CHAPTER 1

Introduction

The volatility of the general price level has long been receiving both economic and political attention. Inflation or upward movement of price level adversely affects the living conditions of the people in general and poor in particular. The prices of consumer goods are more important in this context, bulk of which is agricultural products. Thus price fluctuation of agricultural crops—mainly upward movement intervenes with the living standard of the people. The movement of agricultural prices is, therefore, a cause of concern. The present study addresses this issue and tries to identify the determinants of agricultural prices.

In the literature, we observe two types of explanatory theories - cost-push and demand-pull. Attempts have been made to investigate the movement of agricultural prices by cost-push and demand-pull factors. Cost-push factors increase prices by raising the cost of production and demand-pull factors increase the price level by enhancing demand. Cost-push factors include the cost of fertiliser, cost of irrigation, cost of labour etc. Short run movement has also been related to weather condition. Agricultural commodities being mostly necessary commodities have stagnant demand. Increasing diversion of food consumption from human being to animal and poultry use or in other words for non-food use, changes in consumption pattern, population growth etc., are some of the significant demand-pull factors. They are no less important. In what follows present investigation concentrates on cost-push factors. In other words, variation in demand may be thought to be relatively less significant for fluctuations in the agricultural price level.
The interconnection between the agricultural price and cost push factors is taken up for deeper investigation. As just stated short run fluctuation of agricultural prices are largely due to climatic conditions. Input prices (continued to) play the crucial role in the long run. They determine the cost of production and hence prices of agricultural crops.

In India, input prices have shown an upward trend since the introduction of new economic policies from early nineties - liberalisation. The government has introduced various policies for controlling input prices. Administrative measures did not give up to expectation - upward movement of agricultural input prices could not be arrested, rather we experience more or less continuously increasing trend. This phenomenon is playing a crucial role in determining the level of agricultural prices in India. At this juncture, we should mention that Indian agriculture is experiencing some change in production technique. Relative significance of productive factors is undergoing some visible changes, consequently its impact on the movement of prices of agricultural products – namely the major field crops. The primary objective of the present study is to investigate the determinants of agricultural prices in quantitative terms during the post liberation period.

1.1. Objective of the Study

The study concentrates on the supply-side explanation of the agricultural price movement. Supply-side factors, that is, the factors that affect cost of production can be classified into two categories, viz. variable factors and fixed factors. Accordingly, cost of production of agricultural crops has two components-variable cost and fixed cost.
Variable cost is the cost that arises due to variable inputs such as fertiliser, water and labour. Fixed cost, on the other hand, includes cost of land and machinery.

Following our above underpinning the objective of the study is therefore further subdivided:

(i) to investigate the contribution of each of the identified variable cost components to the movement of agricultural prices and
(ii) to assess the contribution of fixed cost in determining the price level.

1.2. Framework of Study

The study is divided into seven chapters. After a brief introduction and discussion on methodology and source material in Chapter 1, Chapter 2 concentrates on the movement of agricultural prices and its different components in India for the period from 1992-93 to 2009-10. Different experts have analysed agricultural prices and have provided different explanations. A survey of these studies has been made in the chapter.

Chapter 3 takes up the issue of fertiliser cost as a component of the agricultural cost of production. The influence of fertiliser cost on agricultural prices has been investigated with the use of standard econometric techniques. Of the various inputs fertiliser has in recent past emerged an important one in the farm sector and occupies a major share in variable cost of cultivation. In India, price of fertiliser has increased continuously and alleged to have influenced the prices of agricultural products i.e. played a role in determining the movement of agricultural prices. The relationship between fertiliser price
and agricultural price has been investigated at both overall level and crop-specific levels. As a matter of fact, agricultural crops are divided into two categories - fertiliser intensive crops and fertiliser non-intensive crops. The causal linkage between fertiliser prices and agricultural prices are then examined for both categories of crops. The linkage, it seems, should be more prominent for fertiliser intensive crops than for fertiliser non-intensive crops. A comparative study has also been carried out in this context between India and United States.

Irrigation is output augmenting and it increases cost of cultivation. The causality between cost of irrigation, another major variable input, and the level of agricultural price is examined in chapter 4. Unfortunately, reliable time series data on irrigation cost are not available for empirical analysis in India. Some indirect method is adopted to capture the effect of cost of irrigation on agriculture price. Energy is a significant input for irrigation. The present study considers prices of electricity and diesel as representatives of irrigation cost because these are major inputs in the irrigation process and occupy major shares in the cost of irrigation. An attempt has been made to examine whether such a causal relation exists between ‘agricultural prices and diesel price’ and ‘agricultural prices and price of electricity’ in the context of India. Further, the study turns to a crop-specific analysis. For that purpose major crops are divided into two groups, viz. irrigation intensive crops and irrigation non-intensive crops. The causal relation has been examined between electricity price and agricultural prices for both groups of crops.
Chapter 5 analyses the labour component. The relationship between wage cost and crop prices is explored. Wage cost is an important variable cost component in the agricultural sector. Agriculture labour wage apart from regional and seasonal variation exhibits gender variation. Involvement of child labour in rural areas in particular in the agricultural sector is well known and we are yet to influence positively. They are paid substantially low wage. There are three types of data on wage rate in India, viz., wage for male, women and children. For the empirical analysis male wage has been considered since male workers dominate the sector. However, between wage rate and agricultural price there can exist bi-directional causality. Increase in wage rate may enhance crop prices, but, at the same time, increase in crop prices may also raise the wage level as agricultural crops constitute mostly the wage goods. The study investigates into the direction of causality.

The study attempts to estimate fixed cost of production in agriculture. Noticeably, the share of fixed cost in total cost of production is quite high. For paddy, for instance, almost 66% of cost arises due to fixed factors of production which justifies the hypothesis that agricultural prices are governed by them. The study therefore examines in chapter 6 whether such a relationship is tenable.

Finally, chapter 7 summarises the findings of the study and the study is concluded.

1.3. Methodology

Method of investigation as could be understood from our above discussion has two different facets - theoretical underpinning and empirical investigation. Theoretical
discussion regarding the cost push factors has largely been briefly described in setting the objective of the study. Further elaboration is made at the beginning of each chapter. For empirical investigation the standard time-series econometric techniques are used. To explore causality running from input prices to agricultural prices, bivariate approach has been followed. Thus, the relationship between agricultural prices and input prices are investigated separately for each input.

The study considers the level of agricultural prices \( (Y_t) \) and one of the variable cost components \( (X_t) \) at a time. The empirical exercise starts with log transformation of the variables. Thus, instead of working with absolute values of the variables logarithmic values are considered for the empirical exercise as logarithmic transformation reduces heteroscedasticity and asymmetry. Existence of ‘trend’ and ‘seasonality’ has been examined for both the series. Trend is examined by the moving average method and seasonality is tested using dummy variable method. If there is any ‘trend’ in the series, detrending procedure is done for removing deterministic trend from the series. For detrending, we regress the variable on time and take the residual values which serve as the detrended series. Seasonality has been tested on the detrended series. After appropriate detrending and deseasonalising, whenever necessary, ADF (Augmented Dickey Fuller) test has been used for checking stationarity of the series.
ADF test for a time series $Y_t$ requires estimating the regression:

$$\Delta Y_t = \beta_1 + \beta_2 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \epsilon_t \quad \text{..........(1)}$$

where $t$ stands for time, $\beta_1$, $\beta_2$, $\delta$ and $\alpha$ are the parameters and $\epsilon_t$ is pure white noise term and where $\Delta Y_{t-1} = Y_{t-1} - Y_{t-2}$, $\Delta Y_{t-2} = Y_{t-2} - Y_{t-3}$, etc. The number of lagged difference terms to include is determined empirically, the idea being to include enough terms so that the error is serially uncorrelated. We test

$$H_0: \delta = 0 \text{ against } H_1: \delta < 0$$

The series $Y_t$ is said to be stationary if $H_0$ is rejected and nonstationary if $H_0$ is accepted.

According to the test results, three kinds of situations may arise:

- Both series are stationary
- Both series are nonstationary
- One series is stationary and the other is nonstationary

**Case I: Both series are stationary**

If both series ($X_t$, $Y_t$) are stationary, the causal relationship between the two series is examined by fitting unrestricted VAR (Vector Auto Regressive) model:

$$X_t = \alpha + \sum_{j=1}^{k} \beta_j X_{t-j} + \sum_{j=1}^{k} \gamma_j Y_{t-j} + u_{1t} \quad \text{..........(2)}$$

$$Y_t = \alpha' + \sum_{j=1}^{k} \theta_j X_{t-j} + \sum_{j=1}^{k} \eta_j Y_{t-j} + u_{2t} \quad \text{..........(3)}$$

where $u_{1t}$ and $u_{2t}$ are the stochastic errors terms and $\alpha$, $\alpha'$, $\beta$, $\theta$ and $\gamma$ are the parameters.
Y causes X if all $\gamma$s are not zero and X causes Y if all $\theta$ s are not zero.

The optimum lag length of the VAR model is chosen on the basis of standard model selection criteria, viz., AIC (Akaike Information Criterion) and SBC (Schwartz Bayesian Criterion). For the precise information regarding causality, however, we have relied upon the relevant F- tests which test for overall dependence of one variable on the other, using the optimum lag length of the VAR model. The results of the F-tests show the rejection or acceptance of the null hypotheses: ‘Y does not Granger Cause X’ and ‘X does not Granger Cause Y’.

**Case II: Both series are nonstationary**

If both series ($X_t$, $Y_t$) are nonstationary but both are stationary at first differences i.e. both are I(1), cointegration test has been made to inquire into the relationship between the variables. The variables may be nonstationary but a linear combination of them can be stationary. Thus, the test for cointegration in a bivariate analysis searches whether such a \( \beta \) vector \((\beta_1, \beta_2)\) exists so that

$$\beta_1 X_t + \beta_2 Y_t \sim I(0)$$

If such a \( \beta \) exists then $X_t$ and $Y_t$ are said to be cointegrated to mean that there is a long run equilibrium relationship between $X_t$ and $Y_t$.

However, there may be disequilibrium in the short run. Vector Error Correction Model (VECM) shows how short run disequilibrium corrects in the process. The error term, for instance, establishes the relation between short run behaviour of a variable to its long run value. For two cointegrated variables $X_t$ and $Y_t$, VECM is estimated as follows:
\[ \Delta X_t = \alpha_1 + \alpha_x [X_{t-1} - \beta_1 Y_{t-1}] + \sum_{i=1}^{\alpha_1(i)} \Delta X_{t-i} + \sum_{i=1}^{\alpha_12(i)} \Delta Y_{t-i} + \epsilon_{xt} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4) \]

\[ \Delta Y_t = \alpha_2 + \alpha_y [X_{t-1} - \beta_1 Y_{t-1}] + \sum_{i=1}^{\alpha_21(i)} \Delta X_{t-i} + \sum_{i=1}^{\alpha_22(i)} \Delta Y_{t-i} + \epsilon_{yt} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5) \]

where \( \beta_1 \) is the parameter of the cointegrating equation \( X_t = \beta_0 + \beta_1 Y_t + \epsilon_t \), \( \epsilon_{xt} \) and \( \epsilon_{yt} \) are the white noise disturbances and \( \alpha_1 \), \( \alpha_2 \), \( \alpha_x \), \( \alpha_y \), \( \alpha_{11(i)} \), \( \alpha_{12(i)} \), \( \alpha_{21(i)} \) and \( \alpha_{22(i)} \) are all parameters. \( Y_t \) is said not to cause \( X_t \) if \( \alpha_x \) is zero and if all \( \alpha_{12(i)} \)s are zero. Similarly, \( X_t \) does not influence \( Y_t \) if \( \alpha_y \) is zero and if all \( \alpha_{21(i)} \)s are zero.

On the other hand, if the variables are not cointegrated, there must be no long run relationship between them. In order to explore short run interdependence, usual unrestricted VAR model has been fitted in such cases. The optimum VAR model and the relevant F-tests are then used to examine causality between the variables.

**Case III: One series is stationary and the other is nonstationary**

If one series is stationary and the other is nonstationary then cointegration test can not be carried out. For investigation of causality we need to know integration order of the nonstationary series. After sufficient differencing the variable comes to be stationary. Then, VAR model is established between these two variables - one which is originally I(0) and the other which comes to be I(0) after appropriate transformation.

**1.4. Sources of Information**

The study is based on the secondary information. Data on prices of major agricultural crops, fertiliser, electricity and diesel have been collected from various publications of
OEA (Office of the Economic Adviser), Ministry of Commerce and Industry, Government of India for the period from April 1994 to May 2010. The monthly data on agricultural price index as such are not available. The present study has therefore treated wholesale price index of primary articles as the proxy for the agricultural price index. Data on wholesale price index of primary articles are collected from the same government publication as above.

Monthly data on wage rate have been collected from ‘Wage Rates in Rural India’, Government of India, Ministry of Labour & Employment, Labour Bureau. The range of the study period is from July’99 to June’09.

The data on fixed cost, fertiliser cost, irrigation cost and wage cost have been collected from ‘Reports of the Commission for Agricultural Cost and Price’, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi. For fertiliser cost, irrigation cost (i.e. cost of diesel and electricity) and wage cost, the study period ranges from 1994-95 to 2009-10. For fixed cost, however, long run time series data could not be availed. The study had to rely upon annual data on fixed cost components for few crops such as paddy and wheat for the period from 2001-02 to 2007-08.

The time series data on fertiliser price and crop price for United States have been collected from the ‘National Agricultural Statistics Service (NASS)’, Agricultural Statistics Board, U.S. Department of Agriculture. Monthly data have been used for the purpose. The study period ranges from January 1995 to December 2010.