SUMMARY AND CONCLUSION

5.1. Introduction

Monetary aggregates are widely used by the central banks all over the world either as an intermediate target or as an indicator. Irrespective of the end use to which it is put by the monetary authority, the construct of monetary aggregates must be consistent with aggregation theoretic framework. However, less attention is paid by the central banks in the construction of monetary aggregates and at large monetary aggregates are measured by simply summing various monetary components which differ in terms of their ‘moneyness’. In fact, simple summation of various assets with different characteristics implicitly assumes a linear aggregator function. The linearity condition will be satisfied only if the assets included in an aggregate are prefect substitutes to each other. As monetary aggregates consist of assets that yield varying degrees of interest rate the assumption of perfect substitution may not hold.

Imperfect substitution among the component of monetary aggregates implies the requirement of nonlinear aggregator functions. In this respect aggregates with aggregation theoretic foundations such as Divisia quantity aggregates proposed by Barnett (1980) and the currency equivalent aggregates by Rotemberg, Driscoll, and Poterba (1995) can be considered as appropriate candidates for money. Both these
aggregates track the monetary aggregator function implied by economic theory accurately. More specifically, the Törnqvist discrete time approximation of Divisa aggregate can track the monetary aggregator function only by an error of third order reminder term. Similarly, currency equivalent aggregates are considered as an aggregation theoretic stock of money due to Barnett 1991. Application of these aggregates in empirical studies has established its superiority over simple sum aggregates. Recent changes in the financial environment particularly in developing countries make application of such measures relevant than ever.

In this context, this study attempted to construct and examine properties of currency equivalent monetary aggregate developed by Rotemberg, Driscoll, and Poterba (1995) in the Indian context. The study is particularly relevant in the Indian context as the economy have undergone a structural change during last two decades. Integration of Indian financial markets with global economy, introduction of new market oriented financial instruments like certificate of deposits, deregulation of interest rate regime and changes in the payment mechanism due to the introduction of credit cards, automatic teller machines and internet and mobile banking make constructs of monetary aggregates with aggregation theoretic foundations appropriate in policy matters. There are only a few studies in the Indian context that explored the properties of currency equivalent monetary aggregate. However, no study has explored its relevance in current monetary policy settings since the introduction of ‘multiple indicator approach’. In this context, the thesis focuses on the methodological and empirical issues involved in the measurement of monetary aggregates in the Indian context.

5.2. Summary and Evaluation

Specific objectives of the thesis are to construct currency equivalent monetary aggregates for India, document its properties in terms of some stylised facts, and examine its role as leading indicator of inflation and to assess its role in explaining inflation dynamics in a P-star framework. The background of these issues with a brief introduction to the literature on monetary aggregation is discussed in chapter one.
Chapter 2 reviews the theoretical foundations of the currency equivalent monetary aggregates and documents some stylised facts on the performance of currency equivalent monetary aggregates in applications of policy interest. As mentioned above currency equivalent aggregate approximates the monetary aggregator function implied by economic aggregation theory and it can be derived from the expected intertemporal utility function of a representative individual. Further, Barnett (1991) interpreted the currency equivalent monetary aggregates as economic stock of money, which is defined as the present value of the monetary service flows by current and future holdings of monetary assets, under certain assumptions.

Barnett’s economic stock money was later modified by Kelly (2009, 2011) by isolating the discounted stock of monetary expenditure incurred only by the current portfolio of monetary assets defined as current stock of money. In fact the current stock of money can be treated as equivalent to aggregation theoretic measure of narrowly defined money as it isolates the portion in each asset that functions as currency. In this context, Kelly (2011) proved that currency equivalent aggregates are unbiased estimates of current stock of money. Currency equivalent aggregates as aggregation theoretic measures of money stock are far more superior to simple sum aggregates as documented by Barnett, Chae, and Keating (2006) and Kelly, Barnett, and Keating 2011.

In this chapter we have constructed the monthly and quarterly simple sum and currency equivalent monetary aggregate at four nested levels of aggregation using various components as recommended by third working group on money supply (RBI, 1998). Accordingly, three monetary aggregates namely, M1, M2, and M3 and one liquidity aggregate L1 are constructed using the data on quantities of monetary assets \( m_n \) and appropriate rate of returns \( r_n \) for the period from April 1993 to June 2009. The data on quantities of monetary assets and interest rates are collected from various issues of Handbook of Statistics on Indian Economy, other publications of the Reserve Bank of India and State Bank of India. The benchmark rate of interest \( R_b \) required for the construction of currency equivalent monetary aggregate is chosen as the maximum rate among a set of market rates such as prime lending rate of State
Bank of India, yield on long-term government securities ($r_{gr}$) and the rates of return on components of the broadest aggregate (i.e. $L1$).

The properties of currency equivalent and simple sum aggregates so constructed were examined using some conventional statistical methods such as scatter plots, correlation analysis, information content tests etc. Besides, the contemporaneous, lagged and leading cyclical co-movements of money and real output are examined via cross correlation coefficients between cyclical component of money and cyclical component of real output (proxied by IIP at monthly frequencies and GDP at Quarterly frequencies). Similarly the trend and behaviour of income velocity of money was documented using time series plots and relevant descriptive statistics.

Chapter 3 focuses on the relevance of monetary aggregates as leading indicators of inflation and evaluate the performance of currency equivalent monetary aggregates vs simple sum monetary aggregates. The role of monetary aggregate as indicators, targets and instruments is one of the most debated issues in economic literature. In fact, many central banks used monetary aggregates as intermediate targets of monetary policy during 70s and early 80s. The conduct of monetary policy during this period was influenced by monetarist model which accorded direct role for money in transmission of policy impulses.

The monetary aggregates have eventually lost their significance as the systematic association between money and economic activity weakened and money demand function became unstable over the period of time. Consequently, central banks de-emphasized monetary aggregates and adopted interest rate instruments in the conduct of monetary policy. Thus theoretical models where money plays no direct role in monetary transmission mechanism become prominent in monetary policy analysis.

However, monetary policy without reference to monetary aggregates has been subject to criticism (see for e.g Nelson (2003), and Leeper and Roush (2003)). In this context, ‘Barnett critique’ becomes relevant which attributes the instability in econometric models due to the use of aggregates which are theoretically inconsistent. Besides, integration of financial markets across countries and continuing financial
innovation with technological advancements since 1990 instilled considerable uncertainty in the financial system. The uncertainties in the system in turn necessitated central banks to monitor the movements in a host of macroeconomic indicators as a guide for the growth rate of money emerged as one of the indicators to guide the conduct of monetary policy.

In this background, this chapter focuses on the relevance of currency equivalent monetary aggregates as indicator in the conduct of monetary policy in India. Like other central banks Reserve Bank of India also depends on simple sum aggregates which makes no economic sense. Monetary aggregates constructed via theoretically consistent data construction procedures may be useful at present. Hence the present study exclusively focuses on the superiority of currency equivalent aggregates as a predictor of inflation as the Reserve Bank of India has a forward looking approach and inflation continues to be a dominant concern.

The usefulness of growth rate of monetary aggregates as leading indicator of inflation is examined using the methodology of Ribba (2003). The empirical analysis was carried out using monthly data on growth rates of simple sum and currency equivalent monetary aggregates and inflation for a period from April 1993 to June 2009. An econometric methodology is based on the bivariate cointegrated VAR is used to examine the dynamic relationship between inflation and growth rate of money. The unidirectional causality that run from growth rate money to inflation is tested by imposing restrictions on speed of adjustment parameters. By restricting the error correction term in money growth equation the model assumes that only inflation adjusts to the long run equilibrium. Further, impulse response functions and decomposition of forecast error variance are also estimated to evaluate the predictive performance of simple sum vs. currency equivalent monetary aggregates.

Chapter 4 examines the inflation dynamics in India using P-star framework. P- Star model incorporates monetary factors in modeling inflation and is based on quantity theory of money. According to P-Star model deviation from actual price from its equilibrium price level, that is consistent with current stock of money, potential output and equilibrium velocity, drive the inflation. The price gap, the deviation of actual price from its equilibrium level, contain the information of both
real sector captured by output gap as well the monetary dynamics captured by velocity gap. Thus, P-star models take into account the monetary policy impulses that affect the inflation dynamics via real demand as well the liquidity conditions. Whereas the New Keynesian models, which are popular in policy deliberations, emphasize real factors measured by output gap in modeling inflation.

Empirical specification of P-star model often relates inflation or changes of inflation to lagged values of price gap. Reduced form equation can also be specified taking components of price gap i.e output gap and velocity gap. Supporting empirical evidence for P star model has been found in the literature for various countries. In this context, this chapter attempts to examine the dynamics of inflation in a P-star framework using quarterly data from 1997Q1 to 2009 Q2. Further the study uses constructs of simple sum and Currency equivalent monetary aggregates to examine the possible impact of measurement errors in the monetary aggregates.

Empirical estimation of P-star model is conducted following Hallman, Porter and Small (1991). Prior to estimating the model, the time series properties of the inflation rate was tested using Augmented Dicky Fuller and Phillips-Peron unit root tests. Based on the Unit root tests the present study estimated the P-star model where changes in the inflation is related to lagged values of output gap and velocity gap. Series of potential output and equilibrium velocity obtained using H-P filter in order to construct output gap and velocity gap. Similarly, to assess the performance of alternative monetary aggregates the model was estimated using measures of velocity gap constructed using simple sum and CE monetary aggregates. The forecasting ability of models was then examined using both in-sample and out-of-sample forecast. In-sample forecasts allows us to investigate the forecasting performance of the models estimated for the whole available sample period. Out-of-sample forecasting performance was carried out by estimating each model recursively, beginning with the period 1997 Q1 to 2007 Q1, and introducing successively a new quarter at each recursion. In order to evaluate the forecasting performance of models this study used Root Mean Square Error (RMSE) and mean absolute error (MAE) criteria. The major findings and policy implications of the empirical analysis is given in section 5.3
5.3. Major Findings and Policy Implications

The stylised facts documented in chapter 2 in general gives an edge to currency equivalent aggregates over their simple sum counterparts in terms of desired properties. Both aggregates exhibit considerable divergence as a measure of money stock. The divergence between both constructs at various aggregation level increases with level of aggregation. Similarly, after allowing for lags in monetary transmissions, the growth rate of currency equivalent aggregates shows strong association with inflation. The trend and pattern of velocity are more stable with respect to currency equivalent aggregates compared to simple sum aggregates. The cross plots of velocity and interest rate indicate relatively stable functional relation when we use velocity measures from currency equivalent monetary aggregates. The information content test also indicates that currency equivalent aggregates in general contain more information than simple sum aggregates regarding output at quarterly frequency and inflation at monthly and quarterly frequencies. Similarly, cyclical behaviour of currency equivalent and simple sum aggregates exhibits considerable difference, proving that inference with currency equivalent aggregates are in sharp contrast to that with simple sum aggregates.

The econometric evidence from a vector error correction model indicated that the growth rates of currency equivalent monetary aggregates serve as a better predictor of inflation whereas there is a feedback causal relationship from inflation to growth rates of simple sum monetary aggregates. This inference is also consistent with the evidence obtained from impulse response function and decomposition of forecast error variance. The overall evidence is found to be in favor of growth rates of currency equivalent aggregates as a potential predictor of inflation; suggesting that the Reserve Bank of India can have a better understanding of future inflationary trend by observing the movements in the growth rates of currency equivalent aggregates.

Results from P-star models shows that monetary factors do contain information regarding changes in the information as the coefficient with respect to velocity gap is significant and have correct sign. CE aggregates performs as good as simple sum aggregates in predicting the movements in inflation. The in sample and out of sample forecasting performance gives similar results with respect to CE and simple sum aggregates.
5.4. Directions for Future Research

Substantial refinements in the construction of currency equivalent monetary aggregates can be made to improve its potential use in policy analysis. For example, this study used maximum interest rate among a set of interest rate (upper envelope) to proxy the benchmark rate used in the construction of currency equivalent monetary aggregates. The calculation of appropriate benchmark rate remains to be a major issue both empirically and conceptually. The application of currency equivalent monetary aggregates in New Keynesian models need to be explored further. Similarly, the thesis have not explored the role of monetary aggregates in explaining output. Research along this line would be useful. Finally, currency equivalent monetary aggregates are interpreted as stock measure of money. Thus currency equivalent aggregates would be appropriate candidates in models where stock of money enters as a variable.