CHAPTER III

REVIEW OF LITERATURE

So far the nature, advantages and limitations of different time-series models generally adopted have been critically reviewed. Now comparison with reference to forecast accuracy of different models and their applications in the past are discussed below.

Christ (1951) in his work indicated that when structural changes are taking place in the economy, econometric models are not superior to time-series approaches.

3.1 Application of Forecasting Models in the Past

Gerra (1959) presented a series of behaviour relations and identities which were believed to stimulate the basic economic system for the egg industry. He indicated that in using the equations fitted (an econometric model) to forecast values of variables in the egg industry beyond the years for which equations were fitted, better estimates of the annual quantity variable (domestic egg consumption, egg production on farms, average number of layers on farms, and the number sold) were obtained from simultaneous equation approach, while better estimates for some variables like storage movement and price variables were obtained by least square method.
Suits (1962) while presenting an econometric model of the U.S. economy demonstrated its use as a forecasting instrument and explored its implications for policy analysis. He divided the presentation into two parts. Part-I deals with the general nature of econometric models using a highly simplified schematic example, illustrating how forecasts were made with a model, how a model could be modified to permit the introduction of additional information and judgment, and how short-run and long-run policy multipliers were derived from the inverse of the model. Part-II presented 32 equation in economics.

Bluestone (1963) applied traditional methods of seasonal adjustment and data filtering to estimate broiler cycles. He employed the Bureau of census method for seasonal adjustment and found what he called “4 well-defined cycles”. For broiler chick placements a cycle of approximately 27 months is needed and for broiler prices a cycle of approximately 30 months was suggested. Peaks in broiler prices by about 21 months at these cycles.

Tobin and Arthur (1964) used a low-pass filter (simple Moving Average) of six months length for broiler chick prices and of twelve months length for hatchery supply flocks. The resulting filtered series revealed cycles of approximately 30 months for both series. A time difference of 12 to 18
months existed between the peaks of the two series for the 30 months cycle. Similar findings were also observed by Gross and Ray.

3.2 Comparison among Time-Series Models

Lirby (1966) compared three different time-series methods viz., moving averages, exponential smoothing, and regression. He found that in terms of month-to-month forecasting, horizon was increased to six months. The regression models included was found to be the best method for longer-term forecasts of one year or more. Sleckler found that econometric models were not entirely successful in improving the accuracy in forecasting.

Schmitz and watts (1970) used parametric modeling to forecast wheat yields in the United States, Canada, Austria and Argentina. The essence of this approach was that the data were used for identifying the estimation of the random components in the form of moving average and autoregressive process. It did not identify and measure the structural relationship as was attempted when forecasting with econometric models. They used exponential smoothing to forecast yields in United States and Canada. They also compared the forecasting accuracy between parametric modeling and exponential smoothing.
Leuthold et.al (1970) in their study of forecasting daily hog price and quantities used Theil’s inequality coefficient for comparing the predicative accuracy of the different forecasting approaches. For price forecast to hog market they compared econometric model, random walk model, and mean model and for supply forecasts they compared econometric model, random walk model, mean model and time-series models. They concluded that the data required for time series modeling was the concerned data on the variable to be forecasted, whereas for econometric models data are needed on both the regressor and regressand. Therefore the forecasts using econometric model are slightly better than those using a stochastic non-casual frame-work. Further, the cost of making slightly greater error in using the latter will be less than the additional cost involved in setting up an econometric model and collecting the data.

Chambers et.al. (1971) in their study of “how to choose the right forecasting technique” discussed time-series analysis also. They discussed the different forecasting techniques viz, qualitative method, time-series analysis, and projection (moving average, exponential smoothing, Box-Jenkins and trend projections), and casual methods (regression model, econometric model, input-output model, leading indicator and life-cycle
analysis). For each method they provided description, accuracy, identification or turning points, typical application and requirement of data. They tried to explain the potential of forecasting to the manager focusing special attention on sales forecasting for products of Corning glass works as these have matured through the product life cycle. They indicated that the need to-day is not for better forecasting methods but the better application of the techniques at hand. Similar findings were also observed by Gross and Rain.

Both Reid and Newbold (1971) concluded that the Box-Jenkins approach of ARIMA models gave more accurate results than exponential smoothing or step-wise regression methods.

Soliman (1971) worked out several major relationships that explained the behaviour of the United States turkey industry in 1946-66. He constructed the model that consisted of four structural equations and he also used four different estimation techniques to derive the values of the structural parameters. He further observed that no one method proved superior to another with respect to their forecasting ability against the observed data in the post 1966 period.
Kulshreshtha (1971) developed a model for predicting the monthly egg production in Canada at least six months in advance. He indicated that the production process of eggs could be studied in two alternative ways: (i) as a single-step analysis, where the egg-production of a particular month was determined by economic and technical factors which affect the profitability of the enterprise and (ii) as a multi-step analysis in which the role of the above mentioned factors was not estimated at the final state of production but rather the whole production process was divided into finite, technically feasible stages, some of which might be the decision making ones. The role of economic and technical factors was then estimated by one or more of these stages of production of eggs. He adopted the multi-step method.

Cooper (1972) concluded from his study that econometric models are not in general superior to purely mechanical (time-series) method of forecasting. Similar findings were also observed by Gross and Krampf.

Myers (1972) in his study on “Combining Statistical Techniques with Economic Theory for Commodity Forecasting” concluded that in the problems associated with determining future hog prices and marketing alternative, a combination of spectral analysis, autoregression and multiple
regression analysis and recursive system could be used. In forecasting, however, a model can only be evaluated by its ability to provide adequate answers to pricing problems and also only incidentally by internal statistical properties.

Naylor et al (1972) made more extensive and detailed comparison of alternative methods and examined Box-Jenkins approach in contrast to Wharton econometric model for the year 1963 through 1967. They observed that the accuracy of ARMA models of Box-Jenkins methodology was considerably better than the accuracy of Wharton econometric model.

Nelson (1972) compared econometric (regression) and time-series (ARMA) methods for a longer time horizon. He concluded that the simple ARMA models are relatively more robust with respect to post sample predictions than the complex econometric models. If the mean square error is an appropriate measure of loss’ an unweighted assessment clearly indicated that a decision maker will be better off relying simply on ARMA predictions in the post sample period i.e. in the forecasting phase.

Adam (1973) reported that the factors including the number of observations in the series, seasonality of the data, the number of periods in the time horizon are to be forecasted to the extent in which randomness in
the series and others had a substantial impact on the accuracy and performance of individual forecasting models.

Kimball and Gutterrez (1973) adopted Mincer-Zarnowitz technique of the goal of forecasting the minimization of the mean square error (MSE) i.e. the squared difference between the actual and forecast values, which is a measure of dispersion around the line of perfect forecast. They indicated that a least square straight line must be fitted to a scatter diagram of actual realization and estimates. They gave the idea that on the overall forecast accuracy, i.e. the square root of the MSE has been computed and expressed as a percent of the actual mean value. They also said that $R^2$ is not a reliable guide since it merely represents errors explained by a linear adjustment of the forecast series.

Formm and Klein (1973) concluded that no single econometric model is overwhelmingly superior to others. They recognized that differences may exist in the forecasting performance for single items or over a limited time horizon but on the average these differences in accuracy do not consistently favour one model to another.
Groff (1973) observed from his study that Box-Jenkins methodology gave results that were approximately equal in accuracy or slightly worse than those achieved by using exponential smoothing.

Roy and Johnson (1973) developed seven simultaneous equation systems for wholesale shell-egg price and estimated it by using three-stage least squares method. The seven-equation quarterly models for wholesale shell-egg prices indicated that all estimated relations were consistent with economic or logical expectations. Price forecasts developed from the models appeared to be satisfactory, especially for the first three quarters of the calendar year. Methodologically price forecasts based on three-stage least squares equations were more accurate than those developed from the corresponding two-stage least squares equations. They suggested that one should re-estimate the model periodically after taking into account the changes in the structural parameters. This helps a lot to maintain accuracy of prediction.

Larson (1974) applied a well defined and thoroughly-examined (theoretically) model known as Larson’s harmonic model to the egg industry. The harmonic model is the result of a small but important modification of the cobweb model.
Hartman (1974) examined the often discussed instability of the price of eggs by the use of spectral analysis and confirmed the existence of an egg cycle. He found that while explaining the cycle, the familiar cobweb model is inferior to an alternative model. The alternative model proposed by Nerlove had producers planning changes in their production levels in response to prices, with the changes being realized only after a lag. He gave economic justifications for such producer behaviour to continue even though it causes instability. He further discussed recent destabilizing factors which were not related to the cycle.

Newbold and Granger (1974) concluded that Box-Jenkins’ approach of ARIMA models gave more accurate results than exponential smoothing or step-wise regression methods.

Leuthold (1974) observed that cash cattle prices were found to be the more accurate indicators of subsequent cash cattle prices conditions than the future prices for distant contracts. He applied an explicit method of determining the ability of future prices to estimate subsequent cash prices with the model $FP_t = a + b FP_{t-I}$ where $FP_t$ is the closing future price for a contrast at delivery and $FP_{t-I}$ is the future price for the i th month before maturity. He calculated mean squared error (MSE) to gain more information
about the efficiency of future prices in indicating the final cash price on weekly corn and cattle prices. The same conclusions were drawn by Geurts and Ibrahim.

Cromarty and Myers (1975) in their study argued that the work done by Connel and company on egg product prices provided a good practical example of working with partial equations to forecast prices in an appropriate time period. Research for egg products had been concentrated on forecasting price levels during the spring peak period.

Asbridge and Sappington (1976) fitted a regression model using currently known data to predict the price of broilers in 11th week following the prediction. This 11th week lead is to give producers an indication of the price that they can expect when they market the broilers from the time that the fertile eggs are put into incubator.

Lakshminarayan et al. (1977) developed the following form of Box-Jenkins model.

\[ Z_t = Z_{t-1} + a_t + 0.70 a_{t-12} - 0.15 a_{t-13}. \]

To forecast the broiler chicken production for the year 1976. The mean absolute percentage of error was under 5 percent while the error in the total production for the year was 1.7 percent. The forecast followed the pattern of the actual data. The actual
production was always within the 50 percent confidence limits of the forecast.

Sullivan et al. (1977) used the data regarding ambulance company calls responded to by the EMS company over 12 months. He compared the estimated and original for the models, double Moving Average, Single Moving Average, Single Exponential smoothing and Double Exponential Smoothing, Triple Exponential smoothing, and Winter's Method. In his case Double Exponential Smoothing can be given the minimum mean square error and Winter's as the second. When they performed the same analysis for quarterly data for plant and equipment expenditures over seven years the winter's method gave the best with the minimum Mean Square Error. The Triple exponential Smoothing model came next.

Haynes and Keyyon (1978) developed price forecasting models to predict broiler prices in one, two and three quarters in advance. The models were turn forecasting models in that all values of independent variables are estimated or known when forecasts were made. The ability of the model to forecast was evaluated out-side the data base to estimate the equations. The results indicated that all the three models predicted were better than no-
change extrapolation. The models which predict broiler price two and three quarters in advance are better for future market.

Hernandez-Estrada (1978) estimated demand parameter co-efficient for future use in price forecasting or price projection models for graded eggs. He analysed the problem with a theoretical model which postulated the existence of a kinked demand curve for graded eggs and a regression was applied to estimate the effects of several variables on this. The result of the study using 1965-76 data indicated that price of graded eggs is inversely related to the quantity of graded eggs.

Kersen (1978) used statistics on hatching eggs put into incubation in GFR and Netherlands during the base period 1966-77 to measure production decisions. Turning points, prediction accuracy of trends and deviation of predictions from reality were used to evaluate export forecasts. Export forecast of eggs put into incubation predicted all turning points accurately as well as slaughtering and imports. The analysis of prediction of accuracy of trends provided a good supplement to the analysis of turning points error.

Suzuki and Nagano (1979) in their study on time-series analysis of the wholesale egg price in Tokyo examined the fluctuations in wholesale
prices of eggs by applying such methods as Pearson's linkage method and multiplication model. The seasonal fluctuation of egg prices has probably been influenced more strongly by demand than by production. The cyclical fluctuation found is to exist not in wholesale prices and production but in egg-feed ratio.

Agrawal-R et.al. (1980) used two different models to forecast paddy yields of the rice using 25 years of data. In one model they used weighted averages for weather variables. In another model they used step-wise regression technique for obtaining forecast equation.

Hansen and sergeant (1981) provided optional forecasting which are formulated for variables evolving over time according to general ARMA process.

Bessler (1982) reviewed the relationship between the adaptive expectation, the exponentially weighted moving average, and optional univariate statistical predators. He showed that the behavioural-based adaptive expectations were a sub class of both the exponentially weighted moving average and the ARIMA (0,1,1) model. The applicability of the adaptive expectations model to 25 empirical price and quantity series was investigated. The adaptive expectations behaviour and the optional
statistical forecasts were equivalent to 13 series, 11 on yield and two on prices. Numerous price series while exhibiting the general form of the adaptive expectations (a ARIMA (0,1,1) process) did not have a coefficient of expectation within the originally hypothesized range. The behaviour consistent with the model underlying these price series was trend extrapolation rather than averaging (averaging the most recent observation and its forecast). Series measured at monthly or quarterly intervals were not adequately modelled by adaptive expectations or as a ARIMA (0,1,1) process.

Smith (1983) characterized egg industry economic relationship by seasonal patterns in retail and wholesale prices, production and fresh-vs-breeding utilization and chick placement, forced molting and rates of lay. He focused the effects of seasonal fluctuations on the above sources. A monthly econometric model was developed for the period 1967-75 and analysed the month to month changes in production by size, wholesale and retail prices and influence of interstate shipments and markets on California egg industry.

Larson (1983) argued that information about the structure of the error terms is essential to accurately evaluate any model and its summary statistics. He found that such information is neither generally requested nor
provided by most economic journals. Also such information is generally neither requested by buyers nor provided by sellers of models, or model forecasts. In this opinion an effective method for evaluating a model and its forecasting abilities was to compare the out-of-sample forecasts of simple models. Auto Regressive integrated Moving Average (ARIMA) and Vector Auto-regression (VAR) models were two such models which provide relatively good forecast.

Busurd (1985) developed a price forecasting model for accurately predicting the price of slaughter hogs one quarter in advance. Both time-series and econometric models were hypothesized, estimated and tested. In an attempt to improve the forecasting accuracy composite models were developed which utilized the price forecasts from both time-series and econometric models as inputs. Two types of time-series models were estimated. The simplest was an ARIMA model which assumed that current price is related to past price plus a random error term. Another one was a transfer function which is similar to the ARIMA model but included an input variable.

Goodall (1986) in his studies on prediction of milk and milk solids production collected milk yield and milk solids data for 4470 locations from
43 commercial dairy herds in Northern Ireland for the period 1978 and 1982. He used the following extrapolation model. \( Y = A t^b e^{(d-ct)} \) The coefficients A, b and c denote the underlying curve, d-a seasonality measure and \( Y \) the expected production in a week \( t \). He obtained estimates of the parameters for the twelve calving months and for parities 1, 2, 3, & > 3. The actual patterns obtained from the Milk Marketing Board for Northern Ireland and the forecasts were reasonably agreeing. He argued that this could be used in management decisions on fixing milk price.

Kalylen (1986) in his study of “Time-series modelling of the live hog market” analysed the dynamic relationship between hog market related variables. The variables included in his study were sow barrowing income, feed price, hog slaughter, hog price, retail pork price. He also included nine deterministic variables primarily to account for seasonality in the data. He developed forecasting models specifically for these variables which included Auto Regressive Integrated Moving Average (ARIMA) and Vector Regression (VAR) models.

Conway et al. (1987) observed that the ability of a stochastic coefficient model to adapt quickly to changing economic conditions is uniformly to a fixed co-efficient model in forecasting the quarterly retail price.
for beef and chicken. The Cochrane-Orcutt and maximum likelihood procedures appeared to forecast pigmeat prices better. Agricultural commodity analysis have systematically over-predicted livestock prices during the 1980’s by using econometric forecasting models that did not account for changing economic conditions. They compared the estimates of red meat and chicken prices obtained from out-of-samples forecast performance of the Swamy-Tinsley stochastic coefficients model with ordinary least squares, Cochrane-Orcutt and maximum likelihood procedures. To compare forecasting methods, meat demand equations were re-estimated using several different estimation methods. The result showed that factors affecting meat demand varied significantly during 1970’s. The empirical results for all livestock equations amply demonstrated that contrary to the common assumption, a constant relationship between explanatory variables and endogenous variable was not correct for this specification.

Stillman (1987) developed a new model for the United States egg industry. The model provided forecasts of egg price quantities for use in short to medium-term outlook and policy analysis. The model incorporated both behavioural and biological factors to generate supply and use information. Simulations of the model indicated that the model performed
both inside and outside the estimation period. Dynamic multipliers were derived for feed costs, broiler price, and disposable income. The model was estimated for the period 1972-82 using ordinary least square estimation procedure.

Bogahawatte-C (1988) examines the appropriateness of price forecasting using Box-Jenkins Auto Regressive Integrated Moving Average Method. He has shown that the forecast values over-estimate actual prices.

Abdul (1988) dealt with the inherent problem of price expectations by comparing the method utilizing prices i.e., ARIMA forecasting and two other methods for combining the two individual forecasts. ARIMA model performed better in forecasting broiler prices in the shorter forecast ranges. When all ranges were considered the combined simple average method performed best. For corn prices the individual forecast based on future prices performed the best and for soyabean-meal prices, the combined-linear regression method was the best.

Lee (1988) compared single equation price models of simple weighted, native, autoregressive moving average (ARMA) and future price lagged seventeen weeks (FP_{t-17}) to determine the accuracy of price prediction for different market positions relative to futures market delivery.
Simple weighted and native models exhibited four times less variability as measured by RMSE. $FP_{t-17}$ exhibited low Durbin Watson values and ARMA for RMSE model accurately reflected time trend changes (turning points). Bootstrapping confirmed the statistical accuracy of RMSE evaluation with histograms of MSE frequency distributions, widest for ARMA and narrow and simple weighted and native. The $FP_{t-17}$ price expectation model improved in prediction accuracy when bootstrapped. Bootstrapping indicated that $FP_{t-17}$ may be a more accurate source of outlook information for cash price than indicated by RMSE evaluation.

Reza (1988) formulated the demand, yield, acreage and production response functions for cotton at farm level in Arkanas. He incorporated the functions into simultaneous equation systems to generate equilibrium price and quantities. He forecasted the future price changes induced by the explanatory variables using the secondary data for the period 1960-1982.

Dean (1989) proposed a post sample forecasting method for testing probabilistic or Granger definition of full causality between two economic variables. The method was applied to the question of causality between the live cattle future market and Taxas-Okala-shoma slaughter cattle cash price. A time-series method was employed to study the effect of market information
efficiencies and their dynamic interrelationship, the cattle future markets
effect on price uncertainty in the cattle cash market was examined within a
forecast context.

Mitra (1989) in his study on “Growth and instability of agricultural
prices in West Bengal: a note” used Linear, Quadratic and Cubic curves to
predict the actual prices.

Babula and Bessler (1990) applied vector auto regressive model for
maize, farm egg and retail egg prices in the United States of America. They
observed that retail egg price was endogenous which was highly influenced
by farm egg price.

Lance and Purcell (1990) traced the evolution of the United States
turkey industry from 1950 to 1988. Production, farm price equivalent and
value of production at the farm level were analysed with sequential five
year trends. Five year moving averages smoothened the short-term
fluctuations in turkey industry. They found a persistent increase in production
throughout the period 1950 to 1988.

Maragnon (1990) reported that an earlier study of price series in the
production of poultry meat showed the existence of distinguishable regular
fluctuations in the trend components, seasonal changes in the demand, and
short cycles. He forced an econometric forecast model which compared the said fluctuations and attempted to interpret what determined the level of prices said to broiler producers in the short term. A study on supply and demand situation at national level for Italy lead to a more economic and statistical study of the market for this type of product. He analysed the available data and constructed a statistical model and estimated parameters of the model. It was concluded that the data currently available contained elements which could usefully contribute to choice at the farm level.

Seema (1990) in his study on structure of egg prices in Hyderabad (A.P.) applied linear trend model and worked out 12 months moving average and seasonal index for monthwise egg price date for the period 1973 to 89. He made projection by multiplying trend value and seasonal index.

Sabur.S.A. et.al. (1993) in their paper used ARIMA models for forecasting the prices. They have shown that the ARIMA model has to be used only to short term forecasts.

Khan S.A. et.al. (1995) have used multiple regression analysis to predict the yields of winter rice on the basis of the rainfall distribution. The R-Square for their model was more than 70%.
Durairaj.S (2001) used Regression and time series models to forecast prices of selected agricultural Commodities.

Immaculate Mary.M (2006) used deterministic and stochastic models to forecast the probable rainfall for selected places in Tamilnadu.

Kamala Bai.G (2007) used purely Time series models to forecast prices of selected commodities pertaining to Kanyakumari District.