



METHODOLOGY

III. METHODOLOGY

The methodology relating to the study on “**Analysis of Elasticities in the Agro-Based Consumer Goods Industries of India in the Pre and Post Liberalization Period**” is discussed under the following headings:

- A. Selection of the area
- B. Period of study
- C. Sources of data
- D. Concepts and definitions used
- E. Statistical tools
- F. Limitations of the study

A. SELECTION OF THE AREA

Agro based industry refers to the subset of manufacturing that process raw materials obtained from agriculture and associated sectors such as animal husbandary, forestry and logging and intermediate products derived from other industries such as semi-processed hides and skins for manufacturing leather and leather products, edible oils for manufacturing hydrogenated oil. The agro-industry provides crucial farm-industry linkages which helps accelerate agricultural development by creating backward linkages (supply of credit, inputs, farm production enhancement services) and forward linkages (processing and marketing) adding value to the farmer’s produce, generates employment opportunities and increasing the farmers income. Therefore, development of agro-industries implies the development of agriculture on one hand and the entire set of industries. Thus the agro-industry is a distinct off shoot of forward linkage. Agro-processing industries have a prominent place in the Indian economy in terms of income, employment generation, poverty alleviation, improving agricultural productivity, reducing post harvest losses, availability of better nutrition, export promotion and foreign exchange earnings.

B. PERIOD OF STUDY

The reference period chosen for the study covers both pre and post liberalization period. The pre liberalization period covers between 1976-77 and 1990-91 and post liberalization period between 1991-92 and 2005-06.

C. SOURCES OF DATA

The data for the current study is collected from secondary sources. They were collected from the following sources:

- (i) Annual Survey of Industries, various issues.
- (ii) Reserve Bank of India Bulletin, various issues.
- (iii) Economic Survey, various issues.
- (iv) Internet.

D. CONCEPTS AND DEFINITIONS USED

1. Registered Factory

Registered factory is one which is registered under sections 2m (i) and 2m (ii) of the Factories Act, 1948. The sections 2m (i) and 2m (ii) refer to any premises including the precincts there of (a) where on ten or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on with the aid of power, or is ordinarily carried on so ; or (b) whereon twenty or more workers are working or were working on any day of the preceding twelve months and in any part of which a manufacturing process is being carried on without the aid of power, or is ordinarily carried on so.

2. Fixed Capital

Fixed capital represents the depreciated value of fixed assets owned by the factory as on the closing day of the accounting year. Fixed assets are those, which have a normal productivity life of more than one year. Fixed capital covers all types of assets, new or used or own constructed, deployed for production, transportation, living or recreational facilities, hospitals, schools, etc. for factory personnel. It includes the fixed assets of the head office

allocable to the factory and also the full value of assets taken on hire-purchase basis (whether fully paid or not) excluding interest elements. It excludes intangible assets and assets solely used for post manufacturing activities such as sale, storage, distribution, etc.

3. Wages

Wages include all remuneration capable of being expressed in monetary terms and also payable more or less regularly in each pay period to workers (defined above) as compensation for work done during the accounting year.

4. Net Value Added

Net value added is the increment to the value of goods and services that is contributed by the factory and is obtained by deducting the value of total inputs and depreciation from value of output.

5. Number of person Engaged

Number of person engaged relate to all persons engaged by the factory whether for wages or not, in work connected directly or indirectly with the manufacturing process and include all administrative, technical, clerical staff as also labour engaged in production of capital assets for factory's own use. This is inclusive of persons holding supervisory or managerial positions or engaged in administrative office, store keeping section and welfare section, sales department as also those engaged in the purchase of raw materials etc., and production of fixed assets for the factory and watch and ward staff. It also includes all working proprietors and their family members who are actively engaged in the work of the factory even without any pay and the unpaid members of the co-operative societies who worked in or for the factory in any direct and productive capacity.

E. STATISTICAL TOOLS

1. Augmented Dickey Fuller Test

Econometric and time series models have been based on the assumption that the underlying data processes are stationary. Empirically it has been

shown that most of the macro variables are non-stationary in nature. Hence, the analysis of non-stationary series with conventional techniques give rise to a fair possibility of spurious co-movement between the variables. In this context, the co-integration and error correction modeling have been suggested to confront the spurious regression and provide a short-run dynamics of causal relationship.

Before doing any test of co-integration, it is necessary in the first place to ascertain that the concerned series are not $I(0)$ and also the exact order of integration since co-integration between two variables arises only when they are of the same order. Hence, the test for unit-root becomes obvious. Engle and Granger (1987) described a set of seven test statistics for testing the null hypothesis of no co-integration. These are:

1. Co-integrating Regression Durbin Watson (CRDW)
2. Dickey Fuller (DF)
3. Augmented Dickey Fuller (ADF)
4. Restricted Vector Auto Regression (RVAR)
5. Augmented Restricted Vector Auto Regression (ARVAR)
6. Unrestricted Vector Auto Regression (UVAR) and
7. Augmented Unrestricted Vector Auto Regression (AUVAR).

They carried out simulations to investigate the ability of the various tests to detect co-integration and advocated the use of CRDW and DW tests for their simplicity and also in cases where variables follow random walk. In general ADF is the “recommended approach” since it has essentially the same critical value for finite sample experiments. (Engle and Granger 1981).

In the present study non-stationarity or the presence of a unit-root was tested using the Augmented Dickey Fuller (1979, 1981) tests. To test if a sequence Y_t contains a unit-root, two different regression equations are considered.

$$\rho Y_t = \alpha + \gamma Y_{t-1} + \theta t + \sum \beta_i \rho Y_{t-i} + \varepsilon_t \quad \dots\dots\dots(1)$$

$$\rho Y_t = \gamma Y_{t-1} + \sum \beta_i \rho Y_{t-i} + \varepsilon_t \quad \dots\dots\dots(2)$$

The first equation includes both a drift term and a deterministic trend and the second does not contain an intercept but include the deterministic trend. In both the equations the parameter of interest is γ . If $\gamma = 0$, the Y_t sequence has a unit-root. The estimated 't' statistic is compared with the appropriate critical value of Dickey Fuller tables to determine if the null hypothesis is valid. However, if the variables are non-stationary, they are tested for the possibility of a co-integrating relationship.

i) Multi-variate co-integration analysis

The multi-variate co-integration technique developed by Johansen (1998) and Johansen and Juselius (1990) was used to test for the number of co-integrating vectors (co-integration rank) in the system. This test enables the estimation of more than one co-integrating relationship and also permits testing for the validity of any restrictions on co-integrating relationships implied by economic theory. This procedure has a further advantage when testing for co-integration. When there are 'n' series and (n-1) potential co-integrating relationships, it first test the null hypothesis of zero co-integrating relationship and proceeds in step-wise fashion to test the null of higher number of such relationship upto (n-1).

The general form of the model for a higher order autoregressive process is :

$$\Delta \chi_t = \sum \pi_1 \Delta_{t-1} + \pi \chi_{t-m} + \varepsilon_t \quad \dots\dots\dots (3)$$

where c_t is the (n x 1) vector of variables, e_t is an independently and identically distributed 'n' dimensional vector with zero mean and variance matrix $\hat{S}IP$ is a (n x 1) matrix and its rank is equal to the number of independent co-integration vectors.

The rank of a matrix is equal to the number of its characteristic roots that differs from zero. Thus, the number of independent co-integrating vectors

in the system can be determined by checking the significance of the characteristic roots of π (estimated matrix). The test of the number of co-integration vector can be conducted using the following test statistics:

$$I_{\text{trace}}(r) = -T \sum \ln(I - I_i) \dots\dots\dots (4)$$

$$I_{\text{max}}(r, r+1) = -T \ln(1 - I_{r+1}) \dots\dots\dots (5)$$

where I_i are the estimated values of the characteristic roots or eigen values obtained from the estimated π matrix and T is the number of usable observation. The trace test (equation 4) is the test statistic that tests for the null hypothesis that the number of co-integrating vector is less than or equal to 'r' against a general alternative. The maximum eigen value test (equation 5) is the test statistic that test the number of co-integrating vectors 'r' against the alternative of (r + 1) co-integrating vectors. Critical values for both tests are tabulated in Osterwald-Lenum (1992).

ii) Vector Error Correction Model (VECM)

The purpose of the VECM is to focus on the short run dynamics while making them consistent with the long run solution. If a number of variables are found to be co-integrated with at least one co-integrating vector, then there always exists a corresponding error correction representation which implies that the changes in the dependent variable can be formulated as a function of the level of disequilibrium in the co-integration relationship and fluctuations in other explanatory variables. In other words, the error correction term in the VECM provides additional channel for the detection of Granger causality.

In fact if X_t and Y_t are co-integrated, the first difference of X_t and Y_t can be modeled using vector autoregression on VAR augmented by including $Y_{t-1} - \theta X_{t-1}$ as an additional regressor :

$$\rho Y_t = \beta_{10} + \beta_{11} \rho Y_{t-1} + \dots + \beta_{1p} \rho Y_{t-p} + \gamma_{11} \rho X_{t-1} + \dots + \gamma_{1p} \rho X_{t-p} + \alpha_1 (Y_{t-1} - \theta X_{t-1}) + u_{1t} \dots\dots\dots (6)$$

$$\rho Y_t = \beta_{20} + \beta_{21} \rho Y_{t-1} + \dots + \beta_{2p} \rho Y_{t-p} + \gamma_{21} \rho X_{t-1} + \dots + \gamma_{2p} \rho X_{t-p} + \alpha_2 (Y_{t-1} - \theta X_{t-1}) + u_{2t} \quad \dots \dots \dots (7)$$

where the β 's and the γ 's are unknown coefficients and u_{1t} and u_{2t} are error terms.

The term $Y_t - \theta X_t$ is called error correction term. The combined model in equations (6) and (7) is called a vector error correction model (VECM). In a VECM, past values of $Y_t - \theta X_t$ help to predict future values of ρY_t and / or ρX_t (Stock and Watson, 2004).

The Granger causality can be detected through the statistical significance of t-test for the lagged error-correction term and/or the F-test applied to the joint significance of the sum of lags of each explanatory variable. The non-significance both the t-test and F-test in the system indicates econometric exogeneity of the dependent variable. In addition to indicating the direction of causality among variables, the VECM also allows us to discriminate the short run and long run Granger causality. The F-test of the explanatory variables (in their first differences) indicates the "short run" casual effects, whereas the "long run" causal relationship is implied through the significance of the t-test of the error correction term, since it contains long run co-integration information between the variables.

2. Exponential Growth Function

To find out the growth rate of wage rate, capital, number of factories, net value added, fixed capital number of person engaged and net value added exponential growth function of the following form was applied.

$$Y = AB^t$$

$$(B = 1 + i)$$

$$(i = B - 1)$$

Where i = Annual growth rate. The value of A and B are estimated by converting the exponential equation into linear function of the form.

$$\text{Log } Y = \text{Log } A + t \text{ log } B$$

3. Regression Analysis

a. Employment Elasticity

Employment elasticity was estimated as follows, where employment is regressed on the net value added and fixed capital.

$$\ln L_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 \ln K_t$$

Where, L_t = Number of person engaged

Y_t = Net value added

K_t = Fixed capital

α_0 = Constant

α_1 = Elasticity of employment with respect to net value added

α_2 = Elasticity of employment with respect to fixed capital

$\alpha_2 > 0$ = implies of employment and capital are complements

$\alpha_2 < 0$ = implies of employment and capital are substitutes.

b. Output Elasticity

The elasticity of output with respect to employment of labour and fixed capital measures the change in output due to change in one unit of labour or change in one unit of capital. The output elasticities was estimated as follows:

$$\ln Y_t = \alpha_0 + \alpha_1 \ln L_t + \alpha_2 \ln K_t$$

Where, α_0 = Constant

L_t = Number of person engaged

K_t = Fixed capital

α_1 = Elasticity of output with respect to labour

α_2 = Elasticity of output with respect to capital

Y_t = Elasticity of output with respect to net value added

c. Wage Elasticity

The wage elasticity with respect to labour productivity and net value added measures the change in wage rate due to change in one unit of the above mentioned variables. The elasticity can be estimated as follows:

$$W_t = \alpha_0 + \alpha_1 \ln L_p + \alpha_2 \ln y$$

W = Wage

L_p = Labour productivity

Y = Net value added

α_0 = Constant

α_1 = Elasticity of wage with respect to labour productivity

α_2 = Elasticity of wage with respect to net value added

4. Other Tools

Besides the above-mentioned tools percentages, indices, graphs and diagrams were also used to analyze the data.

F. LIMITATIONS OF THE STUDY

1. The choice of the variables is fully governed by the availability of data.
2. The conclusion emerging out of this study may not suit other areas and reference periods.