CHAPTER VII
SUMMARY AND CONCLUSIONS

This chapter presents main points of analysis and conclusions. In the first section empirical findings are given. The second section gives policy implications and limitation of the study.

1. EMPIRICAL FINDINGS

This study attempts to analyze important approaches of the inflation in Nepal. The objectives of the study are to examine the monetarists' and non-monetarists' hypotheses of inflation to explain its trend in Nepal, to identify statistically robust and stable model of inflation in Nepal, and to identify forecasting model of inflation. Three hypotheses are examined in this study: (a) inflation is a monetary phenomenon (Monetarist Hypothesis), (b) inflation is a fiscal deficit induced phenomenon (Keynesian Hypothesis), and (c) inflation is determined by structural factors (Structuralist Hypothesis).

Two types of data frequencies (annual and quarterly) are taken for the examination of the above hypotheses. Annual data are used to test all the three hypotheses whereas; quarterly data are used to examine the monetarist hypothesis only.

Statistically robust and stability of the model are tested using various test statistics such as t, F, DW test and R^2. The response to unsatisfactory test leads to necessary improvement and modification of the equation. Too high R^2 associated with too low DW statistic in the equation lead us to go for unit root test and cointegration tests, and derivation of Error Correction Model (ECM).

Major forecasting methods such as trend method, regression method, smoothing method, Box Jenkins ARIMA(p,d,q) method, Vector Autoregression (VAR) Method are used in this study applying both quarterly and annual data. A criterion of Mean Absolute Percentage Error (MAPE) is chosen to validate the best forecast model of inflation

(A) Hypotheses of Inflation

The findings on the Monetarist, Keynesian, and Structuralist hypotheses are explained below. Monetary aggregates are considered major important independent variables in the monetarist hypothesis. In Keynesian hypothesis, the effect of deficit budget of the government and interest rate on inflation is examined. Structural hypothesis includes import price, agricultural non-agricultural GDP ratio, relative price of food to general price level, and export and export to GDP ratio as explanatory variables.

The testing of hypotheses begins with simple monetarist equation where inflation is determined by mere money supply. In anticipation of improving explanatory power of the model, additional variables are included in monetarist model. In this connection, Keynesian hypothesis and structuralist hypothesis are tested one after another. Lagged effect of various independent variables to inflation is also examined for dynamic analysis. All the estimated coefficients of inflation equation are interpreted as elasticity coefficient. This study follows specific to general methodology to find a robust model of inflation in Nepal.

(i) Monetarist Hypothesis

The relationship between variation of monetary aggregates (M1 and M2) and variation of inflation is tested under monetarist hypothesis. Inflation equation is estimated using annual as well as quarterly data frequencies. Identification of determinants of inflation and its, length of lag, long and short term effect of

monetary aggregates in inflation equation are examined in the analysis. Real GDP variable is included in monetarist model to see the effect of velocity on inflation in Nepal.

Using annual data, narrow monetary aggregate (M1) is better explanatory variable of inflation in Nepal as compared to broad monetary aggregate (M2). The elasticity coefficient of M1 with respect to inflation is 0.60 whereas that of M2 is 0.53. M1 is considered as more liquid asset which is mostly used for transaction purpose. Therefore, the effect of changes in M1 to the changes in inflation is relatively higher than that of M2. The elasticity coefficient of inflation to real GDP variable (Y_t) is found statistically insignificant and contrary to expected sign. It implies that there is no velocity impact of money supply on output, and hence on inflation. If we strictly test the Fisherian assumption that there is direct and proportionate (one-to-one) relationship between money supply and inflation, the assumption is not found valid. This implies that money supply has direct but not proportionate impact on inflation.

The long-term elasticities (total sum of short-run elasticity with sufficient lags) of inflation with respect to both the M1 and M2 almost equal to the corresponding elasticities measured contemporaneously. This implies that inflation in Nepal is a monetary phenomenon in short-run but proportionate relation between money supply and inflation is not valid. This finding is also confirmed by Adaptive Expectation Model as hypothesized by monetarists. The expectation coefficient of 0.08, as generated by the adaptive expectations mechanism, signifies that about 8 percent of the discrepancy between actual and expected inflation is eliminated per year which implies that full adjustment takes a quite long period of time.

The effect of an increase in M1 on inflation is instant and effect of lagged value of $M1_t$ is insignificant.

Using quarterly data, the elasticity coefficients of inflation with respect to $M1_t$ and $M2_t$ are found 0.59 and 0.52 respectively. If we disaggregate the overall inflation series into food and non-food inflation series and estimate the elasticity, both the food and non-food elasticities with respect to M1 are found to be higher than that of M2. The food and non-food elasticities with respect to M1 are found to be 0.60 and 0.58 respectively whereas the elasticities with respect to M2 are 0.53 and 0.50. Therefore, managing of M1 can have a higher desired result in controlling inflation.

The elasticities of the components of food prices like restaurant, vegetable, meat inflation with respect to M1 are found to be comparatively higher than that of the overall food inflation. The elasticities of fuel, education, house rent, housing and furnishing inflation to M1 are found comparatively to higher than that of the overall non-food inflation. It implies that desired impact of policy changes to control inflation in Nepal should be achieved through these components commodities.

An introduction of sufficient lags (in quarters) in regression equation does not increase long-term elasticity of inflation with respect to the $M1_t$ and $M2_t$. This implies that inflation in Nepal is a monetary phenomenon in short-run but proportionate relation between money supply and inflation is not valid.

M1 has two quarters (i.e. $M1_{t-1}$, $M1_{t-2}$) lag effect on inflation. However, M2 has contemporaneous ($M2_t$) effect on inflation. The effect of an increase in M1 on both the food and non-food inflation is distributed over the one quarter. However, the effect of M2 on both the food and non-food inflation seems contemporaneous.

The $M1_t$ and $M1_{t-2}$ are found to be dominant explanatory variable of M1 while in the case of M2, only $M2_t$ is dominant.

(ii) Keynesian Hypothesis

The Keynesian hypothesis is tested using annual data alone as the quarterly data frequency of budget deficit and interest are not available. A high correlation is found between monetary aggregate and budget deficit. Considering the problem of multicollinearity, budget deficit is taken as a proxy of money supply in monetarist equation of inflation. The effect of fiscal action on inflation is examined.

The elasticity of inflation with respect to budget deficit is 0.57 as regression equation includes only budget deficit variable.. If we include real GDP (Y_t) as an additional variable along with budget deficit, elasticity coefficient of inflation with respect to Y_t is 1.57. It is found to be statistically significant but contrary to expected sign. However, the explanatory power of the inflation equation is not increased after including real rate of interest.

To sum, as the elasticity of inflation with respect to budget deficit is slightly less than that of money supply (M1), the effects of budget deficit on inflation is found equally significant. Since budget deficit is one of the basic sources of rise in money supply, it can be used as a proxy for money supply. Fiscal actions are found to be influenced by the desired changes in real GDP of the economy. Therefore, the change in real GDP has also likely effect on inflation along with budget deficit in Nepal.

(iii) Structuralists' Hypothesis

Structuralists contend that inflation is not a purely structural phenomenon. If money supply is not increased to neutralize the effect of structural bottlenecks, there is no effect of structural factors on inflation. Therefore, their model is considered as non-structural cum structural. In order to test the effect of non-structural-cum-structural variables on inflation, non-structural variables like

money supply, expected rate of inflation and government deficit are incorporated in structuralists' model.

Every structural variable individually has significant impact on inflation. The elasticity coefficient of inflation with respect to Indian inflation, import/GDP ratio, agriculture/non-agriculture GDP ratio, food price relatives and export/GDP ratio are found to be 1.21, 0.72, -2.74, 18.84 and 0.70 respectively.

The elasticity coefficients of inflation with respect to non-structural combined with structural variables are statistically significant either at 1 percent or at 5 percent level. However, the elasticity coefficients are found statistically significant when one of the variables from each (non-structural and structural variables) is taken while running regressions. Therefore, inflation in Nepal is also a structural phenomenon.

To sum up the three hypotheses of inflation, as analyzed above, coefficients are found statistically significant when at the most three independent variables (one from each non-structural, structural and opportunity cost) are included in a regression equation. Therefore, lesser the variables are included in an equation, higher the precision and simplicity has been found in an inflation equation in Nepal.

2. STABILITY AND CAUSALITY TEST

Structural stability and casual relationship between the variables of monetarist model are tested using quarterly data. FY1989/90 is considered as break year for testing structural stability of the model. Pair-wise Granger causality test is examined between overall inflation and monetary aggregates (M1 and M2) and between food inflation and monetary aggregate (M1 and M2).

(A) Stability Test of the Model

Parametric stability in a model is necessary to use the model for prediction. Parameters are supposed to change because of the significant changes in policy regime in an economy. The effect of liberalization policies adopted by the government of Nepal before and after FY1989/90 is examined to identify the structural stability of the monetarist model. A rejection of null hypothesis is that there is no structural change in relationship between inflation and monetary aggregates. Chow stability test implies that there is structural and parametric change (instability) in the regression model. The dummy variable method has been used to test the stability of the model. It further confirms the structural instability of the regression model of inflation in terms of both the differential intercept as well as slope coefficients.

(B) Causality Test between the Variables

A bi-directional causality is found between inflation and M1 by applying pair-wise Granger causality test. Bi-directional causality is also found between food inflation and each of M1 and M2 aggregate. The reason for bi-directional causality between the variables stems from the variables reinforcing each other. A unidirectional causality is found between M2 and inflation, where causality is running from M2 to inflation but not the other way round.

(C) Statistically Robust and Stability of Inflation Model

Using annual data, inflation and monetary aggregates (M1 and M2 - monetary variables), lagged per capita real GDP ($PRGDP_{t-1}$ –a real sector variable), ratio of food to overall inflation (FP/CPI_t –a structural variable) and lagged Indian wholesale price index ($IWPI_{t-1}$ –international price variable) are found non-stationary in level form while they are stationary in first difference both in the case of quarterly as well as annual data frequency. Studies based on level form

create spurious results that can be biased and inconsistent while first difference data, though they are stationary, gives only short-run relationship. However, if dependent and explanatory variables are cointegrated in same order, then and then only, level form data can be used for analytical purpose (so that coefficients are not considered spurious). By the same reasoning, variables like M1 and M2, PRGDPt-1, FP/CPI and IWPIt-1 as explanatory factors of inflation (selected on the basis of specific to general methodology) are found cointegrated. The cointegrated variables as specified above can be used to show short-run unbiased and consistent relationships by Error Correction Model (ECM). The Error Correction Term (ECT) in the ECM decides how quickly the long-run equilibrium is restored.

Statistically significant coefficient of ECT is 0.84. This suggests that CPI adjusts to changes in explanatory variables in a relatively longer period of time. Dynamic multiplier of inflation path also supports the result of ECM. In case of variation in M1 and $PRGDP_{t-1,}$ the period of inflation convergence to equilibrium ranges between 2 to 3 years while in the case of $IWPI_{t-1,}$ it is 4 years. These results are consistent given economic conditions in Nepal such as underdeveloped financial market, difficult geographical structure, subsistence economy, fragmented market structure, escalation of the conflict and lack of smooth supply of commodities.

Using quarterly data, CPIO and M1 and M2 are found to be non-stationary in level form while they are stationary in first difference. These variables are found to be conintegrated of first order. A statistically significant ECT coefficient is 0.096. This suggests a fast adjustment between inflation and its explanatory variables. An unexpected negative sign of the coefficients of changes in M1 and M2 implies disequilibrium -that there is an inverse relationship between inflation and money supply (M1 and M2) in the short-run. However, in the long-run there is a positive relationship between inflation and money supply (M1 and M2), as depicted by the cointegrating equation.

(D) ARCH Model

The ARCH model has been used to examine volatility clustering of inflation series in Nepal using 116 quarterly observations (1975I-2003IV). If we introduce only one period lagged variance term, the null hypothesis of no ARCH(1) is accepted. However, if we introduce up to three periods lagged variance term, the null hypothesis of no ARCH(3) effect is rejected. This result shows that there is volatility clustering in the inflation series of Nepal. Volatility clustering of annual inflation series is not examined in this study because of the insufficient data observation.

(E) Inflation and Business Cycle

Aggregate consumption, monetary aggregates and real GDP are procyclical variables to inflation. These variables have predominantly positive and statistically significant correlation coefficients with inflation. If the peak correlation coefficients occurred when the variables are lead relative to contemporaneous inflation; we refer to them as lagging variables. The variables are displaying non-cyclical behaviour because the correlation coefficients are not displaying a pronounced peak. Aggregate consumption and monetary aggregates are found weak procyclical variables. Budget deficit and investment are strong procyclical, whereas agriculture real GDP and balance of payment are not procyclical as their coefficients of correlation are being statistically insignificant.

3. FORECASTING OF INFLATION

In this study, inflation in Nepal is forecasted using different methods such as trend, regression, Box-Jenkins and VAR. Mean Absolute Percentage Error (MAPE) criterion is chosen to validate the best forecast model of inflation. The

better forecasting performance of a model is examined in terms of two criteria in this study: better explanatory variable of inflation; and better forecasting performance by using either annual data or quarterly data.

(A) Trend Method

As the comparison of the forecasting performances between the two models can be made when they are having same specification, the forecasting performance of autoregressive model is better (less MAPE) than that of linear trend in both the quarterly and annual data. Similarly, log/autoregressive model is found better than exponential growth model. However, if we compare forecasting performance between autoregressive and log/autoregressive models in terms of data frequency, former model is found better in the case of annual data and latter is better in case of quarterly data.

(B) Regression Method

Using annual data, a regression model of inflation on M1, GDPR, IWPI and EP is found to have the highest predictive power after a number of trials. This model is the best in terms of other test statistics also. The regression equation of inflation on M1 is found better than inflation regressed on M2 by using quarterly data. The forecasting performance of regression equation of inflation on M1 is found better by using quarterly data as compared to that of annual data.

(C) Box-Jenkins Methodology

Using annual data frequency, the inflation model with ARIMA(1,1,1) data generating process is better as compared to ARIMA(1,0,1). The AEMP for the year 2003 is found 3.25 using ARIMA(1,1,1) model while that of ARIMA(1,0,1), the AEMP is 3.51.

Using quarterly data, the ARIMA(4,0,5) data generating process found to be adequate by the a re-identification and re-estimation of ARIMA(p,d,q). The AEMP of ARIMA(4,0,5) model for the last quarter of 2003 is 2.56. The model includes four AR terms (lag 1,4,8 and 16) and five MA terms (lag 1,4,8,12,and 16).

Since, the AEMP of ARIMA(4,0,5) model, using quarterly data, is found to be least, it is better forecasting model as compared to ARIMA (1,1,1) and ARIMA(1,0,1) models using annual data.

(D) VAR Methodology

The difference between actual and forecasted values of inflation for in-sample periods from 2003I to 2003IV is ranging from 31.1 percent to 39.2 percent applying VAR Methodology. The large difference between the actual and forecasted values suggests very poor forecastability of inflation of only two variable VAR model.

4. POLICY IMPLICATIONS

1. Nepal Rastra Bank (the central bank of Nepal), monetary authority of Nepal, design and conduct its monetary policy. It one of the important objectives is to control inflation. The instruments used to affect money supply are several. The effect of money supply on inflation is quite uncertain because of the lag, lead and other factors. Therefore, authorities attempt to identify important determinant variables of inflation and use their effects.

2. The monetarists and the non-monetarists (Keynesians and structuralists) schools have distinct approaches regarding the determinants of inflation. The basic contention of the monetarists is that inflation is essentially a monetary

phenomenon, and it can be controlled by the regulation of money supply. The non-monetarists argue that rise in inflation is a much more complex phenomenon, that includes the factors of fiscal policy, and other macro-variables shaping the structure of the economy. Therefore, inflation cannot be controlled by mere regulation of money supply alone, and it needs a very comprehensive approach.

3. An examination of monetarist hypothesis is found valid in this study. This conclusion is made on the basis of elasticity of inflation with respect to M1 and M2 at 0.60 and 0.53 respectively. Monetary authorities may achieve objective of inflation control slightly better by regulating narrow monetary aggregate than broad monetary aggregate as suggested by respective elasticities. When quarterly and annual data are used in the models, the results of money-price relationship are found the same.

4. Inflation in Nepal is a monetary phenomenon. However, proportionate relation between money supply and inflation is found valid. M1 has two quarters (i.e. $M1_{t-1}$, $M1_{t-2}$) lag effect on inflation. However, M2 has contemporaneous ($M2_t$) effect on inflation. This hypothesis is also confirmed by adaptive expectation model. That is, one percent increase in M1 has ultimate effect of 0.50 percent on prices in the long-run. Similarly, an 8 percent discrepancy between actual and expected inflation is eliminated within a quarter which is a slow adjustment.

5. The regulation of monetary aggregates by the central bank is not in its full control. The central bank, working as an agent of the government, may be influenced by the policy actions of the government, and hence may not be able to control inflation independently. Monetization of deficit of the government is a recurring phenomenon which leads to rise in inflation. In this context, Keynesian hypothesis is examined to find out the effect of budget deficit on inflation in Nepal. As the elasticity coefficient of inflation with respect to

budget deficit is found to be 0.57, it is concluded that the policy actions of the government are also equally responsible in rising inflation.

6. There are certain structural factors such as Indian inflation, agricultural non-agricultural GDP ratio, food price relative, and export to GDP ratio and export to GDP, which are outside the control of monetary authority, are found responsible in triggering inflation. However, the non-monetarist variables combined with the monetarist variables have a significant impact on inflation in Nepal, if it is examined by taking one variable from each model.

7. Though M1 monetary aggregate is found to be a better explanatory variable to inflation in Nepal, as explained above, a bi-directional causality between M1 and inflation signifies that M1 is not fully controllable variable for the monetary authority. This indicates that M1 and inflation are reinforcing each other. However, in terms of M2 monetary aggregate, uni-directional causality is found running from M2 to inflation not the other way round. Therefore, M2 is better controllable variable than M1 as found by using Granger causality test. An analysis of inflation and business cycles shows that M1 and M2 are procyclical variables to inflation. Therefore, they are considered as lagging variables to inflation.

8. If parameters of the model are not found stable, policymaker should not use such a model for prediction for a long period of time. One of the major factors contributing such instability is some policy changes in an economy. In this study, the rejection of null hypothesis is that there is no structural change in relationships between inflation and its determinants (M1). Chow stability test indicates that there is structural instability in the regression model. The dummy variable method to test the stability also confirms the structural instability of the regression model. Therefore, monetary authorities require prior estimation of inflation equation before using such a model for prediction.

9. An another aspect of the stability of the time series model is related to the examination of the data for the valid use of classical linear regression model (CLRM). If data are found non-stationary, they should be transformed to stationary in order to valid CLRM. There are two ways to examine the data: testing the data already used in estimating the model for the validity of that model; testing data before they are used for analysis. This study is following former criteria. In this context, inflation and its determinant variables in Nepal are found cointegrated in the same order. It validates stability of the models for long-run, where use was made of non-stationary data in their level form.

10. Further, an application of Error Correction Model (ECM), which uses cointegrated variables, can be better tool of analysis for the policymakers to find both the short-run as well as long-run relationship between the variables. A comparison of quarterly data and annual data suggests that inflation adjusts to changes in explanatory variables faster in the former case. It is confirmed by the almost zero coefficient of ECT in case of former data frequency as compared to 0.84 in case of latter data frequency.

11. There are two methodologies of forecasting: econometric forecasting and time series forecasting. The former method is based on different statistical criteria (in terms of various statistical tests, right specification of models), while the latter on past values of the variable to be forecast. Since econometric forecasting can not be handy tool of forecasting under statistical complexities, time series methodology of forecasting is found the better. This study found Box-Jenkins methodology, as a variant of time series methodology of forecasting, a better tool as compared to other methodologies of forecasting for the short-term forecast of inflation in Nepal.

5. LIMITATION OF THE STUDY

The sources of the data for analysis are compiled from government and central bank publications. Limitations of secondary data are well known. Because of the unavailability of quarterly data series (except for inflation and monetary aggregates), this study has used annual data which may not give short-run guidance for policy purpose. The data series of inflation used for the analysis are based on national urban consumer price index which may be considered as less than sufficient coverage. Measurement of Wholesale Price Index in Nepal is recent initiation and thus, is not considered here for want of sufficient number of observations. Only M1 and M2 monetary aggregates are proxied for money supply variables in this study. However, there can be many more measures of money supply.

6. SUGGESTIONS FOR FURTHER RESEARCH

Measurement of core inflation and examining its implication would be of greater value to all concerned. In inflation targeting regime, central banks, need to forecast inflation and adjust policy in response to actual deviations of inflation from target. A number of developed countries have experimented successfully with inflation targeting. One can explore this possibility in other countries as well. An effectiveness of inflation targeting regime in the monetary policy framework for developing countries is also another area of further research. Central Bank independence is another issue for further research. Dynamic inconsistency and credibility of policy are also equally interesting areas for research.