-scale monetisation of the fiscal deficit (RBI, 2005).

Against this backdrop, the Report of the Committee to Review the Working of the Monetary System (RBI, 1985) recommended a monetary targeting framework to target an acceptable order of inflation in line with output growth. With empirical evidences supporting stability in the money demand functions, broad money emerged as an intermediate target of monetary policy. Thus, the RBI began to formally set monetary targets as nominal anchor for inflation, although the framework was a flexible one allowing for various feedback effects.

In the early 1990s, the process of financial liberalisation began which along with the gradual opening up of the economy necessitated shifts in the monetary policy operating procedures. With the pace of liberalisation and globalisation of the economy gaining momentum, efficacy of broad money as an intermediate target of monetary policy came under question. Despite most studies lending support to the argument that money demand functions in India have been fairly stable, the RBI's Monetary and Credit Policy Statement of April 1998 observed that financial innovations emerging in the economy provided some evidence that the dominant effect on the demand for money in the near future need not necessarily be real income, as in the past. Interest rates too seemed to exercise some influence on the decisions to hold money (RBI, 2005). The Working Group on Money Supply: Analytics and Methodology of Compilation (RBI, 1998) also observed that monetary policy exclusively based on the money demand function could lack precision.

In line with international experience and the liberalisation process initiated by structural reforms of the early 1990s, the monetary policy framework in India also witnessed a major transformation. A key development that shaped the conduct of monetary management during the 1990s was the progressive opening up of the Indian economy to capital flows.[1] Therefore, apart from dealing with the usual agricultural supply shocks, monetary policy also had to increasingly manage external shocks emanating from swings in capital flows, volatility in the exchange rate and global business cycles. Accordingly, maintaining orderly conditions in financial markets for ensuring financial stability emerged as an additional objective of monetary policy, apart from price stability and credit availability, which necessitated refinements in the conduct of monetary policy by the RBI.

Against this backdrop, the RBI formally adopted a 'multiple indicator approach' in April 1998 with a greater emphasis on rate channels for monetary policy formulation. As part of this approach, besides money supply, the information content in a host of macroeconomic indicators including interest rates or rates of return in different markets along with such data as on currency, credit, fiscal position, trade, capital flows, inflation rate, exchange rate, refinancing and transactions in foreign exchange are juxtaposed with output data for drawing monetary policy perspectives.[2]

Globally, it is now recognised that the task of monetary management has become more and more complex in an environment of ongoing structural reforms and increasing trade and financial integration of economies. These changes, in turn, have distorted the relevance of explicit intermediate targets and altered the transmission of monetary policy to the real economy. In this backdrop, there is now an emerging consensus that the process of monetary policy formulation be guided by the information content available from a number of macroeconomic indicators rather than the reliance on a single intermediate anchor (RBI, 2005). It is argued that with Central bankers operating in an environment of high uncertainty regarding the functioning of the economy as well as its prevailing state and future developments, a single model or a limited set of indicators may not be a sufficient

1 Ramachandran (2000) observed that the growing openness of the economy and the market-oriented reforms in the financial sector had brought in significant changes in the money supply process and as a consequence, the monetary targeting turned out to be a more complicated and less useful exercise.

2 This large panel of indicators is often criticised as a 'check list' approach, which tend to undermine the concept of a nominal anchor for monetary policy. However, in line with the transition of the Indian economy towards an open market-oriented economic system, there were shifts in the channels of monetary policy transmission, which required the Central bank to operate through all the paths that transmit its policy impulses to the real economy.

guide for monetary policy. Instead, an encompassing and integrated set of data is required (Trichet, 2004).

In fact, Central banks like the US Fed, the ECB and the Bank of Japan (BoJ) regularly monitor a number of macroeconomic indicators such as prices, output gaps, and developments in asset, credit and other financial markets, which have a bearing on price stability (RBI, 2007). It may be noted that despite money's relegation to the background, most Central banks in developed countries continue to include measures of money and credit in the range of economic indicators used to assess the economic outlook (Bloor *et al.*, 2008). The relevance of money for aggregate demand, in turn, lies not via real balance effects, but on money's ability to serve as a proxy for the various substitution effects of monetary policy that exist when many asset prices matter for aggregate demand (Nelson, 2003). Thus, most Central banks now monitor a number of macroeconomic indicators which have a bearing on the ultimate objective of price stability.

Although the movement of a host of variables is now monitored within the multiple indicator approach in India, the monetary aggregates continue to play significant role as an indicator if not as an intermediate target variable. However, the RBI like other Central banks largely rely on monetary aggregates which are measured as simple sum of relevant monetary components. Such simple sum approach can be justified only if the component assets are perfect substitutes or in other words the component assets do not yield any explicit or implicit monetary return. In reality, most of the monetary candidates such as fixed deposits of various maturities, however, yield explicit monetary return; hence, they cannot be treated as perfect substitutes. Therefore, simple sum aggregates suffer from aggregation bias and the magnitude of bias tends to be larger with higher level of aggregation. Use of such aggregates as indicators of monetary policy is likely to send wrong signals and the policy actions based on such wrong signals might produce undesirable impact on goals of monetary policy. In this context, the present study intends to explore the potential use of weighted monetary aggregates derived from index number theory within the current monetary policy settings.

II. Why Divisia Monetary Indices?

The economic monetary constructs derived from Divisia index number formula held promises in applications, particularly in the context of developed countries, for several reasons. First, an aggregate in economic sense must be viewed as if it were a single good. Such an aggregate can evolve only from a strong microeconomic aggregation theoretic foundation. In this regard, the Divisia index number has microeconomic aggregation theoretic foundation as it belongs to the class of superlative index numbers (Diewert, 1976). The superlative index numbers approximate any arbitrary exact aggregator function up to a third-order reminder term; hence, eliminate the distinction between index number theory and economic aggregation theory (Barnett, 1980 and 1997; and Barnett *et al.*, 1992).

Second, it does not involve econometric estimation of parameters and depends upon quantity and price data. The use of aggregator function to construct monetary aggregates is less appreciated as such aggregates cannot be used for communication purposes. This is because, when new data are used in estimation the parameters of the function tends to change and therefore, the monetary aggregates in the past will also change. On the contrary, construction of index numbers is free from estimation of parameters; hence, arrival of new data will not change measure of monetary aggregates in the past.

Third, voluminous empirical evidence exists to support the theoretical merits of Divisia monetary aggregates and they have an edge over their simple sum counterparts in their role as predictor of inflation and output. Further, the demand for such weighted monetary aggregates is found to be fairly stable functions of few determinants (Barnett, 1980; Binner *et al*., 1999; and Stracca, 2001).

III. What were the Experiences in India?

In India, there are few studies which have attempted to construct and evaluate the performance of weighted monetary aggregates. The empirical studies on monetary aggregation can be classified into two groups. First, studies that attempted to identify theoretically admissible asset groups using both parametric separability tests (Ramachandran and Kamaiah, 1994 and Subrahmanyam and Swami, 1994) and nonparametric separability tests (Acharya and Kamaiah, 1999). Second, there are studies focussed on evaluating the performance of weighted *versus* simple sum monetary aggregates, mainly in terms of their information content about the future movement of prices and income and stability of their demand functions (Kamaiah and Bhole, 1982; Kamaiah and Subrahmanyam, 1983; Kannan, 1989; Subrahmanyam and Swami, 1991; Ramachandran, 1994, 1995, 1998; Acharya, 1998; and Acharya and Kamaiah, 1998).

Three major inferences emerge from the earlier studies in the Indian context: (i) in contrast to theoretical merits, simple sum aggregates outperformed Divisia aggregates even at higher levels of aggregation; (ii) the performance of Divisia aggregates over their sum counterparts are found to be conditional upon sample period, frequency of time series data, the context in which the role of aggregates are evaluated and econometric tools used; and (iii) even those studies that report supporting evidence in favour of Divisia monetary aggregates received severe criticism on methodological grounds.[3]

One of the prominent reasons attributed to the failure of Divisia monetary aggregates is that the time series data used in the construction of monetary aggregates pertain to the period of repressed financial regime. Under repressed financial system, the relative prices of most of the financial assets are constant over time. Therefore, Divisia monetary

3. The study by Kannan (1989) provided supporting evidence for the use of weighted monetary aggregates to predict nominal income. However, Jadhav (1989) found that the methodology followed by Kannan to obtain weights had circular reasoning. The better predictability of monetary aggregates is embedded in the very construction of weights.

aggregates tend to converge to their simple sum counterparts, yielding little or no gain over simple sum aggregates in applications. However, the studies by the RBI (1998) and Acharya and Kamaiah (2001) could find marginal gain with Divisia aggregates in terms of their stable demand function and information content. This might be due to the reason that these studies use data from a relatively liberalised financial market regime. Indeed, weighted monetary aggregates perform better if the financial market is deregulated.

IV. Why do we Need a Fresh Study?

Over time, database gets revised, data on new monetary candidates are available, policy regime changes, financial innovations and changes in payment technology occur, and there are advancements in economic theories and econometric tools. For instance, time series data on new financial candidates at highly disaggregated levels and on interest rates are made available thanks to the recommendations of the Working Group on Money Supply (RBI, 1998). In the recent years, there is a clear evidence of interest rate deregulations, financial innovations, and growing financial disintermediation. The increased use of alternative instruments as medium of exchange has brought in significant changes in payment technology. Under such an environment, Divisia monetary constructs embracing all the relevant monetary and financial candidates tend to provide a better measure of liquidity, especially at higher level of aggregation. Such aggregates will be highly useful in understanding the implications of liquidity movement on other economic variables.

Although targeting Divisia constructs is a bit difficult, they can serve as potential indicators of monetary policy in the context of currently followed multiple indicator approach. The Annual Monetary and Credit Policy Statement for 2003-04 and the Report of the Internal Group on Liquidity Adjustment Facility (LAF) have emphasised the need to strengthen the RBI's liquidity forecasting model so as to provide a more scientific basis to the decision-making process for LAF operations. In this regard, using the information contained under the Divisia monetary aggregates might provide better assessment of liquidity than their simple sum counterparts. Given the recent developments in the Indian financial markets, it is, therefore, ideal to re-explore the potential use of economic monetary aggregates, especially at higher level of aggregation, in relevant applications.

V. The Methodology and Empirical Results

The empirical analysis has two aspects: (i) constructing Divisia monetary aggregates; and (ii) evaluating the relative merits of such constructs *vis-à-vis* simple sum aggregates. The second phase of the empirical analysis is designed to understand whether Divisia monetary aggregates have an edge over their simple sum counterparts in their role as indicators of inflation. In this context, we propose to use the cointegration and error correction framework to understand the short-run and long-run dynamics between the growth rates of money and inflation

The Divisia Index

The growth rate of Divisia quantity index is defined as:

$$\log(Q)_t - \log(Q)_{t-1} = \sum_{i=1}^{n} S^*_{it}(\log x_{it} - \log x_{it-1}) \quad (1)$$

where $S^*_{it} = 0.5(S_{it} + S_{it-1})$ is the average expenditure shares of two adjacent periods, $S_{it} = p_{it}x_{it} / \sum p_{it}x_{it}$ is the expenditure share of i^{th} asset and p_{it} is the user cost (Barnett, 1978)[4] of i^{th} asset defined as: $p_{it} = (R_t - r_{it})/(1+R_t)$ with r_{it} being the return on i^{th} asset and R_t being the return on a benchmark asset that does not provide monetary services.[5] Thus, equation (1) describes that the growth rate of Divisia monetary aggregate is the share-weighted average growth rates of the component assets.

The study uses monthly data for the period from April 1993 to June 2008, as major deregulations in the financial market have taken place during this period.[6] Moreover, consistent time series data on components of new monetary aggregates are available for this period. The first phase of the empirical analysis needs time series data on various monetary/financial candidates (x_{is}), rate of return on these variables (r_{is}) and a benchmark interest rate (R_t). The new official measures of M2, M3 and Liquidity aggregate *L1* proposed by the Third Working Group are considered for empirical evaluation.[7]

The benchmark prime lending rate (BPLR) of State Bank of India (SBI) is chosen as a proxy for benchmark interest rate. However, the highest rate among the chosen interest rates offered on the components of monetary aggregates and the BPLR at each time period is used as benchmark rate to calculate the user cost of money. This is done to avoid negative user cost for some components, because the call money rate and interest rate on certificate of deposits issued by the commercial banks exceeded the BPLR of SBI during some months.[8] The details of various components and corresponding interest rate proxies

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4. The recent studies by Barnett (1995), Barnett *et al*. (1997), Barnett *et al*. (2000), Barnett and Liu (2000) and Barnett and Wu (2005) focus on risk adjusted user cost of money. The present study has not taken up this exercise as the aggregates considered by this study contain monetary component which are, to a larger extent, risk free.
5. Barnett (1978) defines the benchmark return as the yield on human capital in a world where there is no slavery system.
6. There was a suggestion from the referee of this study to conduct the empirical investigation for the period beginning from 1998, because major deregulation of interest rates is perceived to have taken place since 1998. However, we could not find strong cointegrating relationship between growth rates of both Divisia/simple sum monetary aggregates and inflation. This might be due to the small size of sample given the low power of the test that we have used in the study.
7. The narrow monetary aggregate M1 is not considered as their components are highly liquid asset; hence, there will be hardly any difference between sum M1 and its Divisia counterpart.
8. We have received suggestions to use yield on long-term government securities as a proxy for benchmark interest rate. We could not use it as a proxy for benchmark rate because we encounter negative user cost at large number of data points.

used in the construction of user cost of monetary assets are given in Appendix A.[9] The data are collected from *Handbook of Statistics on Indian Economy* and other publications of the RBI.

The relative merits of simple sum *versus* Divisia monetary aggregates need to be carried out using some empirical criteria of policy interest. In this respect, the study intends to examine the strength of association between Divisia monetary measures and inflation and also whether Divisia monetary measures are better predictor of inflation as compared to their sum counterparts. Evaluating the predictive power of monetary aggregates is more crucial in the present policy setup as we have done away with explicit monetary targeting framework and moved into a sort of multiple indicator approach wherein the growth rate of M3 monetary aggregate is considered as an important policy indicator.

In this respect, we present some basic statistics to know the direction and strength of association between growth rate of monetary aggregates and inflation. The statistics in Table 1 are the correlation coefficients between the average annual growth rates of various monetary aggregates and average headline inflation rate measured as point-to-point percentage change in wholesale price index (π), average inflation rate excluding the food items (π^{exfo}), and average inflation rate excluding both food and fuel items (π^{exfofu}). The latter two measures of inflation are considered as proxy for core inflation. Apart from the cotemporaneous correlation between money growth and inflation, we also report the correlation between lagged money supply growth and inflation.

The growth rates of Divisia m_2 and simple sum m_2 have statistically significant contemporaneous correlation with inflation and the magnitude of correlation coefficient is relatively larger in the case of Divisia m_2. The growth rates of simple sum m_3 and L1 seem to have contemporaneously insignificant correlation with headline inflation and core inflation (π^{exfo}) while the growth rate of Divisia m_3 and Divisia L1 have significant correlation with both headline inflation and core inflation measures. The degree of correlation between money growth and inflation remains the same at higher level of aggregation.

When three months lagged growth rate of monetary aggregates are related to inflation, the correlation coefficients turned out to be statistically significant irrespective of methods of monetary aggregation. However, the magnitude of correlation coefficients is found to be relatively larger with respect to growth rates of Divisia aggregates, especially at higher level of aggregation. In the case of 6 months and 12 months lagged money supply growth, the

9. The empirical studies at large assumed zero return on currency and demand deposits. However, commercial banks compete among themselves to attract funds through current account by offering non-monetary benefits to the account holders. As a consequence, construction of time series data on implicit yield on demand deposit received attention in the literature and an attempt was initiated by Klein (1974). There are few studies that take into account such measure as return on demand deposits while constructing monetary aggregates. We have assumed zero return on demand deposits since construction of implicit yield on demand deposits itself can be an independent study.

correlation between simple sum and Divisia monetary growth and inflation seem to be statistically significant, but the magnitude decline. Nonetheless, the growth rates of Divisia monetary aggregates seem to have consistently stronger association with both headline and core inflation measures as compared to their simple sum counterparts.

There are broadly three inferences that emerge from Table 1: (i) the growth rates of Divisia aggregates have higher correlation with inflation as compared to that of simple sum aggregates; (ii) the growth rates of Divisia aggregates have higher correlation with core inflation than with headline inflation; and (iii) the correlation between simple sum money growth and inflation seems to be declining as the levels of aggregation increases while, on the contrary, the correlation between inflation and growth rates of Divisia money increases as the level of aggregation increases. These findings are consistent with the Divisia index number theory in the sense that it weights transaction balances more heavily and thus, capturing only the share of monetary services produced by component assets. It is largely this monetary service that has more relevance to inflation.

Table 1

Correlation between Growth Rate of Money (m) and Inflation (π)

	Correlation between m_t and π_t				Correlation between m_t and π_t		
Variables	π	π^{exfo}	π^{exfofu}	Variables	π	π^{exfo}	π^{exfofu}
m_2	0.31*	0.19*	0.41*	m_2	0.43*	0.37*	0.59*
Dm_2	0.43*	0.44*	0.57*	Dm_2	0.42*	0.49*	0.65*
m_3	0.08	-0.03	0.17**	m_3	0.24*	0.19*	0.39*
Dm_3	0.39*	0.38*	0.53*	Dm_3	0.38*	0.45*	0.62*
l_1	0.08	-0.03	0.17**	l_1	0.24*	0.20*	0.39*
Dl_1	0.39*	0.38*	0.53*	Dl_1	0.38*	0.46*	0.62*
	Correlation between m_{t-3} and π_t				Correlation between m_{t-12} and π_t		
Variables	π	π^{exfo}	π^{exfofu}	Variables	π	π^{exfo}	π^{exfofu}
m_2	0.44*	0.36*	0.57*	m_2	0.32*	0.28*	0.51*
Dm_2	0.47*	0.52*	0.67*	Dm_2	0.33*	0.32*	0.52*
m_3	0.23*	0.14	0.34*	m_3	0.20*	0.22*	0.41*
Dm_3	0.43*	0.48*	0.64*	Dm_3	0.28*	0.30*	0.50*
l_1	0.22*	0.15**	0.34*	l_1	0.18**	0.22*	0.42*
Dl_1	0.43*	0.48*	0.64*	Dl_1	0.28*	0.30*	0.49*

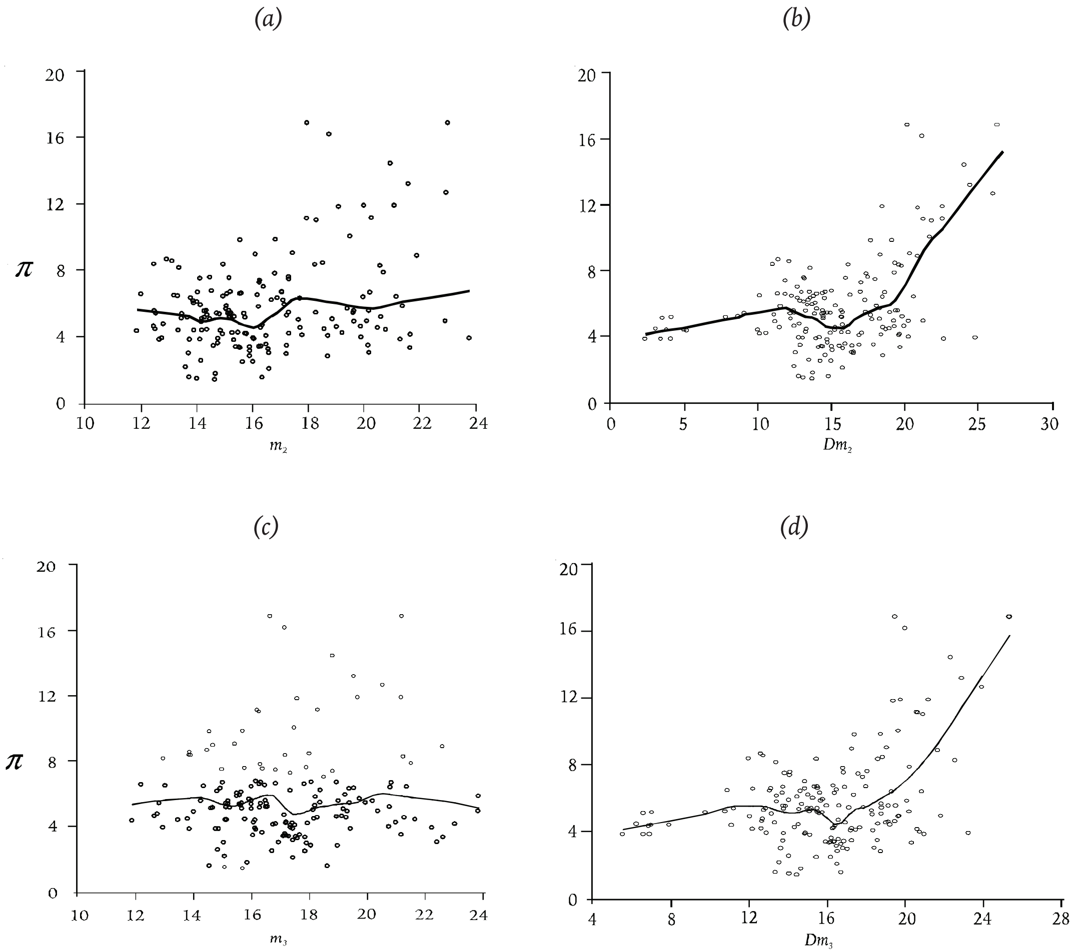
Note: * and ** indicate statistical significance at 1 per cent and 5 per cent level, respectively.

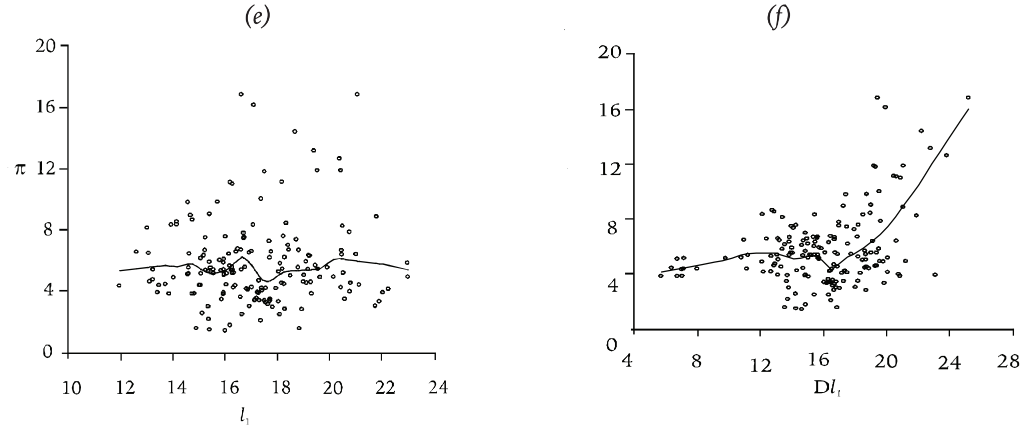
The plots of annual headline inflation (π) against alternative measures of annual growth rates of money (m) are produced in Figure 1(a) through Figure 1(f) along with a curve reflecting the plots of fit of the nearest neighbourhood regression. The nearest neighbourhood fit regression of inflation on growth rates of money is obtained using the

LOESS method described by Cleveland (1993). The plots look like clusters and the regression fit appears to be a flat line in the case of growth rates of simple sum aggregates; suggesting that there is no clear evidence of any relationship between headline inflation and growth rates of simple sum monetary aggregates. On the contrary, there is a clear evidence of a positive association between growth rates of Divisia monetary aggregates and headline inflation. The striking feature of the evidence is that regression fit sharply increases when Divisia money growth exceeds 16 per cent; indicating that the growth rate of Divisia aggregates beyond certain level is more inflationary.

Figure 1

Plots of Inflation (π) against Money Growth (m)

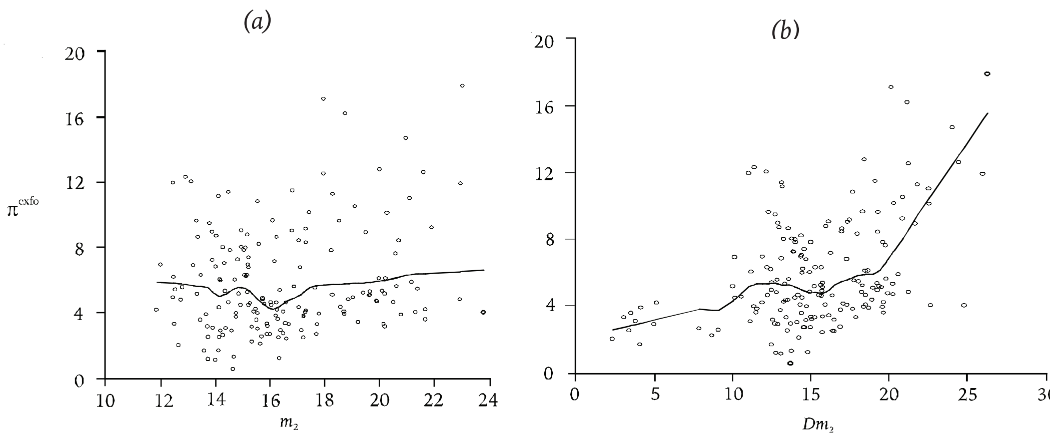




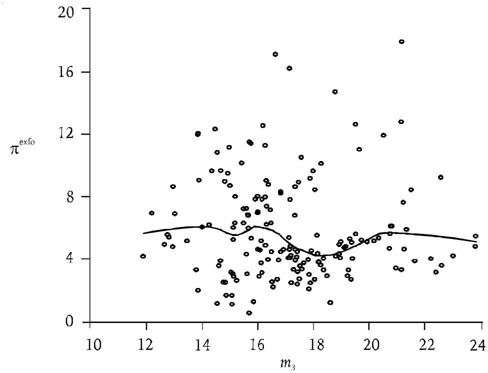
The plots in Figure 2(a) through Figure 2(f) exhibit the association between core inflation measured as headline inflation excluding food items (π^{exfo}) and money growth (m) and plots in Figure 3(a) through Figure 3(f) exhibit the relationship between money growth (m) and core inflation measured as headline inflation excluding food and fuel items (π^{exfofu}). The plots and the regression fit do not show any association between the core inflation and sum money growth while the regression fit regarding Divisia money growth is found to be sharply rising when annual money growth exceeds 16 per cent. In sum, the evidence drawn from correlation statistics and the nearest neighbourhood regression indicate that growth rate of Divisia monetary indices have stronger association with headline and conventional measures of core inflation as compared to their simple sum counterparts; thus, supporting the theoretical superiority of Divisia monetary measures over their simple sum counterparts.

Figure 2

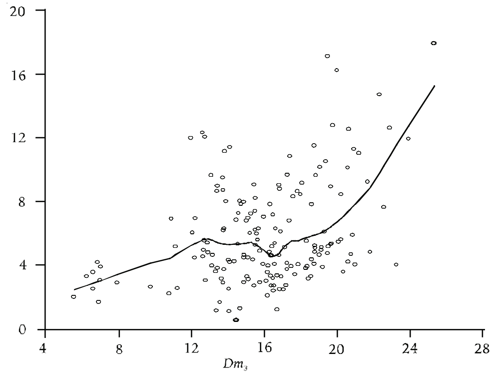
Plots of Inflation Excluding Food (π^{exfo}) against Money Growth (m)



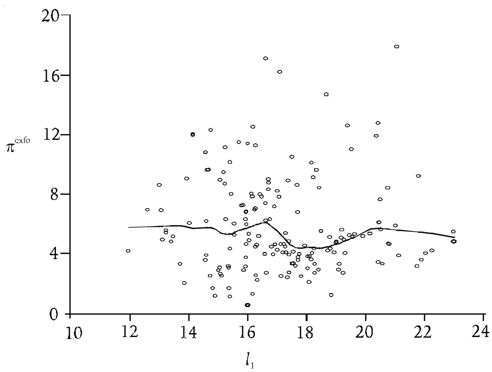
(c)



(d)



(e)



(f)

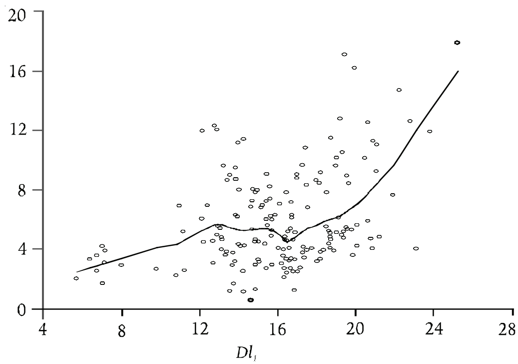
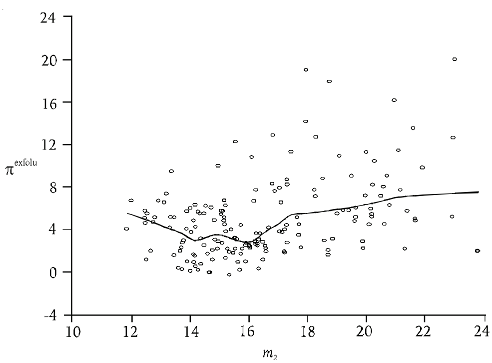


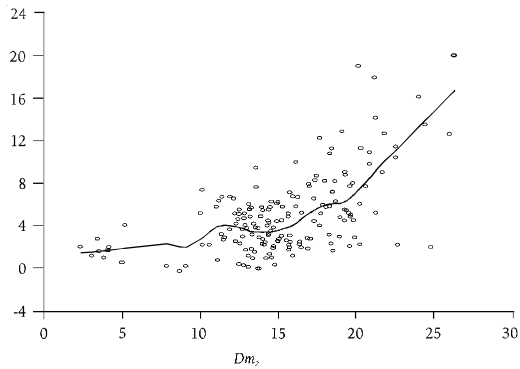
Figure 3

Plots of Inflation Excluding Food and Fuel (π^{exfofu}) against Money Growth (m)

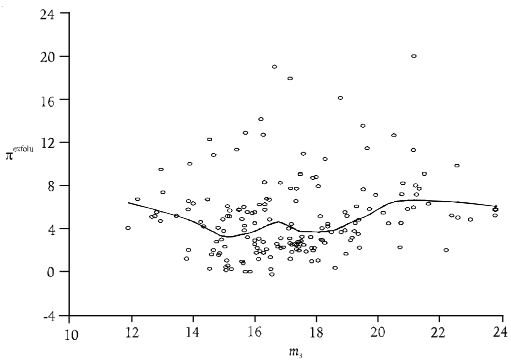
(a)



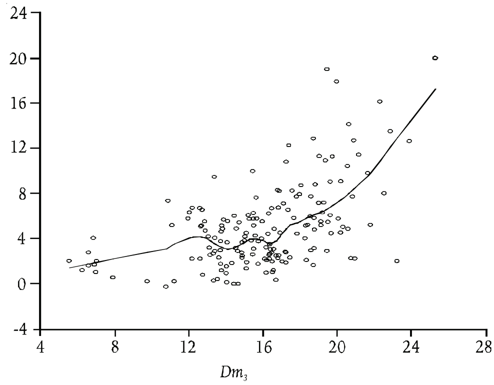
(b)



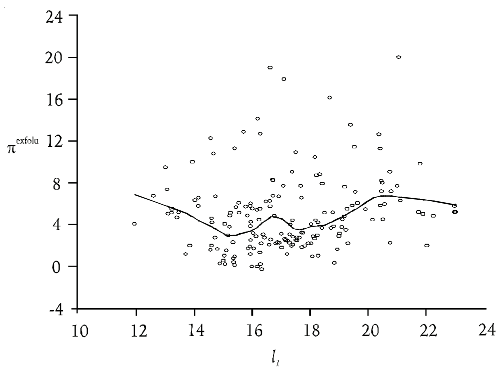
(c)



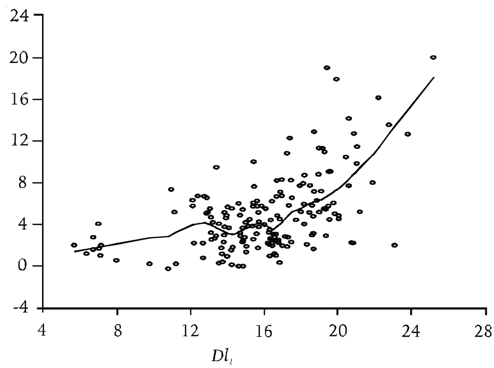
(d)



(e)



(f)



VI. Does Growth Rate of Divisia Money Predict Inflation?

In this section, we examine whether growth rates of Divisia money has an edge over their simple sum counterparts in predicting inflation. The empirical evaluation of this issue is based on the maximum likelihood approach to test for cointegration invented by Johansen (1991) and the estimation of corresponding error correction mechanism. However, we adopt the strategy of Ribba (2003) to test for cointegration and impose restrictions on the speed of adjustment parameters to infer whether growth rate of money can be an useful predictor of inflation. In this respect, we estimate the following error correction model:

$$\Delta\pi_t = b_{11}(L)\Delta\pi_{t-1} + b_{12}(L)\Delta m_{t-1} + \alpha_{11}(\pi_{t-1} - \beta m_{t-1}) + \varepsilon_{\pi t}$$

$$\Delta m_t = b_{21}(L)\Delta\pi_{t-1} + b_{22}(L)\Delta m_{t-1} + \alpha_{21}(\pi_{t-1} - \beta m_{t-1}) + \varepsilon_{\pi t} \qquad (2)$$

Where L is lag operator; $\Delta = (1-L); \beta$ is cointegrating coefficient; $\varepsilon_t = (\varepsilon_{pt}, \varepsilon_{mt})$ such that $E(\varepsilon_t) = 0$ and $E(\varepsilon_t \varepsilon_t') = \sum_\varepsilon$. The equation (2) with restriction $\alpha_{21} = 0$, implies that π_t

adjusts to long-run equilibrium whereas m_t does not. Hence, shocks in money growth can influence the long-run forecast of inflation and not vice-versa. In other words, there is one-way causality from money growth-to-headline inflation at zero frequency. If so,

$$\lim_{h\to\infty} \frac{\partial E(\pi_{t+h})}{\partial \varepsilon_{mt}} \neq 0 \text{ and } \lim_{h\to\infty} \frac{\partial E(\pi_{t+h})}{\partial \varepsilon_{mt}} = 0$$

The above conditions imply that the conditional forecast of inflation $(\pi_t)\,h$ period ahead depends only on growth rate of money (m_t). Thus, there are two steps involved in testing the predictive accuracy of growth rates of money: (i) testing for cointegration between money growth and inflation; and (ii) testing the validity of restriction imposed on the error correction representation defined in equation (2). The Maximum likelihood approach to test for cointegration proposed by Johansen necessitates that the variables be integrated of the same order. Hence, the first step in conducting cointegration test is to pretest each variable to determine its order of integration. In this respect, we choose to use the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests to test the integration properties of the variables.

The test statistics for testing the null hypothesis that the monthly data on annual growth rate of seasonally adjusted monetary aggregates measured as $m_t = (M_t - M_{t-12})/M_{t-12}) \times 100$; headline inflation and measures of core inflation rates based on seasonally adjusted wholesale price index (P) measured as $\pi_t = (P_t - P_{t-12})/P_{t-12}) \times 100$ have a unit root are presented in Table 2. The results indicate that the null is rejected at 1 per cent significance level for all the variables under consideration in first differences while it is accepted in levels. This confirms that the variables in levels are non-stationary while they are stationary in first differences; suggesting that they are integrated series of first order.

Table 2

Unit Root Tests

Variables	*ADF*		*PP*	
	Levels	*First Difference*	*Levels*	*First Difference*
π	-2.419 (0.14)	-9.187 (0.00)	-2.284 (0.18)	-9.153 (0.00)
π^{exfo}	-2.175 (0.22)	-9.532 (0.00)	-2.252 (0.19)	-9.532 (0.00)
π^{exfofu}	-1.764 (0.40)	-11.596 (0.00)	-2.039 (0.27)	-11.748 (0.00)
m_2	-2.471 (0.12)	-17.058 (0.00)	-0.118 (0.64)	-17.768 (0.00)
Dm_2	-0.708 (0.41)	-14.717 (0.00)	-0.708 (0.41)	-14.794 (0.00)
m_3	-0.085 (0.71)	-18.155 (0.00)	-0.106 (0.71)	-19.012 (0.00)
Dm_3	-2.412 (0.14)	-5.523 (0.00)	-2.507 (0.12)	-15.933 (0.00)
l_1	-2.333 (0.16)	-17.899 (0.00)	-0.110 (0.72)	-18.708 (0.00)
Dl_1	-2.493 (0.12)	-5.516 (0.00)	-2.558 (0.11)	-15.883 (0.00)

Note: Figures in parentheses are p-values.

The test statistics (λ_{TRACE} and λ_{MAX}) for testing null hypothesis that number of cointegrating vector r = 0 against the alternative hypothesis that r ≤ 1 rare presented in Table 3(a) through 3(c). The statistics presented in Table 3(a) indicate that there is one cointegrating relationship between alternative measures of money growth and headline inflation at 5 per cent significance level. The results in Tables 3(b) and 3(c) also reveal that there is one cointegrating relationship between growth rates of money and conventional measures of core inflation.

Table 3(a)

Cointegration Between Money Growth and Inflation

Variables	Hypothesis	Eigenvalue	λ_{TRACE}	λ_{MAX}
π, m_2	r = 0	0.096	16.804*	16.788*
	r ≤ 1	0.00009	0.016	0.016
π, Dm_2	r = 0	0.072	12.933*	12.396*
	r ≤ 1	0.003	0.537	0.537
π, m_3	r = 0	0.0879	15.316*	15.271*
	r ≤ 1	0.0003	0.045	0.045
π, Dm_3	r = 0	0.732	12.730*	12.616*
	r ≤ 1	0.0007	0.114	0.114
π, l_1	r = 0	0.0899	15.573*	15.548*
	r ≤ 1	0.0001	0.0242	0.024
π, Dl_1	r = 0	0.0728	12.679*	12.543*
	r ≤ 1	0.0008	0.1363	0.136

Note: * indicate significance level at 5 per cent. The critical values of trace and maximum eigenvalue tests for 5 per cent level are 12.320 and 11.225, respectively.

Table 3(b)

Cointegration Between Money Growth and Core Inflation (π^{exfo})

Variables	Hypothesis	Eigenvalue	λ_{TRACE}	λ_{MAX}
π^{exfo}, m_2	r = 0	0.094	16.874*	16.653*
	r ≤ 1	0.001	0.221	0.221
π^{exfo}, Dm_2	r = 0	0.080	15.037*	14.075*
	r ≤ 1	0.006	0.963	0.963
π^{exfo}, m_3	r = 0	0.086	15.215*	15.190*
	r ≤ 1	0.0001	0.025	0.025
π^{exfo}, Dm_3	r = 0	0.084	15.289*	14.829*
	r ≤ 1	0.003	0.459	0.459
π^{exfo}, l_1	r = 0	0.084	14.776*	14.739*
	r ≤ 1	0.0002	0.037	0.037
π^{exfo}, Dl_1	r = 0	0.083	14.970*	14.486*
	r ≤ 1	0.003	0.484	0.484

Note: * indicate significance level at 5 per cent. The critical values of trace and maximum eigenvalue tests for 5 per cent level are 12.320 and 11.225, respectively.

Table 3(c)

Cointegration Between Money Growth and Core Inflation (π^{exfofu})

Variables	Hypothesis	Eigenvalue	λ_{TRACE}	λ_{MAX}
π^{exfofu}, m_2	r = 0	0.076	13.526*	13.338*
	r ≤ 1	0.001	0.188	0.188
π^{exfofu}, Dm_2	r = 0	0.078	14.721*	13.684*
	r ≤ 1	0.006	1.037	1.037
π^{exfofu}, m_3	r = 0	0.070	12.167	12.156*
	r ≤ 1	6.42E-05	0.011	0.011
π^{exfofu}, Dm_3	r = 0	0.073	13.186*	12.736*
	r ≤ 1	0.003	0.451	0.451
π^{exfofu}, l_1	r = 0	0.069	11.963	11.942*
	r ≤ 1	0.0001	0.021	0.021
π^{exfofu}, Dl_1	r = 0	0.072	12.963*	12.487*
	r ≤ 1	0.003	0.476	0.476

Note: * indicate significance level at 5 per cent. The critical values of trace and maximum eigenvalue tests for 5 per cent level are 12.320 and 11.225, respectively.

To examine whether growth rate of money is a useful predictor of inflation, we test the null hypothesis $\alpha_{21} = 0$ and $\alpha_{11} = 0$. Accepting the former and rejecting the later imply that inflation responds while growth rate of money does not respond to disequilibrium errors in the last period. In this regard, the estimates of cointegrating parameters and the speed of adjustment or the loading coefficients concerning headline inflation are presented in Table 4(a). The speed of adjustment parameter in inflation equation (α_{11}) is found to be statistically significant at 1 per cent level in all the equations. In the case of simple sum M2 growth rate, however, the coefficient on lagged error correction term is (α_{21}) found to be significant at 10 per cent level; suggesting that growth rate of M2 money does respond to disequilibrium shocks. In other words, the growth rate of M2 money is not exogeneous to inflation; hence, it may not serve as a predictor of inflation. However, the coefficient on lagged error term is found to be statistically insignificant in Divisia M2 growth equation. This confirms that the Divisia M2 growth rate can serve as a useful predictor of inflation. The evidence becomes symmetrically stronger at higher level of aggregations; suggesting that the growth rates of Divisia money can serve as potential indicator of inflation while their sum counterparts do not seem to be.

Further, we conduct the formal test of whether the speed of adjustment parameter in money supply equation is equal to zero using the χ^2 test (De Brouwer and Ericsson, 1998). The value of χ^2 for the restriction is presented in the last column of the Table 4(a). In the case of M2 growth rates and its Divisia counterpart, the restriction is not binding at conventional level of significance. In contrast, the Divisia M3 and Divisia L1 growth rates do not respond to the discrepancy of long-run equilibrium relationship since the restriction is not binding while the restriction is binding in the case of simple sum M3 and L1 growth rates. These evidences indicate that the growth rates of Divisia aggregates at higher level of aggregation seem to be weakly exogeneous to inflation while the growth rates of simple sum monetary aggregates have feedback relationship with inflation. This suggests that Divisia money growth especially at higher level of aggregation can serve as potential predictor of inflation.

The cointegrating parameters and the corresponding loading coefficients for core inflation measures are presented in Tables 4(b) and 4(c). These evidences are qualitatively similar to the results produced in Table 4(a); suggesting that the growth rate of Divisia aggregates can serve as potential indicators of the two conventional measures of core inflation under consideration while their simple sum counterparts cannot be used as an indicator of inflation.

Table 4(a)

Results of Cointegration Space

Variables	*Normalised Cointegrating Vector*		$H_0{:}\alpha_{21}=0$ χ^2 *Statistics*
π, m_2	1.00	-0.343 (0.036)*	2.516
Loading coefficients (α_s)	-0.095 (0.003)*	0.064 (0.042) ***	[0.11]
π, Dm_2	1.00	-0.360 (0.042)*	0.0009
Loading coefficients (α_s)	-0.092 (0.026) *	*0.005 (0.058)	[0.98]
π, m_3	1.00	-0.332 (0.039)*	3.387
Loading coefficients (α_s)	-0.082 (0.024) *	-0.061 (0.034) **	[0.06]
π, Dm_3	1.00	-0.347 (0.042)*	0.349
Loading coefficients (α_s)	-0.091 (0.026) *	*0.029 (0.048)	[0.55]
π, l_1	1.00	-0.347 (0.042)*	3.128
Loading coefficients (α_s)	-0.082 (0.024) *	0.060 (0.033)**	[0.07]
π, Dl_1	1.00	-0.347 (0.042)*	0.331
Loading coefficients (α_s)	-0.091 (0.026) *	0.028 (0.047)	[0.57]

Note: Figures in (#) [#] are standard errors and p-values respectively; *, **, and *** indicate significance level at 1 per cent, 5 per cent and 10 per cent, respectively.

Table 4(b)

Results of Cointegration Space

Variables	Normalised Cointegrating Vector		H_0:α_{21}=0 χ^2 Statistics
π^{exfo}, m_2	1.00	-0.374 (0.044)*	3.194
Loading coefficients (α_s)	-0.088 (0.024)*	-0.059 (0.033)***	[0.07]
π^{exfo}, Dm_2	1.00	-0.394 (0.046)*	0.91
Loading coefficients (α_s)	-0.099 (0.027)*	-0.049 (0.050)	[0.34]
π^{exfo}, m_3	1.00	-0.366 (0.048)*	3.881
Loading coefficients (α_s)	-0.077 (0.023)*	-0.055 (0.028)**	[0.05]
π^{exfo}, Dm_3	1.00	-0.381 (0.045)*	2.143
Loading coefficients (α_s)	-0.095 (0.026)*	-0.059 (0.040)	[0.14]
π^{exfo}, l_1	1.00	-0.363 (0.048)*	3.762
Loading coefficients (α_s)	-0.077 (0.023)*	-0.053 (0.028)**	[0.05]
π^{exfo}, Dl_1	1.00	-0.380 (0.045)*	2.109
Loading coefficients (α_s)	-0.095 (0.026)*	-0.058 (0.040)	[0.14]

Note: Figures in (#) [#] are standard errors and p-values respectively; *, **, and *** indicate significance level at 1 per cent, 5 per cent and 10 per cent, respectively.

Table 4(c)

Results of Cointegration Space

Variables	Normalised Cointegrating Vector		H_0:α_{21}=0 χ^2 Statistics
π^{exfofu}, m_2	1.00	-0.323 (0.054)*	3.470
Loading coefficients (α_s)	-0.074 (0.024) *	-0.057 (0.031)***	[0.06]
π^{exfofu}, Dm_2	1.00	-0.340 (0.050)*	2.160
Loading coefficients (α_s)	-0.092 (0.027) *	-0.070 (0.047)	[0.14]
π^{exfofu}, m_3	1.00	-0.318 (0.059)*	3.710
Loading coefficients (α_s)	-0.062 (0.022) *	-0.049 (0.026) **	[0.05]
π^{exfofu}, Dm_3	1.00	-0.329 (0.053)*	3.089
Loading coefficients (α_s)	-0.082 (0.025) *	-0.066 (0.037)	[0.08]
π^{exfofu}, l_1	1.00	-0.315 (0.059)*	3.732
Loading coefficients (α_s)	-0.065(0.022) *	-0.048(0.025)****	[0.05]
π^{exfofu}, Dl_1	1.00	-0.337 (0.053)*	3.100
Loading coefficients (α_s)	-0.080 (0.025) *	-0.065 (0.037)	[0.08]

Note: Figures in (#) [#] are standard errors and p-values respectively; *, **, and *** indicate significance level at 1 per cent, 5 per cent and 10 per cent, respectively.

The plots of impulse response coefficients of headline inflation for a one standard deviation shock in the growth rates of sum m_2 and of Divisia m_2 are produced in Figure 4(a). The solid line indicates the response of inflation to a shock in growth rate of Divisia m_2 while the dotted line indicates the response of inflation to a shock in the growth rate of sum m_2. Although there is hardly any difference in the response of inflation to shocks in the growth rates of both monetary measures in the initial period of eight months, the response of inflation to the shock in the growth rate of Divisia m_2 subsequently rises while it declines in response to the shock in growth rate of sum m_2 money. The plots of impulse coefficients produced in Figures 4(b) and 4(c) also indicate that response of inflation to shocks in the growth rates of Divisia m_3 and Divisia l_1 is relatively stronger as compared to the response of inflation to shocks in the growth rates of corresponding sum aggregates.

Figure 4(a)

The Response of π to a One Standard Deviation Shock in m_2 and Dm_2

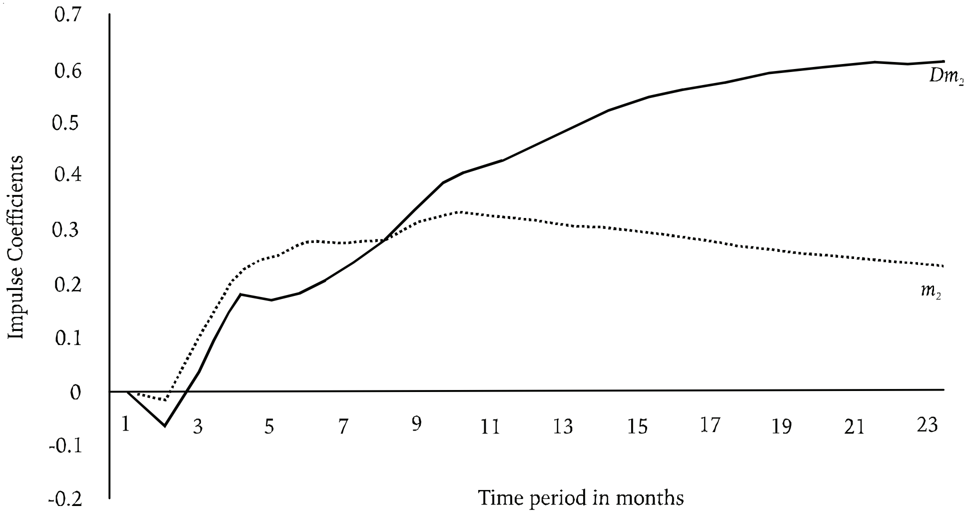


Figure 4(b)

The Response of π to a One Standard Deviation Shock in m_3 and Dm_3

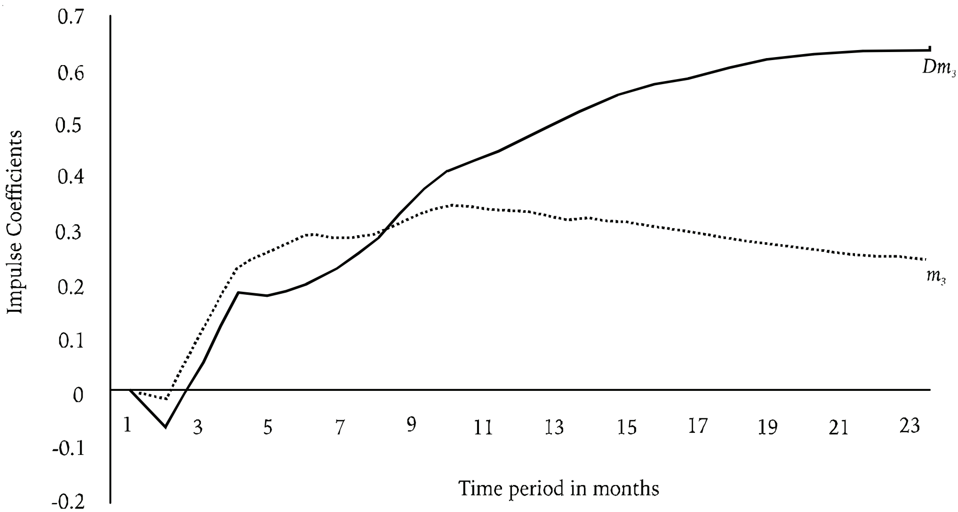
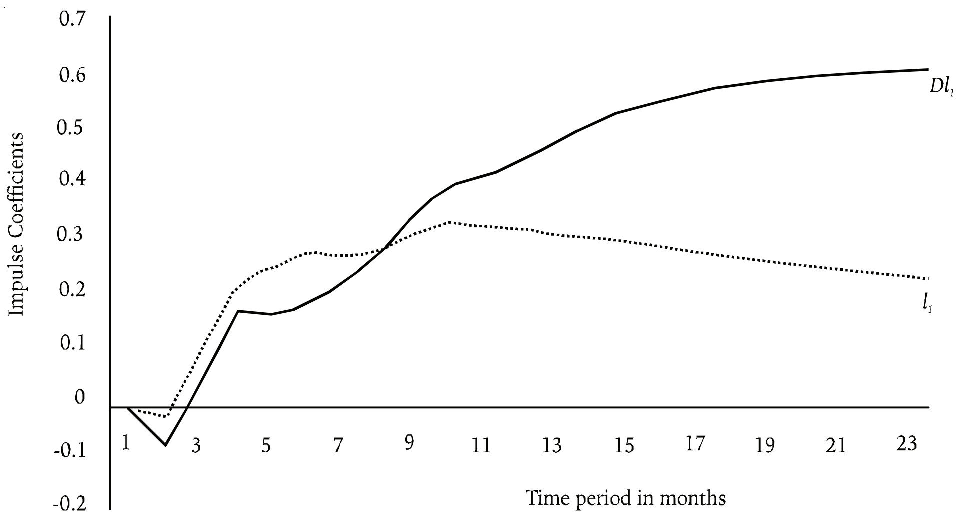


Figure 4(c)

The Response of π to a One Standard Deviation Shock in l_1 and Dl_1



The results concerning the proportion of forecast error variance of headline inflation and growth rate of sum and Divisia m_2 money for the forecast horizon of upto 48 months are presented in Table 5(a). The forecast error variance of inflation is increasingly explained by shocks in growth rate of m_2 money and at the same time forecast error variance of sum m_2 growth is also increasingly explained by shocks in headline inflation as the forecast horizon increases. For instance, 15.12 per cent of forecast variance of inflation is explained by shocks in growth rate of sum m_2 money in 12 months forecast horizon and further increases to 36.99 per cent in 48 months forecast horizon. The error variance of sum m_2 growth explained by shocks in inflation increases from 21.29 per cent in 12 months forecast horizon to 31.01 per cent in 48 months forecast horizon. These evidences indicate that the growth rate of sum m_2 is not an exogenous sequence to headline inflation. On the contrary, the proportion of error variance of inflation due to shocks in the growth rate of Divisia m_2 (Dm_2) jumps from 15.10 per cent in 12 months forecast horizon to 53.84 per cent in 24 months forecast horizon and to 77.09 per cent in 48 months forecast horizon. In contrast to the evidence concerning growth rate of sum m_2, 99.15 per cent of forecast error variance of Dm_2 growth is explained by its own shock even at 48 months forecast horizon. This indicates that the growth rate of Dm_2 is an exogeneous sequence in the model.

The corresponding results concerning Divisia m_3 (Dm_3) and Divisia l_1 (Dl_1) presented in Tables 5(b) and 5(c) respectively further confirm that the growth rates of Divisia monetary aggregates outperform their simple sum counterparts. Thus, the evidence from forecast error variance also indicate that the growth rate of Divisia monetary aggregates can serve as better indicators of inflation as compared to the growth rates of simple sum aggregates.[10]

Table 5(a)

Decomposition of Forecast Error Variance

Forecast Horizon (Months)	Variance Decomposition of	Due to Shocks in		Forecast Horizon (Months)	Variance Decomposition of	Due to Shocks in	
		π	m_2			π	Dm_2
1	π	100	0.00	1	π	100	0.00
	m_2	0.49	99.51		Dm_2	0.20	99.80
12	π	84.88	15.12	12	π	84.90	15.10
	m_2	21.29	78.71		Dm_2	1.12	98.88
24	π	71.62	27.38	24	π	46.16	53.84
	m_2	29.28	70.72		Dm_2	0.98	99.02
36	π	67.56	32.44	36	π	30.36	69.64
	m_2	30.48	69.52		Dm_2	0.89	99.11
48	π	63.01	36.99	48	π	22.90	77.09
	m_2	31.01	68.99		Dm_2	0.85	99.15

10. The results regarding impulse response and variance decomposition pertaining to conventional measures of core inflation under consideration are consistent with the evidence concerning headline inflation. The results are available from the authors on request.

Table 5(b)

Decomposition of Forecast Error Variance

Forecast Horizon (Months)	Variance Decomposition of	Due to Shocks in		Forecast Horizon (Months)	Variance Decomposition of	Due to Shocks in	
		π	m_3			π	Dm_3
1	π	100	0.00	1	π	100	0.00
	m_3	0.20	99.80		Dm_3	0.14	99.86
12	π	88.03	11.97	12	π	87.14	12.86
	m_3	21.14	78.86		Dm_3	0.60	99.40
24	π	77.75	22.25	24	π	55.79	44.21
	m_3	27.72	72.28		Dm_3	2.04	97.96
36	π	72.92	27.08	36	π	40.68	59.32
	m_3	28.38	71.62		Dm_3	2.73	97.27
48	π	68.56	31.44	48	π	32.44	67.56
	m_3	28.68	71.32		Dm_3	3.00	97.00

Table 5(c)

Decomposition of Forecast Error Variance

Forecast Horizon (Months)	Variance Decomposition of	Due to Shocks in		Forecast Horizon (Months)	Variance Decomposition of	Due to Shocks in	
		π	l_1			π	Dl_1
1	π	100	0.00	1	π	100	0.00
	l_1	0.19	99.81		Dl_1	0.14	99.86
12	π	88.08	11.92	12	π	87.61	12.39
	l_1	21.23	78.77		Dl_1	0.64	99.36
24	π	78.61	21.39	24	π	57.12	42.88
	l_1	28.46	71.54		Dl_1	2.32	97.68
36	π	74.26	25.74	36	π	42.10	57.90
	l_1	29.39	70.61		Dl_1	3.15	96.85
48	π	70.24	29.76	48	π	33.80	66.20
	l_1	29.81	70.19		Dl_1	3.47	96.53

VII. Concluding Remarks

The focus of this study is to investigate whether weighted monetary aggregates constructed from Divisia quantity index number formula has an edge over their simple sum aggregates. Two official measures of monetary aggregates, m_2 and m_3, and one liquidity measure, l_1, are considered for empirical comparison of their superiority especially in the context of their role as an indicator of inflation. In this respect, the study constructs monthly Divisia quantity indices for the sample period from April 1993 to June 2008, covering fairly the liberalised financial regime. The empirical evidences are found to support the theoretical superiority of Divisia monetary aggregates over their corresponding simple sum aggregates.

The correlation coefficients indicated that there is relatively strong association between annual headline inflation rate measured as point-to-point percentage change in wholesale price index and Divisia monetary measures. Also, the potential gain of Divisia monetary measures is found to be more visible when they are correlated with two conventional measures of core inflation. On the contrary, the correlation between inflation and growth rates of simple sum aggregates seems to be weak.

The plots of annual headline inflation against alternative measures of annual growth rates of money indicated that there is no clear evidence of any relationship between both headline or core inflation measures and growth rates of simple sum monetary aggregates. This stylised observation is further supported by the fit of the nearest neighbourhood regression of inflation on growth rates of money in the sense that the fit appears to be a flat line. On the contrary, there is a clear evidence of a positive association between growth rates of Divisia monetary aggregates and inflation. The striking feature of the evidence is that regression fit sharply rises when Divisia monetary growth exceeds 16 per cent. This indicates that the growth rate of Divisia money beyond certain level is more inflationary.

The econometric evidence derived from a vector error correction model indicated that the growth rates of Divisia aggregates serve as better predictor of both headline and core inflation measures whereas there is a feedback causal relationship from inflation to growth rates of simple sum monetary aggregates. Hence, the official measures of simple sum aggregates seem to be less useful in predicting inflation.

These inferences are further corroborated by the results derived from impulse response function and decomposition of forecast error variance of inflation and growth rates of monetary aggregates. Although there is only little difference in the response of inflation to shocks in growth rates of sum and Divisia monetary aggregates in the initial period of eight months, the response of inflation to the shocks in the growth rates of Divisia aggregates subsequently rises while it declines in response to the shocks in growth rates of corresponding simple sum aggregates. The results concerning the forecast error variance indicated that the growth rates of Divisia monetary aggregates emerge as an exogeneous sequence with respect to inflation and on the contrary, error variance of growth rates of sum aggregates is increasingly explained by the shocks in inflation. These evidence suggest that the growth rates of sum aggregates cannot serve as an indicator of inflation while that of Divisia monetary measures can be used as an indicator of inflation.

The overall empirical evidences of this study unambiguously establish the superiority of Divisia monetary aggregates over their corresponding simple sum aggregates in predicting either headline inflation or the conventional measures of core inflation which are widely used by the Central banks all over the world. Hence, the study suggests that the

RBI can observe the growth rates of Divisia monetary aggregates to have a better understanding of future inflation within its multiple indicator approach. This, however, does not mean that the RBI can dispense the use of M3 money. It can better be used for accounting purposes than as indicator of future inflationary pressure. Also, the RBI can publish monthly time series data on various measures of Divisia money, as it would provide more reliable information regarding inflation expectation to the public; hence, the policy gains more credibility.[11] The availability of time series data on Divisia monetary measures would help for further exploration of its merits in applications. The most important among them are: (i) examining the use of Divisia money as predictor of output growth, especially the growth rate of manufacturing output; (ii) evaluating the stability of demand for Divisia money as compared to its simple sum counterparts; and (iii) investigating the role of Divisia money in macroeconomic models to establish its theoretical superiorities.[12]

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11 Divisia monetary aggregates are available for the United Kingdom by the Bank of England (BoE) and for the United States by the Federal Reserve Bank of St. Louis besides regular computation of the same by the National Bank of Poland. In addition, Divisia monetary measure is used by the executives of Bank of Japan (BoJ) for an assessment of the economy.

12 We have not attempted these issues in the present study since our focus is to examine the relative role of Divisia monetary aggregates as predictor of inflation.

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APPENDIX A

Measures of Monetary Aggregates Used in the Study

Monetary Aggregates	Monetary Components (x)
m_2	Currency with the public + demand deposits with banks + other deposits with the RBI + time liability proportion of the savings deposits with banks + term deposits with the contractual maturity of up to and including one year with banks + certificate of deposits issued by banks
m_3	m_2 + term deposits with the contractual maturity of over one year with banks + call borrowings from non-depository financial corporations by banks
l_1	m_3 + all deposits with the Post Office Savings Banks (excluding National Savings Certificates)

Monetary Components and Corresponding Interest Rate Proxies

Monetary components (x)	Interest rates (r)
Currency with the public	Zero
Demand deposits with banks	Zero
Other deposits with the RBI	Zero
Term deposits with the contractual maturity of upto and including one year with banks	Interest rate on one year term deposits
Term deposits with the contractual maturity of over one year	Interest rate on 5-year term deposits
Certificate of deposits issued by banks	Interest rate on certificate of deposits issued by banks
Call borrowings from non-depository financial corporations by banks	Average call money rate
All deposits with the Post Office Savings Banks (excluding National Savings Certificates)	Interest rate on postal time deposits