*International Journal of Applied Social Science*
*Volume 6 (1&2), January & February (2019) : 68-80*
*Received : 07.11.2018; Revised : 21.11.2018; Accepted : 08.12.2018*

***RESEARCH PAPER***
ISSN : 2394-1405 (Print)

# Agricultural Trade in India: An Empirical Analysis

**SUMEDHA BHATNAGAR*[1], CHITRA CHOUDHARY[2] AND SWAPNIL BHARDWAJ[3]**
[1]Intern, Industries Department, Government of Rajasthan, Jaipur (Rajasthan) India
[2]Assistant Professor, Department of Economics, University of Rajasthan, Jaipur (Rajasthan) India
[3]Assistant Professor, Department of Economics, University of Rajasthan, Jaipur (Rajasthan) India

## ABSTRACT

Agriculture trade of India has multiplied over the years. It is majorly composed of raw material and edible food items. There are many factors that affect the direction and volume of trade. The objective of the paper is to estimate import and export elasticity of agricultural products in India, it tries to establish a relationship between the independent and dependent variables of both export and import function and also examine the causality and the direction of the relationship between the variables, during the span of 1990-2015. Import and export value of agricultural trade are used as regressand and income and exchange rate are used as regressor. To analyse the relationship among the variables Vector Error Correction Model (VECM), Ordinary Least Square (OLS) model, and Granger Causality have been used. The results indicate that both import and export price elasticity is less than their income elasticity. Imports are less sensitive to exchange rate and are comprehensively explained by the change in Gross Domestic Product (GDP) of India. Thus, a change in real exchange rate will have limited impact on the import and export of India. The focus should be to strategise the distribution of resources and emphasize the restructuring of overall production process to improve the quality of goods produced and to encourage import substitution of intermediate goods.

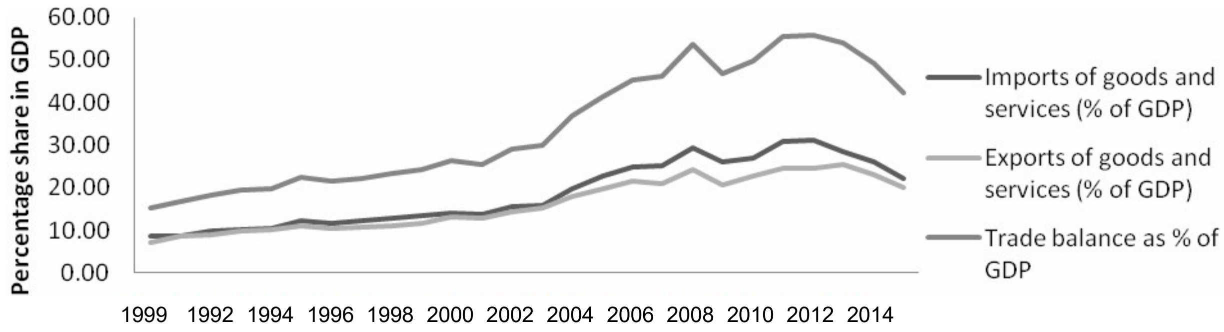
**Key Words :** India, Agriculture trade, VECM, Granger causality

## INTRODUCTION

Today, India is one of the fastest growing economies in the world it has established its presence in every domain of social and economic front. The growth of Indian economy is broadly based on three sectors namely agricultural, industrial and services sector. Over the years, the service sector has grown at a faster rate than the agricultural and industrial sector. The contribution of agriculture to national income has declined but its role in economic development cannot be undermined even today, agriculture and the allied sector continue to be a pivotal factor for sustainable development of developing India. After independence, India suffered from famine and scarcity of food. Since then the principle objective of the country is to become self-sufficient and self-efficient in terms of food availability. With the progress in economy and liberalization, it has not only managed to become self-sufficient but has also become a significant trader of many products like rice, cotton of which it is one of the largest producers.

In terms of trade, trade liberalization in India began in the 1970s along with China but in few years' time, China progressed systematically to achieve liberalized trade regime by 1980s which India managed to achieve by 1990s (Pangariya, 2008). Trade balance of India as a percentage of Gross Domestic Product (GDP) was 15.24 per cent in 1990 which increased to 42.22 per cent in 2015. Fig. 1 (appendix) indicates the trend of trade balance as a share of GDP. In 1990-91, foreign exports from India were 31.59 billion USDollars (USD) which grew to 501.52 billion USD in 2015-16 and imports increased from 33.49 billion USD to 514 billion USD. As a share of GDP, exports contributed 7.13 per cent in 1990 and imports contributed 8.55 per cent which increased to 19.94 per cent and 22.25 per cent, respectively in 2015-16. India is the member of numerous bilateral trade organizations in 2015; its largest exporting partners were

**How to cite this Article:** Bhatnagar, Sumedha, Choudhary, Chitra and Bhardwaj, Swapnil (2019). Agricultural Trade in India: An Empirical Analysis. *Internat. J. Appl. Soc. Sci.,* **6** (1&2) : 68-80.




Source: Computed

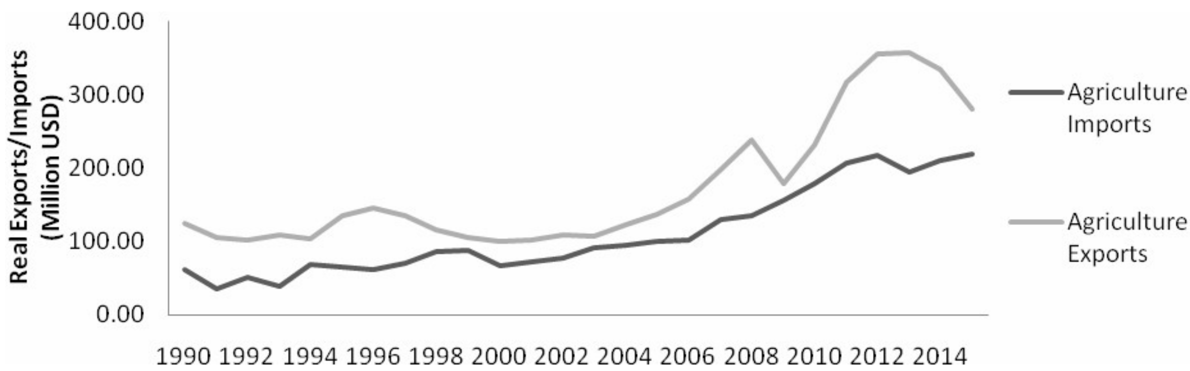
**Fig. 1 : Import and Export Share in GDP**

the USA, the UAE and China with 16.9 per cent, 15.2 per cent and 11.3 per cent share in country's total exports, respectively. In terms of imports, India imports maximum from China, Saudi Arabia and Switzerland with 15.8 per cent, 11.2 per cent and 5.5 per cent, respectively. In reference to trade unions, European Union is the largest trading partner of India, it contributes 52 per cent to India's total exports of goods and services and nearly 62 per cent its total imports from EU.

**Agriculture Trade Scenario :**

In terms of agriculture produce, India has become a significant exporter of rice, cotton, meat, oil meals, pepper and sugar. Agriculture exports of India have jumped from 124.74 million USD in 1990 to 279.87 million USD in 2015. Due to subdued global demand, the exports declined from 334.45 million USD recorded in 2014-15. On the other hand, agriculture imports of India have increased from 61.24 million USD in 1990 to 219.28 million USD in 2015. Over the years export market of the country has diversified and has spread to a wide range of nationalities. Buta contrasting picture is seen in imports of India that has become asymmetrical towards vegetable oil and pulses that have a notable share in total agriculture imports of the country. India's pulse imports are largely from Canada, Myanmar and Australia and Vegetable oil is majorly imported from Malaysia.

The overall trend of real exports and imports of agriculture produce is given in Fig. 2 (appendix). According to World Trade Organization, all product groups defined under Standard International Trade Classification (SITC) are broadly classified as primary products, manufactured products and other products (which are not classified elsewhere). Primary products include agricultural products, fuel and mining products. Manufactured products are further classified as iron and




Source: World Bank database

**Fig. 2 : Real Export and Import of Agriculture Produce of India (in Million USD)**

steel, chemical, other semi-manufactures, machinery and transport equipment, textiles, clothing and other manufactures. The paper focuses only on trading of agricultural products and the attempt is to estimate trade elasticity of agriculture products of India during the period of 1990-2015. As per the definition provided by the WTO, agricultural products include food (both processed and unprocessed), raw materials like hides and skins, crude rubber, pulp and waste paper etc.

The paper is broadly discussed under three broad objectives, the first section deals with the estimation of import and export elasticity of agriculture products of India. The second section focuses on the establishment of a relationship between the independent and dependent variables of both export and import functions. The last section checks the causality and the direction of the relationship between the variables.

**Literature review :**

Prices of commodity and income of a nation are the key factors to evaluate trade balance response to market fluctuations. Within this framework of analysis, the forward path of trade balance can be predicted using trade elasticity that is defined as the change in a country's imports and exports in response to the change in national income or relative prices of imported goods and services to domestically produced ones (Aiello *et al.,* 2015). Jones and Nusbaumer (1976) discussed bilateral trade elasticity by estimating the total of 182 bilateral trade flows for the period of 1951-1962. The import demand function and export demand function were based on the regression function of bilateral indices and real Gross National Product (GNP) of the trading countries as independent variables. The results reflected that the trade between the selected countries was erratic both in terms of volume and commodity composition. It was also found that in absence of trade ties, imports of certain countries were either due to extreme supply limitations or due to exorbitant price advantages. The authors supported these unexpected results by the fact that the goods selected to analyze trade flow were not the goods traded by both the trading countries.

Hatemi-J. and Irandoust (2005) tried to explore long-run bilateral trade elasticities between Sweden and its six major trading partners for the period of 1060-99. The authors applied the asymptotic theory of panel cointegration developed by Pedroni (1995, 1997, and 1999). The bilateral elasticity of import and export functions were estimated using dummy least square method by taking domestic income and the bilateral exchange rate of Sweden and its partnering country as the independent variables. The approach concluded that import function was very elastic for domestic income but less elastic to terms of trade in real terms and export function was foreign income elastic but was less price elastic.

Aiello *et al.* (2015) also estimated trade elasticities for China and the OECD countries for the period of 1990-2013 using dynamic and error correction mechanism on non-stationary and cointegrated time series data. The results indicated that both exports and imports both were income elastic in the long-run supporting the previous studies.

Narayan and Narayan (2010) estimated import demand elasticities for Mauritius and South Africa for the period of 1963 to 1995 and 1960 to 1996, respectively using the autoregressive distributed lag and error correction test concluded domestic income and relative prices have a significant impact on the long run import demand of both the countries. Also, any shock to imports will drag away Mauritius by three years and South Africa by 8 years from their respective equilibrium level. Previous to this study, Bahmani-Oskooee (1998) used Johansen and Juselius (JJ) (1990) technique for cointegration to estimate long run import demand elasticities for South Africa also found that income and relative price elasticities of import demand to be elastic. Using the similar techniques, Bahmani-Oskooee and Niroomand (1998) re-estimated the import demand model for South Africa over the 1960 to 1992 period by excluding the nominal exchange rate inferred a contrasting result that income and relative prices elasticities to be inelastic to import demand. This result was supported by Senhadji (1998) who used Phillip-Hansen Fully Modified (FM) estimator to derive the long run elasticities for South African and Mauritius import demand for the period 1960 to 1993.

Hasan and Khan (1994) examined the impact of devaluation on Pakistan's trade balance for the period 1972-91. According to their results devaluation led to improvement in trade balance as the Marshall –Lerner (ML) condition was satisfied in the case of price elasticities of Pakistan. The estimation procedure of Hasan and Khan (1994) was further modified by Afzal and Ahmad (2004) who estimated the Marshall-Lerner condition for Pakistan by employing cointegration technique for the period 1960-2003. The results generated were similar to the previous theory of Hasan and Khan. The authors inferred that the satisfaction of ML condition is not sufficient for successful devaluation rather micro economic and macroeconomic aspects also play a major role in the balance of payment adjustment process.

In the working paper of IMF, Hakura and Billmeier estimated trade elasticities in the Middle East and Central Asian countries with respect to real effective exchange rate inferred that import and export elasticities are lower in the oil-exporting Middle East and Central Asian countries compared to non-oil exporting countries of this region.

According to Haliland Oguzhan (2014), foreign trade balance and its dynamics can be studied under three different approaches that are elasticity approach, absorption approach and the monetarist approach. They tried to determine foreign trade of Turkey through its national income, foreign direct investment, real exchange rate and export and import prices for the period 1987-2011 on the basis of absorption and elasticity methods. The import and export demand function of Turkey were estimated using unit root test, co-integration analysis and Granger Causality tests. The paper also stated that when the conditions of elasticity approach are not met in short term then J-curve effect emerges in the foreign trade of that country. Noland (1989), estimated Japanese trade elasticity using generalized gamma distributed lag model and through the estimated results J-curve is developed for Japan.

Raissiand Tulin (2015) gave an overview of short-run and long-run price and income elasticity of Indian exports over the period 1990 to 2013. They estimated elasticities using panel ARDL approach, where the long-run effects were calculated from OLS estimates of short-run coefficients export volume for 45 Indian industries and industry specific international relative prices. The results stated that Indian exports are sensitive to international relative prices and external demand. Binding supply-side constraints dampen price responsiveness in the short run.

Dutta and Ahmed (2006) empirically analyzed the behavior of Indian Aggregate imports during the period of 1971-95 by using cointegration and error correction modeling approach and found that imports are largely explained by real GDP of India and are least sensitive to import price change, they also found that import liberalization has very little impact on the overall import demand of the country.

The voluminous literature also indicates that exports and imports of a country are majorly dependent on relative prices of imports and exports, real exchange rate and GDP of the importing and exporting country. Theoretically, it is often presumed that trade imbalance can be checked by controlling exchange rate which has a high impact on overall trade balance of a country. Much research is based on the basic assumption that imports and exports are imperfect substitutes for each other, as formalized by Goldstein and Khan (1985). Carrying forward this basic assumption, the paper attempts to provide new evidence on the import and export elasticity of India with respect to USA (largest trading country). The paper will also propose an updated analysis of the trading behavior of Indian agriculture product market after liberalization and also the period with numerous transitions in world trade structure.

## METHODOLOGY

The study of trade elasticity is based on the period ranging from 1990-2015. The selected period will represent the trade elasticity of agricultural products of Indian after Liberalization Privatization and Globalizations (LPG) reforms of 1991. The data on GDP at constant price (2010=100) for India and USA is sourced from World Bank database. Since the USA is the highest importing country of India and contributes nearly 16 per cent of total exports of the country, we have estimated export elasticity of the country using the GDP constant price (2010=100) of the USA. Under the framework of imperfect substitutes, exports are the function of real exchange rate (which is a proxy for relative prices) and income of the US, while imports depend on GDP of India and real exchange rate. It is also assumed that world supply of imports to India is perfectly elastic for the simple reason that India imports relatively small fraction of total world imports (Dutta and Ahmed, 2006). Double-log model of two functions is then further used to empirically test for causality and estimated elasticity. The log-linear specification of imports and exports are as follows:

Export Function

$$\ln AGREX_t = a + b \ln REXCH_t + c \ln YGDP^{US}_t + u_t \quad \ldots(1)$$

Import Function

$$\ln AGRIMP_t = a' + d \ln REXCH_t + e \ln GDPI_t + u_t \quad \ldots(2)$$

where,

$AGREX_t$ = Total exports of agriculture products of India at time t

$AGRIMP_t$= Total imports of agriculture products of India at time t

$REXCH_t$= Real exchange rate of India at time t

$GDP^{US}$= Real GDP of USA (2010=100)

GDPI = Real GDP of India (2010=100)

Given the log-linear form of equation 1 and 2, b and d are the export and import elasticity to the real exchange rate, respectively.

**Table 1: Trade elasticity of agriculture in India**

| Independent variables / Dependent variables | Real Imports | Real Exports |
|---|---|---|
| Real GDP India | 0.9195 | - |
| | (0.000) | |
| Real GDP the USA | - | 1.0743 |
| | | (0.0000) |
| Real Exchange Rate | -0.5687 | -2.0053 |
| | (0.0256) | (0.0000) |
| R-Square Values | 0.9417 | 0.8683 |
| F-Value | 185.94 | 75.85 |

Source: Author's Calculation based on Secondary Data
p-value in parenthesis

## RESULTS AND DISCUSSION

**Trade elasticity :**

Elasticity is a measure of variables sensitivity to a change in another variable. In equation 1 and 2 export and import of agricultural products are the function of real exchange rate and income. The change in exports and imports due to change in income of the countries will determine the income elasticity of those countries whereas, change in export and import values due to change in real exchange rate will determine the export and import price elasticity. Income and price elasticity are calculated by applying ordinary least square method in the above-defined import and export functions.

According to the theory export price elasticity is expected to be negative as devaluation is expected to increase the real exports of the country. Similarly, import price elasticity is expected to be positive as devaluation or depreciation of domestic currency will result in the decline of imports due to rise in import prices. Income elasticity of both the countries is expected to be positive as the increase in national income in either of the country will result in the increase in imports of that country.

Computed OLS results are given in the Table 1 (appendix). It reflects that one per cent increase in GDP of India will result to increase in its real agriculture imports by 0.9 per cent and 1 per cent increase in GDP of US will result in nearly one per cent increase in the real agriculture exports of India. In terms of price elasticity, one per cent increase in the real exchange rate will decrease the import by 0.5 per cent as the value of domestic currency depreciates and foreign goods become more expensive. On the other hand, a per cent increase in the real exchange rate is also decreasing the real exports by two per cent which is contrasting to the theory which states that exports and the increase in real exchange rate has a positive relationship, but the calculated export price elasticity is further supported by its significant probability values. The table also shows income elasticity of India and US are close to unity and are more elastic than both export and import price elasticity of India. The OLS method used to determine elasticity is supported by significant R square value and Durbin-Watson value and other statistical assumptions of normality, serial correlation and heteroscedasticity for both import and export functions given in the appendix Table 8 and 9.

**Long-run and short-run relationship :**

Before fitting the model, stationarity of time series variables is checked through the unit root test.

**Step 1 : Check for stationarity of variables :**

In general, a time series model is said to be stationary if the two conditions are satisfied. First, the whole potential distribution is independent of time and second, the covariance at any two-time points is dependent only on the distance between those points and are independent of time. It is important to have a stationary time series data as it will be time invariant and also it ensures that time series distribution will fluctuate around its mean value with nearly constant amplitude. Also, it is difficult to generalize the results of non-stationary distribution as it can only be studied at a particular point in time. And is therefore of least practical use. The approach to unit root testing implicitly assumes that the time series that is to be tested can be written as

$Y_t = D_t + z_t + \varepsilon_t$

where,

$D_t$ = deterministic component (trend, seasonal components etc.)

$z_t$ = stochastic component

$\varepsilon_t$ = stationary error process

The aim is to determine whether the stochastic component contains a unit root or is stationary

Given a time series data, Augmented Dickey-Fuller (ADF) considers three differential-form autoregressive equations to detect the presence of a unit root:

$Y_t$ is a random walk:

$$\Delta Y_t = \gamma\, Y_{t-1} + \sum_{j=1}^{p} [(\partial]_j\, \Delta Y_{t-j}) + \varepsilon_t$$

$Y_t$ is random walk with drift:

$$\Delta Y_t = \alpha + \gamma\, Y_{t-1} + \sum_{j=1}^{p} [(\partial]_j\, \Delta Y_{t-j}) + \varepsilon_t$$

$Y_t$ is a random walk with drift around a stochastic trend:

$$\Delta Y_t = \alpha + \beta t + \gamma\, Y_{t-1} + \sum_{j=1}^{p} (\partial_j\, \Delta Y_{t-j}) + \varepsilon_t$$

where,

*t* is the time or trend variable

α is the intercept constant called a drift

β is the coefficient on the time trend

γ is the coefficient presenting process root, *i.e.* the focus of testing

p is the lag order of the first difference autoregressive process

$\varepsilon_t$ is an independent identically distributed residual term

The difference between the three equations concerns the presence of the deterministic elements α (a drift term) and $\beta_t$ (a linear time trend). The focus of testing is whether the coefficient γ equal zero that infers the original series has a unit root.

Table 2 (appendix) shows the results of the test, indicating that all the variables are non-stationary at the level and stationary at first difference when Akaike Information Criterion is applied at both intercepts and at the trend. The results are further supported by the output of correlogram of the autocorrelation function (ACF) which is a graphical analysis of stationarity in given data.

Since all the variables are integrated at first difference, the second step will be to apply cointegration on the selected group of variables.

**Table 2: Unit Root Results**

| Augmented Dickey-Fuller Test | | | |
|---|---|---|---|
| Variables | Level/ First Difference | Without Trend (p- value) | With Trend (p- value) |
| LnAGRMP | Level | 0.8644 | 0.1315 |
| | First Difference | 0.0000 | 0.000 |
| LnAGREX | Level | 0.8946 | 0.5955 |
| | First Difference | 0.0077 | 0.0477 |
| LnGDPI | Level | 0.9998 | 0.2559 |
| | First Difference | 0.0015 | 0.0054 |
| LnGDPUSA | Level | 0.1570 | 0.7276 |
| | First Difference | 0.0341 | 0.0299 |
| LnREXCH | Level | 0.5888 | 0.0500 |
| | First Difference | 0.0009 | 0.0040 |

Source: Author's Calculation based on Secondary Data

$H_o$-variable has a unit root  $P<0.05$ null hypothesis is rejected

### Step 2: Cointegration test on models :

When the series individually are stationary at the difference and there is the linear combination of the variables at their levels then the series is said to be cointegrated. When the variables are cointegrated then we can say that there is a long term and equilibrium relationship between the variables. Prior to applying cointegration and VEC model it is important to determine the optimum lag length. Importance of lag length in time series data lies in the fact that in time series data the future values are stochastically dependent of the past observations. Lag length identifies the time delay of the response to known leading indicator. If the lag length is too small then the remaining serial correlation in the errors will bias the test and if lag length is too large then the power of the test will suffer.

Given a set of I (1) variables $\{X_{it}\ldots X_{kt}\}$. If there exists a linear combination of all variables with vector β so that,

$\beta_1 x_{1t} + \ldots + \beta_k x_{kt} = \beta' xt$.....Trend stationary

$\beta_j \neq 0$, j=1,...,k. Then the x's are cointegrated of order C (1, 1)

Cointegration in this paper is tested using Johansen cointegration test also known as Johansen and Juselius (JJ) test. It has two test statistics to check cointegration among the variables namely, trace test and maximum Eigen value test. Trace test has a null hypothesis that there are at most *r* cointegration vectors and maximum Eigen value has a null hypothesis that there are r+1 cointegration vectors versus there are r cointegration vectors.

### Agricultural Exports of India :

Theoretically, there exists a relationship between exports and real exchange rate as exports significantly contribute to the inflow of foreign income of the country. When there is depreciation in the value of domestic currency the export products prices reducerelative to the foreign currency result to which export demand tends to increase. Exports also depend on the real income of importing country and as seen above has a positive relationship with exports. Increase in the GDP of importing country will tend to increase the demand for exporting countries goods. In agriculture products, India majorly exports food items and raw material like rice and animal products. Among which rice is necessary good which will in demand and will have limited impact effect due to change in exchange rate. The export value can significantly depend on the GDP of importing country. Mathematical results also support the following theory. Lag length chosen in export function is 3 on the basis of SC and LR criteria. On the basis of selected lag length, the equations were found to be cointegrated indicating that there is a long-run relationship among the log values of agriculture exports, real exchange rate and real GDP of US. The following Table 3 (appendix) presents the summary results of the evaluation of the demand for export in the long-run during the period 1990-2015 on the basis of Trace test and Maximum Eigen Values.

**Table 3: Johansen Cointegration Results**

| Null | Alternative | Statistic | 95% Critical Value |
|---|---|---|---|
| **Maximum Eigen Value Test** | | | |
| r =0 | r =1 | 35.14182 | 21.13162 |
| r ≤1 | r = 2 | 12.60997 | 14.26460 |
| r ≤2 | r = 3 | 5.097111 | 3.841466 |
| **Trace Test** | | | |
| r = 0 | r =1 | 52.84890 | 29.79707 |
| r ≤1 | r = 2 | 17.70708 | 15.49471 |
| r ≤2 | r = 3 | 5.097111 | 3.841466 |

Source: Author's Calculation based on Secondary Data

The results show that real agriculture exports, real GDP of India and Real exchange rate are cointegrated at 5 per cent level. That is, there exists long-run relationship among the variables of the export model.

**Step 3: VECM Approach- Long Run Relationship:**

Vector Error Correction model (VECM) is a VAR model that is designed to analyze non-stationary data having cointegration relationship, and alsohelps in comprehending the long-run as well as the short run dynamics among the variables.

The VECM with the cointegration rank $r \leq k$ is as follows:

$$\Delta Y_t = C + \Pi\, Y_{t-1} + \sum_{i=1}^{p-1} \tau_i\, \Delta Y_{t-1} + \varepsilon_t$$

where,

$\Delta$ : Operator differencing, where

$\Delta Y_t = Y_t - Y_{t-1}$

$Y_{t-1}$ : Vector Variable endogenous with the 1st lag

$\varepsilon_t$ : Vector Residual

C : Vector Intercept

$\Pi$ : Matrix coefficient of cointegration ($\Pi=\alpha\beta^{\dagger\prime}$)

$\alpha$=vector adjustment, matrix of order (k x r) and

$\beta$=vector cointegration (long-run parameter) matrix

$\tau_i$=Matrix with order (k x k)

Of the coefficient endogenous of the i-th variable.

VECM ties the short run behavior of agriculture exports to its long-run values. It also helps in finding the speed of adjustment of variables that is, the level at which agriculture exports of India can be brought back to equilibrium condition after a shock on other variables (Enders, 2015). Table 4 (appendix) shows the results of VEC mechanism when all the prerequisite conditions of the model are satisfied. Significant R-square value and Durbin Watson (DW) continue to support the results of VECM in agriculture export function of India. The coefficient value of C(1) shows the speed of adjustment of export value in response to any kind of shock given to it due to real GDP of US and real exchange rate the given value is significant at 10 per cent significance level. The coefficient of -1.12 for agriculture exports of India implies that a deviation from the long-run level of exports in the given period is corrected by about 112 per cent in the next period. The negative sign of error correction term implies that the series of agriculture exports of India which is the function of real exchange rate and GDP of US is non-explosive and the long run equilibrium of the series is attainable. In order to test the reliability of error correction model, diagnostic tests are applied for testing normality, serial correlation and heteroscedasticity of the residual term. The results are given in the Table 10 (appendix). The results of LM test show no evidence of autocorrelation in the given model. The model passes the Jarque-Bera normality tests stating that the given error term is normally distributed. The Breusch-Pagan-Godfrey's Heteroscedasticity test shows that the given error term is homoscedastic and independent of the regressor. Hence, it can be safely claimed that the model has a good statistical fit.

**Short run relationship :**

The short run relationship among the variables is further tested with the aid of Wald test. It is also known as Wald Chi-Squared test it is conducted to find out the significance level of explanatory variables in a model that is, whether explanatory variable adds some meaning to the designed model. The null hypothesis of the test is explanatory variable does not add significant value to the model. When the Wald test is used to test the point significance of several coefficients then the Wald statistics is given in quadratic form as:

$$W = \widehat{\beta_2} var^{-1}(\widehat{\beta_2})\widehat{\beta_2}$$

where, $\widehat{\beta_2}$ is the maximum likelihood estimator of $\beta_2$ and $var(\widehat{\beta_2})$ is its variance-covariance matrix.

In the equation produced under VEC model, the coefficients of explanatory variables, namely real GDP of the US and real exchange rate are tested for their short-run impact on the export function using the Wald test.

Equation generated under VEC model is as follows:

D(LNAGREX) = C(1)*( LNAGREX(-1) + 5.31246825502*LNREXCH(-1) - 26.6016503413 ) + C(2)*( LNGDPUSA(-1) + 3.96005182638*LNREXCH (-1) - 32.43892255 ) + C(3)*D(LNAGREX(-1)) + C(4)*D(LNAGREX(-2)) + C(5)*D(LNAGREX(-3)) + C(6)*D(LNGDPUSA(-1)) + C(7)*D(LNGDPUSA(-2)) + C(8)*D(LNGDPUSA(-3)) + C(9)*D(LNREXCH(-1)) + C(10)*D(LNREXCH(-2)) + C(11)*D(LNREXCH(-3)) + C(12)

**Table 4 : VEC Model Results for Export Function**

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C(1) | -1.126303 | 0.618396 | -1.821330 | 0.0986 |
| C(2) | 0.816161 | 0.402226 | 2.029108 | 0.0699 |
| C(3) | 0.624949 | 0.304114 | 2.054983 | 0.0669 |
| C(4) | 0.537540 | 0.483217 | 1.112419 | 0.2920 |
| C(5) | 0.060240 | 0.331087 | 0.181946 | 0.8593 |
| C(6) | -0.451099 | 2.351102 | -0.191867 | 0.8517 |
| C(7) | -0.379917 | 2.647443 | -0.143503 | 0.8887 |
| C(8) | -0.270397 | 3.032734 | -0.089159 | 0.9307 |
| C(9) | 0.365497 | 1.072533 | 0.340779 | 0.7403 |
| C(10) | 1.753198 | 0.626872 | 2.796740 | 0.0189 |
| C(11) | -0.002265 | 0.922428 | -0.002455 | 0.9981 |
| C(12) | 0.018638 | 0.116974 | 0.159331 | 0.8766 |
| R-squared | 0.728402 | F-statistic | | 2.438102 |
| Durbin-Watson stat | 2.098765 | Prob(F-statistic) | | 0.085731 |

Source: Author's Calculation based on Secondary Data

D(LNAGREX) = C(1)*( LNAGREX(-1) + 5.31246825502*LNREXCH(-1) -26.6016503413 ) + C(2)*( LNGDPUSA(-1) + 3.96005182638*LNREXCH(-1) - 32.43892255 ) + C(3)*D(LNAGREX(-1)) + C(4)*D(LNAGREX(-2)) + C(5)*D(LNAGREX(-3)) + C(6)*D(LNGDPUSA(-1)) +C(7)*D(LNGDPUSA(-2)) + C(8)*D(LNGDPUSA(-3)) + C(9)*D(LNREXCH(-1)) + C(10)*D(LNREXCH(-2)) + C(11)*D(LNREXCH(-3)) + C(12)

**Table 5: Vector Autoregressive Results of Import Function**

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C(1) | -0.046311 | 0.234160 | -0.197776 | 0.8451 |
| C(2) | 1.125170 | 0.230504 | 4.881354 | 0.0001 |
| C(3) | 0.081449 | 0.298529 | 0.272836 | 0.7876 |
| C(4) | -11.00167 | 2.321288 | -4.739469 | 0.0001 |
| R-squared | 0.931958 | Prob (F-statistic) | | 0.000000 |
| Durbin-Watson stat | 1.539471 | F-statistic | | 95.87700 |

Source: Author's Calculation based on Secondary Data

LNAGRIMP = C(1)*LNAGRIMP(-1) + C(2)*LNGDPI(-1) + C(3)*LNREXCH(-1) + C(4)

The coefficient value of C(6), C(7) and C(8) gives the short-run impact of GDP of the US on the agriculture exports of India and C(9), C(10), and C(11) gives the short-run impact of real exchange rate on agriculture exports of India. These set of lagged values of GDP US and real exchange rate are tested for their short run impact using the Wald test whose chi-square value helps in determining the effect of these independent variables on the dependent variable, agriculture exports. The results of Wald test as shown in appendix Table 11 and 12 in the appendix indicates that GDP of US does not have any short-run impact on agriculture exports of India while real exchange rate of India has a significant short-run impact on agriculture exports.

Thus, it can be concluded that GDP of the USA only hasa long-run relationship with agriculture exports and real exchange rate has an influential impact on exports in the long-run as well as in the short-run period.

**Agricultural Imports of India :**

In recent years, import of agriculture produce has increased by manifolds. Even after successful years of green revolution, the major food items in which India has witnessed an increase in imports are vegetable oils and wheat. Theoretically, imports depend upon the real income of the country and exchange rate. They become expensive with the depreciation of the domestic currency and results in fall in demand for imports. On the other hand, demand for import increases with the rise in GDP of importing country. Empirically testing the relationship between imports of agriculture produce of India, GDP and exchange rate same procedure to check cointegration is applied. All the variables of agriculture import function are non-stationary at the level and stationary at I (1) thus cointegration can be applied to the function. Optimal Lag length is selected on the basis of SC criterion. When the cointegration is tested using the lag length of one it is found that probability value is more than 0.05 level of significance and thus null hypothesis cannot be rejected. In other words, it can be said that at lag length one, there is no cointegration among the selected variables thus no long run and short run relationship can be stated between the selected variables of import function.

Thus, the import function is analysed on the basis of Vector Autoregressive Model (VAR model) which is also known as unrestricted VAR model. In this model dependent variable is explained in terms of the lagged value of independent variables, its own lagged values and the disturbance terms that have zero means given all past values of the observed variables.

A p-th order vector auto regression or VAR (p),

**Table 6: Granger Causality of Export Function**

Lags: 3

| Null Hypothesis: | Obs | F-Statistic | Prob. |
|---|---|---|---|
| LNGDPUSA does not Granger Cause LNAGREX | 23 | 1.87391 | 0.1747 |
| LNAGREX does not Granger Cause LNGDPUSA | | 1.07697 | 0.3869 |
| LNREXCH does not Granger Cause LNAGREX | 23 | 4.41793 | 0.0191 |
| LNAGREX does not Granger Cause LNREXCH | | 1.87700 | 0.1742 |
| LNREXCH does not Granger Cause LNGDPUSA | 24 | 0.06231 | 0.9790 |
| LNGDPUSA does not Granger Cause LNREXCH | | 3.71350 | 0.0320 |

Source: Author's Calculation based on Secondary Data
Calculated with 3 Lags

**Table 7 : Granger Causality in Import Function**

| Null Hypothesis: | Obs | F-Statistic | Prob. |
|---|---|---|---|
| LNGDPI does not Granger Cause LNAGRIMP | 25 | 27.5965 | 3.E-05 |
| LNAGRIMP does not Granger Cause LNGDPI | | 1.13569 | 0.2981 |
| LNREXCH does not Granger Cause LNAGRIMP | 25 | 1.31640 | 0.2636 |
| LNAGRIMP does not Granger Cause LNREXCH | | 12.0928 | 0.0021 |
| LNREXCH does not Granger Cause LNGDPI | 26 | 6.04275 | 0.0219 |
| LNGDPI does not Granger Cause LNREXCH | | 17.8989 | 0.0003 |

Source: Author's Calculation based on Secondary Data
Calculated with 1 Lag

with exogenous variable *x* can be written as:

$$Y_t = v + A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + B_0 x_t + B_1 x_{t-1} + \ldots + B_s x_{t-s} + u_t$$

where, $Y_t$ is a vector of k variables, each modeled as the function of p lags of those variables and optimally, a set of exogenous variables $x_t$.

In other words, agriculture import of India is explained by the lagged GDP of India, lagged exchange rate and lagged value of agriculture imports. The Table 5 (appendix) shows the results of VAR model. It indicates that C (2) which is the coefficient of lagged GDP of India has significant probability value to reject the null hypothesis that the lagged coefficient is zero. In economics term, it can be said that agriculture imports only depend on the lagged value of GDP of India and exchange rate has no significant effect on it.

**Granger causality :**

Granger Causality test is the test that helps in identifying the direction of the relationship between the two selected variables that is, it is a limited notion of causality where past values of one series ($X_t$) are useful for predicting future values of another series ($Y_t$), after past values of $Y_t$ have been controlled for (Wooldridge, 2012). In this test, it is assumed that disturbance terms are uncorrelated and all the information relevant to the prediction of the selected variables is only present in the available time series data of the variables. The VAR model is a natural framework for examining Granger causality. Thus, the model of $Y_t$ is a linear function of its own past values, plus the past values of X.

That is, if we consider two time series, $\{Y_t\}$ and $\{X_t\}$ and the lagged equation thus formed:

$$Y_t = \sum_{i=1}^{k} \alpha_i Y_{t-i} + \sum_{i=1}^{k} \beta_i X_{t-i} + u_t$$

Then if $\beta_i = 0$ (i = 1,2 …,k), $X_t$ fails to Granger Cause $Y_t$ . The lag length k is, to some extent arbitrary. If X Granger causes Y, then some or all of the lagged X values have non-zero effects on the $Y_t$, $\beta_i \neq 0$ (i = 1. 2 … k).

**Agricultural exports :**

Granger Causality is tested between agriculture exports of India, exchange rate and GDP of the USA with the lag length of 3. Results in Table 6 (appendix) shows, real exchange rate Granger cause the agricultural exports of India and GDP of US Granger cause the real exchange rate. That is, there exists unidirectional relationship between exchange rate and agricultural exports and between exchange rate and GDP of US.

**Agricultural imports :**

Granger Causality in import function is tested between agriculture imports of India, real exchange rate and GDP of India at the lag length 1. The Table 7 (appendix) shows that the imports of India Granger cause the GDP of India and GDP of India Granger Cause agricultural imports of the country. This statement is also supported theoretically that there exists a bidirectional relationship between imports and GDP of the country. There exists a unidirectional relationship between agriculture imports and exchange rate that is, agriculture imports Granger cause exchange rate. The real exchange

**Table 8: Export Function**

| | $H_o$ | Df | Probability |
|---|---|---|---|
| **Residual Diagnostic test of OLS model** | | | |
| Normality Test (Jarque- Bera Value) | Residuals are multivariate normal | 1.57 | 0.4552 |
| Serial Correlation LM Tests | No serial correlation at lag order h | 3,20 | 0.0502 |
| Heteroscedasticity Test | Residuals are homoscedastic | 2,23 | 0.1342 |
| If p> 0.05, we accept $H_o$ | | | |
| df- degrees of freedom | | | |

Source: Author's Calculation based on Secondary Data

**Table 9: Import Function**

| | $H_o$ | Df | Probability |
|---|---|---|---|
| Normality Test (Jarque- Bera Value) | Residuals are multivariate normal | 2.7721 | 0.2500 |
| Serial Correlation LM Tests | No serial correlation at lag order h | 1,22 | 0.9496 |
| Heteroscedasticity Test | Residuals are homoscedastic | 2,23 | 0.0350 |

Source: Author's Calculation based on Secondary Data

**Table 10: Residual Diagnostic Test for VEC model**

| | $H_o$ | Df | Probability |
|---|---|---|---|
| VEC Residual Normality Tests | Residuals are multivariate normal | 0.2660 (Jarque-Bera Value) | 0.8754 |
| VEC Residual Serial Correlation LM Tests | No serial correlation at lag order h | 3,7 | 0.093 |
| VEC Residual Heteroscedasticity Test | Residuals are homoscedastic | 12,9 | 0.9852 |
| If p> 0.05, we accept $H_o$ | | | |

Source: Author's Calculation based on Secondary Data

**Table 11: Wald Test for Real GDP of the USA**

| Test Statistic | Value | df | Probability |
|---|---|---|---|
| F-statistic | 0.050708 | (3, 10) | 0.9840 |
| Chi-square | 0.152123 | 3 | 0.9849 |
| Null Hypothesis: C(6)=C(7)=C(8)=0 | | | |
| **Null Hypothesis Summary:** | | | |
| Normalized Restriction (= 0) | | Value | Std. Err. |
| C(6) | | -0.451099 | 2.351102 |
| C(7) | | -0.379917 | 2.647443 |
| C(8) | | -0.270397 | 3.032734 |
| Restrictions are linear in coefficients. | | | |

Source: Author's Calculation based on Secondary Data

**Table 12 : Wald Test for Real Exchange rate of India**

| Test Statistic | Value | df | Probability |
|---|---|---|---|
| F-statistic | 2.644989 | (3, 10) | 0.1065 |
| Chi-square | 7.934966 | 3 | 0.0474 |
| Null Hypothesis: C(9)=C(10)=C(11)=0 | | | |
| **Null Hypothesis Summary:** | | | |
| Normalized Restriction (= 0) | | Value | Std. Err. |
| C(9) | | 0.365497 | 1.072533 |
| C(10) | | 1.753198 | 0.626872 |
| C(11) | | -0.002265 | 0.922428 |
| Restrictions are linear in coefficients. | | | |

Source: Author's Calculation based on Secondary Data

rate Granger Cause GDP of India and GDP of India also Granger Cause the real exchange rate which ensures bidirectional relationship between exchange rate and GDP of India.

## Conclusion :

International trade has played an important role in both developed and developing countries. In India agriculture exports are more sensitive to income of importing country than to the real exchange rate fluctuations, exports are more demand driven as compared to the currency value fluctuations. Since, the volume of agriculture exports is largely dependent on the income of importing country, the focus of policy reforms should be onto easing the export policy of the country and preparing the agriculture sector for international competition so that the overall demand for the products increases. Raw materials contribute to a large amount of agriculture exports of the country thus, the focus shall be on the diversification of commodity export along with emphasis on export of finished goods for moving up in the global value chain.

The OLS results show that income elasticity is more than India's agricultural import and export price elasticity.

Even though there is an absence of the long-term relationship between the import of agriculture produce and income of India, it is highly dependent on GDP of the country. There is no long-run impact of real exchange rate on the demand for imports. This may be due to the fact that high percentage share of India's agriculture import is of necessary goods and is thus ineffective to the exchange rate. Thus, it can be stated that exchange rate policy will be ineffective to increase the imports of agriculture produce of India and will also have limited impact on the agriculture exports. The Granger Causality results indicates that there exists bidirectional relationship between exchange rate and GDP of India and agriculture imports and GDP of India which further supports the results of VAR model that GDP of India is the determining factor of agriculture import demand of the country it is similar to the results of Dutta and Ahmed (2006) who used error correction approach to analyse the model. Just it can be recommended that the country should work towards increasing the export of agriculture produce by diversifying the exported market. The imports can be reduced by developing import substitutes of imported goods and also by developing the three important economic sectors in harmony which will increase the overall GDP of India and trigger development in the country.

**Policy Recommendation :**

India's Export demand is majorly influenced by the real income of importing country, the focus of the policy makers should be to strategise the distribution of resources and emphasize the restructuring of overall production process in order to improve the quality of goods produced. According to the Economic Survey of India 2016-17, high trade cost of India is one of the factors for reduced overall trade of the country. The policy makers can focus on reducing the trade cost of the country by providing stronger infrastructure to the agriculture sector. Present high export protections and restrictions are negatively affecting the farm income of the country, thus there is a need to simplify the export restrictions of the country that will increase the farm income and will also increase the agricultural produce of the country.

The imported goods should be categorized and the imports of those goods and technologies should be encouraged that could not only add to the processing and technology of existing production process but will also positively affect the employment condition of the country. There is a need to emphasis on research and development division in this sector with the focus on technology upgradation and value addition. Thus, research and development will attract foreign investment in the agriculture sector and will even expose domestic producers to the new farming techniques and domestic exporters to the new export destinations, which will again result in increase in agricultural exports of the country.

## REFERENCES


Afzal, M. and Ahmad, I. (2005). Estimating Long-run Trade Elasticities in Pakistan: A Cointegration Approach. *The Pakistan Development Review,* **43**(4) : 757-770. Retrieved June 3, 2017, from http://www.jstor.org/stable/41261025.

Afzal, M. and Haider, J. (2011). Estimation of Import and Export Demand Functions Using Bilateral Trade Data. *Foreign Trade Review,* **46**(2) : 54-85. doi:10.1177/0015732515110202.

Altintas, H. and Turker, O. (2014). The Dynamics of Export and Import Functions in Turkey: Cointegration And Multivariate Granger Causation Analysis. *Internat. J. Asian Soc. Sci.,* **4** (5) : 676-689. Retrieved August 9, 2017, from http://www.aessweb.com/journals/5007.

Bahmani-Oskooee, M. and Niroomand, F. (1998). Long-run price elasticities and the Marshall–Lerner condition revisited. *Economics Letters,* **61**(1) : 101-109. doi :10.1016/s0165-1765(98)00147-5.

Billmeier, A. and Hakura, D. (2008). Trade Elasticities in the Middle East and Central Asia: What is the Role of Oil? [Abstract]. *IMF Working Papers,* **08**(216), 1. doi:10.5089/9781451870749.001.

Dougherty, C. (2011). *Introduction to econometrics* (4th ed.). Oxford: Oxford University Press.

Dutta, D. and Ahmed, N. (2004). An aggregate import demand function for India: a cointegration analysis. *Applied Economics Letters,* **11** (10) : 607-613. doi:10.1080/1350455042000271134.

Francesco, A., Graziella, B. and Alessia, V. (2015). Trade-elasticities for China and the OECD countries. Facts and myths of global disequilibria. *The European Trade Study Group*. Retrieved June 5, 2017, from http://www.etsg.org/ETSG2015/Papers/525.pdf.

GOI, State of Indian Agriculture 2015-16, Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Farmers Welfare, Directorate of Economics and Statistics, New Delhi.

GOI, Economic Survey 2016-17, Ministry of Finance, Department of Economic Affairs, Economic Division, New Delhi.

Greene, W. H. (2002). *Econometric analysis* (5th ed.). New York, NY: Pearson.

Gujrati, D.N. (2004). *Basic Econometrics*(4th ed.). New York: McGraw Hill Inc.

http://data.worldbank.org/

Hatemi-J.A. and Irandoust, M. (2005). Bilateral trade Elasticities : Sweden versus her trade partners. *American Review Political Economy,* **3** (2) : 38-50. Retrieved June 5, 2017.

Horner, F.B. (1952). Elasticity of demand for the exports of a single country. *The Review of Economics & Statistics,* **34** (4) : 326-342. Retrieved July 18, 2017, from Stable URL: http://www.jstor.org/stable/1926860.

Houthakker, H.S. and Magee, S.P. (1969). Income and Price Elasticities in World Trade. *The Review of Economics & Statistics,* **51**(2), 111. doi:10.2307/1926720.

Jaupllari, S. and Zoto, O. (2013). An Assessment of Demand for Imports through the VECM Model. *J. Knowledge Management, Economics & Information Technol.,* **3**(6). Retrieved July 15, 2017.

Jones, N.W. and Nusbaumer, J. (1976). A method of estimating elasticities in bilateral trade. *WeltwirtschaftlichesArchiv,* **112**(4) : 674-692. doi:10.1007/bf02705979.

Maddala, G.S. (1992). *Introduction to econometrics* (2nd ed.). New York: Wiley.

Marquez, J. (1994). The Econometrics of Elasticities or the Elasticity of Econometrics: An Empirical Analysis of the Behavior of U.S. Imports. *The Review of Economics & Statistics,* **76**(3) : 471-481. doi:10.2307/2109972.

Mehdi, S. and Seyyed, Y.A. (2013). Modeling the impact of money on GDP and inflation in Iran: Vector-error-correction-model (VECM) approach. *African J. Business Management,* **7**(35) :3423-3434. doi:10.5897/ajbm11.2444.

Mohsen, B. and Brooks, T.J. (1999). Cointegration Approach to Estimating Bilateral Trade Elasticities between U.S. and Her Trading Partners. *Internat. Economic J.,* **13** (4) : 119-128. doi:10.1080/10168739900000048.

Narayan, S. and Narayan, P.K. (2010). Estimating Import and Export Demand Elasticities for Mauritius and South Africa. *Australian Economic Papers,* **49** (3) : 241-252. doi:10.1111/j.1467-8454.2010.00399.

Noland, M. (1989). Japanese Trade Elasticities and the J-Curve. *The Review of Economics & Statistics,* **71** (1) : 175. doi:10.2307/1928067.

Orcutt, G.H. (1950). Measurement of Price Elasticities in International Trade. *The Review of Economics & Statistics,* **32**(2) : 117. doi:10.2307/1927649.

Panagariya, A. (2008). *India: the Emerging Giant*. Oxford University Press.

Raissi, M. and Tulin, V. (2015). Price and Income Elasticity of Indian Exports—the Role of Supply-Side Bottlenecks. *IMF Working Papers,* **15**(161), 1. doi:10.5089/9781513544816.001.

Senhadji, A. (1998). Time-Series Estimation of Structural Import Demand Equations: A Cross-Country Analysis [Abstract]. *Staff Papers - International Monetary Fund,* **45**(2) : 236. doi:10.2307/3867390.

Usman, M., Fatin, D.F., Yusuf, M., Barusman, S., Elfaki, Faiz A.M. and Widiarti (2017). Application of Vector Error Correction Model (VECM) and Impulse Response Function for Analysis Data Index of Farmers' Terms of Trade. *Indian J. Sci. & Technol.,* **10**(19) : 1-14. doi:10.17485/ijst/2017/v10i19/112258.

Wooldridge, J.M. (2012). *Introductory econometrics: a modern approach* (5th ed.). Boston, MA, USA: Cengage Learning.

************