Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(2): 131-135
Received: 09-01-2019
Accepted: 13-02-2019

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Econometric analysis of import demand of pulses in India

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Abstract
India is the world's largest producer and consumer of a wide variety of pulses which is dominated by tropical and sub-tropical crops such as chickpea, black gram, red gram (pigeon pea), green gram (Mungbean), lentil and so on. The world pulse production, area and yield during 2013 was 73 million tonnes (MT), in nearly 80.8 million ha and 904 kg ha^{-1} respectively (FAOSTAT 2015). In India, production of pulses is around 19.3 million tonnes from 26.3 million ha (ESI 2015) with a very low average productivity of 764 kg/ha. India has witnessed an impressive growth in pulses production during last 5 years. The overall productivity of pulses increased to an impressive 786 kg ha^{-1} during 2012- 13 as compared to 577 kg ha^{-1}during 2004-05. The credit goes to the improved varieties and production of breeder seed and schemes launched by the government to promote pulses cultivation. Pulses are rich sources of protein and energy but largely cultivated under energy starved conditions, mostly on marginal and sub-marginal land and more than three-fourth of the area under pulses is still rainfed resulting in poor crop productivity (Choudhary, 2013). Green revolution also adversely affected the acreage of pulses causing displacement by rice-wheat cultivation leading to shift of pulse crops in marginal dry lands in the country resulting in decline in the yield of pulses during last few decades. Pulses crop being rich in protein are loved by pests and Blue Bulls (Neelgais). They are also extremely sensitive to heat and cold, besides they are slow crop. All these factors contribute in high fluctuations in yield.
To analyse trend and instability tolls like Cumulative Annual Growth Rate (CAGR) and Cuddy-Della Valle Index (CDVI) is employed. To accomplish the objective of import demand analysis to compute long run elasticity of determinant Stock Watson Dynamic OLS has been used. It has been found that import demand for pulses is determined by income, price and urbanization. Results indicate that import price of total pulses has no statistically significant impact on import demand for total pulses. It is important for policymakers to understand that abolishing the existing constraints on imports will not have a major impact on total pulse imports, because the pulse economy is rather weak to respond to market signals in India.

Keywords: stock watson DOLS, cointegration, pulses, import, time series

Introduction
India being the world's largest producer, consumer and importer of a wide variety of pulses is dominated by tropical and sub-tropical crops. The major pulse grown are viz. Chickpea (gram or chana), pigeon pea (arhar), mungbean (green gram or mungbean), urdbean (black gram or mash), lentil (Masoor) etc. The production of pulses is around 19.3 million tonnes from 26.3 million ha (ESI 2015) with a low average productivity of 764 kg/ha. Pulse being a very thin market serves as a bottleneck in expanding production. The traditional marketing systems characterised by a number of intermediaries, lack of quality grading mechanisms and asymmetric price transmission continue to dominate pulse marketing system. Developing and formalizing institutions which would enable confluence of farmers, processors and consumers of pulses would go a long way in increasing the attractiveness of pulse cultivation. Developing countries account for around 70% of the global pulses production. There is, however, a large difference in the average yield of total pulse between developed (1640 kg ha^{-1}) and developing countries (765 kg ha^{-1}). The sluggish growth in pulse yields in India can be attributed to (i) the shift in crop area from favourable to marginal environments (ii) the slow uptake of improved varieties and other production technologies and (iii) its cultivation on poor soils under erratic rainfall conditions (Parimal *et.al*). Declining area under cultivation coupled with low productivity has led to increasing dependence on import. After 2010, share of imports in total domestic supply varies from 15-22 per cent (Source NCAER 2015). Projection studies reveal that import demand will continue to rise in future. Recently, this rising demand-supply gap of pulses will be met through government-to-government deals in the coming years. Hence it becomes essential to explore short and long-term measures to import the commodities. Therefore, the main challenge for policy makers is to bridge the gap between domestic demand and supply of pulses. In addition, recent studies are not carried out to discern and quantify

factors influencing import demand of pulses. In this backdrop, the specific objectives are (a) to identify the trend and instability for import of pulses and (b) to estimate pulse import demand function and their elasticity.

Te knowledge emanating from the study would provide deep insight to policy makers in formulating suitable measures for containing pulse price inflation.

Data and Methodology

To estimate elasticity of determinants of import demand of chickpea, lentil and total pulses in India, annual time-series data for the period from 1980 to 2015 was used. Data on import quantity, import value, import price of total pulses and domestic wholesale prices were obtained from different volumes of Agricultural Statistics at a Glance (1980-2015) **(**eands.dacnet.nic.in). Data on urban and total population, exchange rate, and per capita GDP for India were obtained from FAOSTAT (www.fao.org/statistics). Relative prices are used for analysis which is ratio of import price (world market) to domestic wholesale price (India). The use of relative prices index eliminates multicollinearity which could potentially exist between import price and domestic price of a product. Engle Granger and Stock Watson dynamic ordinary least squares were used to calculate short run and long run elasticity. Engle Granger equation is

$$y_t = \partial_0 + \partial_1 x_t + u_t \quad \ldots (1)$$

Where, $\hat{u}_t = y - \delta_0 - \delta_1 x_t \quad \ldots (2)$

Econometric Model Specification

$$M_{jt} = a_0 + a_1 RPGDPt + a_2 RP_{jt} + a_3 URB_t + \varepsilon_t \quad \ldots (3)$$

Where M_{jt} denotes the real value of import quantity (in Rupees) in period t, $RPGDP_t$ denotes real per capita GDP for India in period t, and RP_{jt} denotes relative prices of imports, defined as the ratio of import price index to wholesale price index for pulses in period t, URB_t denotes urbanisation, and where j = 1, 2, 3 for total pulses, chickpeas and lentils, respectively,

Approach of stock watson dynamic OLS

The study is based on secondary data and various analytical tools like compound annual growth rate (CAGR) for analysing trend, Cuddy Della Valle Index (CDVI) for determining instability, Johansen co-integration test for examining relation among import demand and its various determinants. Before testing the co-integration, conventional unit root test i.e. Augmented Dickey-Fuller unit root test (Said and Dickey, 1984) was done for testing whether the series is non-stationary and if it is then whether they are integrated of same order or not. Autoregressive Distributed Lag model (ARDL) can be utilised to obtain estimate demand model. But it has a basic assumption that variables shall be stationary at level I(0), or at first difference. This condition could not be satisfied with the given data set. This assumption is relaxed in methods like Engle Granger and Stock Watson Dynamic Ordinary Least Square model. Stock and Watson (1993) suggested this parametric approach to estimate long-run elasticity in systems which may involve variables integrated of different orders but still co-integrated. Stock and Watson is superior in small samples compared to a number of alternative estimators, as well as being not only able to accommodate higher orders of integration but also it accounts for possible simultaneity bias within regressors of a potential demand system. The problem of simultaneity bias and small-sample bias among regressors is corrected by the inclusion of lagged and lead values of the change in the regressors. In estimating long-run parameters of demand function, the DOLS procedure is adopted which basically involves regressing any 1(1) variables on other I(1) variables, any I(0) variables and leads and lags of the first differences of any I(1) variables. However, since an investigation of the short-run dynamics is of interest in the analysis and important for several other factors of modelling, the standard Engle Granger method was employed to estimate short run elasticity.

Results and Discussion

Scenario of import of pulses in India

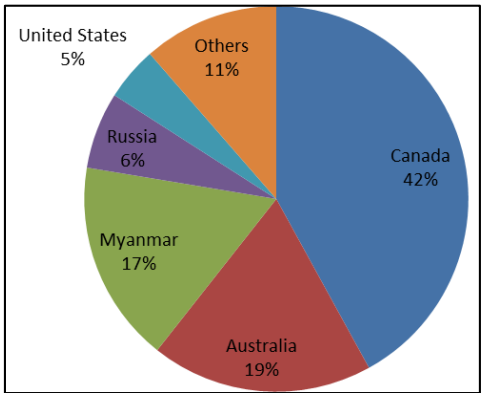
Pulse imports in India have increased over the years almost consistently and appreciably. The overall import of Pulse has grown from 172.96 thousand tonnes in 1980 to 4660 thousand tones in 2015 i.e. by 27 folds (Source: FAOSTAT, 2015). On observing the import demand of individual pulses, we find that the import of Chickpea has grown from 7556 tonnes in 1980 to 538329 tonnes in 2013 (71 folds) while the import of Lentil has from 6368 tonnes in 1980 to 679662 tonnes in 2013(106 folds). The rising gap between domestic production and demand has led to increase in import demand for pulses. In the last five years the share of imports to total production has increased from 17.49 per cent in 2010-11 to 28.29 per cent in 2015-16 (Table 1). It is remarkable to note increasing dependency of India on other countries to meet domestic demand for pulses.

Table 1: Production and Imports of Pulses (2010-16) (Quantity in 000 tones)

Total Pulse	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Production	18,240	17,090	18,340	19,770	17,150	16,470
Imports	3191	3300	3460	3673	4166	4660
Import share in production (%)	17.49	19.31	18.87	18.58	24.29	28.29

***Source*:** DES and FAOSTAT, 2017

Diversified import of pulses: Most of the import demand for the pulses is fulfilled from Canada which accounts for 42 percent of total value of pulse imports (Figure 1). Australia ranked second as exporter of pulses to India containing 19 per cent of the value of pulses imports, followed by Myanmar with 17 per cent. Russia and United States trail far behind accounting for six and five per cent of pulse imports by India respectively.



***Source*:** APEDA, GOI, 2017

Fig 1: Share of India's Pulse Imports from various Countries in 2015-16

The stability of trade of any commodity can be attributed to several demand side as well as supply side factors. In case of pulse trade on the supply side, major factors are weather fluctuations; insect and pest infestations and diversion of resources to the crops that generate comparatively higher net return for the farmers than the pulses like cereals and oilseeds. Price fluctuation, hoarding and high demand during festivals especially during October and November are some of the factors on demand side. The values for compound annual growth rate for pulses, chickpea and lentil have been 17.87, 10.17 and 9.82 per cent respectively. This growth instability can be analysed with their respective instability index values. Among pulses, lentil is most actively traded pulse crop.

Table 2: CAGR and CDVI of import value for selected crops from 1980-2013

Particular	CAGR	CDVI
Pulses	17.87	93.20
Chickpea	10.17	106.02
Lentil	9.82	170.60
Source: Computed by Authors: 2018		

It is also most instable pulse crop with CDVI value of 170.60 (Table 2). Chickpea growth is stable compared to lentil but the same is not when pulses are considered as whole. It can be inferred that there is need for scientific and policy interventions to stabilise trade of lentil and chickpea in India.

Analysis of import demand of pulses in India

As a basic rule for time series estimation, all the variables used must be stationary. Augmented Dickey-Fuller (ADF) unit root test (Said and Dickey, 1984) was tested for total import value of pulses, chickpea and lentil in rupees, real GDP, relative price and urbanisation. The result of both ADF test indicate that all these variables posses unit root, hence are non-stationary at the level, I(0). At the first difference all variables accept relative price, I (1) null hypothesis of model having unit root is rejected by the test where the test statistics was compared with the MacKinnon (1996) one-sided critical values which are 23.675, 22.967 and 22.622 for one, five and ten per cent respectively.

Table 3: Augmented dickey-fuller unit root test results

Total Pulse				
	Fisher Chi-square	**Probability****	**Chi Z-stat**	**Probability****
Level	0.69	0.5425	7.21	1.00
First Difference	48.0019	0.0000	-2.94*	0.00
Chickpeas				
Level	2.12292	0.9992	7.20554	1.00
First Difference	78.9743	0.0000	-3.08866	0.00
Lentil				
Level	1.55376	1.0000	5.89005	0.99
First Difference	31.0031	0.0001	0.92309	0.82

** Probabilities for Fisher tests are computed using an asymptotic Chi square distribution. All other tests assume asymptotic normality

Table 4: Johansen's multiple co-integration test results

Hypothesized No. of CE(s)	Eigen value	Statistic	Critical Value 0.05	Prob.**
Total Pulses				
None *	0.65	67.94	47.86	0.00
At most 1 *	0.51	34.01	29.80	0.01
At most 2	0.30	11.83	15.49	0.16
At most 3	0.007	0.23	3.84	0.63
Chickpeas				
None *	0.71	72.96	47.86	0.00
At most 1 *	0.37	33.63	29.81	0.01
At most 2*	0.33	18.99	15.49	0.01
At most 3*	0.18	6.23	3.84	0.01
Lentil				
None *	0.62	69.67	47.87	0.00
At most 1 *	0.49	38.94	29.80	0.00
At most 2*	0.26	17.34	15.49	0.02
At most 3*	0.22	7.82	3.84	0.00
* Indicates rejection of the hypothesis at the 5 percent level of significance				
**MacKinnon-Haug-Michelis (1999) p-values				

Relative price was found to be stationary at second difference. Since the variables are stationary at different levels Engle granger and DOLS was used to compute short run and long run elasticity respectively. Johansen's multiple cointegration test was conducted to examine existence of cointegration among variables in each equation. Table 4 indicate existence of 2, 4 and 4 cointegrating equations at the 0.05 level of significance for total pulses, chickpea and lentil respectively.

Table 5: Engle-granger test results

Dependent Variable: DIMPVAL				
Total Pulses				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
DRGDP	-4.98	4.52	-1.10	0.27
DRP	-1.34	0.42	-3.16	0.00
DURB	73.86	53.42	1.38	0.17
LAGECT*	-0.92	0.19	-4.79	0.00
C	-0.15	0.47	-0.33	0.74
Chickpeas				
DRGDP	-10.54	7.68	-1.37	0.18
DRP*	1.09	0.41	2.60	0.01
DURB	5.33	96.39	0.05	0.95
LAGECT*	-0.87	0.17	-4.95	0.00
C	0.82	0.90	0.91	0.37
Lentil				
DRGDP	13.57	9.83	1.38	0.17
DRP	-1.52	0.92	-1.65	0.10
DURB	-69.42	116.68	-0.59	0.55
LAGECT*	-0.75	0.18	-4.32	0.00
C	0.04	1.06	0.03	0.97
* Denotes Variables that are significant at 5% level				

The lag of error correction term (LAGECT) was regressed with first differenced values of real gross domestic product (RGDP), relative price (RP) and urbanisation (URB). Variables like lag of error correction term (which is residuals generated from OLS and is checked positively for stationarity) and the relative price has been found to be the significant factors influencing import demand in short run. Result indicates that with one unit change in relative price, the import demand of pulse will decline by 1.34 units *cetris-peribus*. The constant value being negative must be interpreted with care since it is log value and not the absolute figure. It is important to know relative price for chickpea is significant in short run and is relatively elastic with value 1.09.

Among the different variables in models, income and urbanization are significant factors influencing pulse import demand. Other variables if remain unchanged then the value of import demand for pulses will increase by 1.27 units for every unit increase in real GDP (Table 6). Since India is growing economically this results concludes that import demand for pulses will be rising continuously in future.

Table 6: Stock-Watson Dynamic OLS long run parameters of import demand

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Total Pulses				
Real GDP (RS)	1.27*	0.11	11.58	0.00
Relative price	0.05	1.13	0.05	0.96
Urbanisation	8.26 *	1.37	6.05	0.00
Chickpeas				
Real GDP (RS)	1.41*	0.29	4.84	0.00
Relative price	-0.75*	3.63	-0.21	0.84
Urbanisation	10.97*	3.98	2.75	0.01
Lentil				
Real GDP (RS)	0.97*	0.21	4.67	0.00
Relative price	-0.03	2.59	2.27	0.03
Urbanisation	5.88*	2.59	2.27	0.98
* Indicates level of significance at 5%				

Similarly, if urbanisation is increased by one unit, import demand value would increase by 8.25 units, given other factors remain constant. This would be consistent with the pace of urbanization. Due to lack of educational, occupational, health and other facilities, there has been increasing migration from rural to urban areas. Since expanding urbanisation is unavoidable in present condition, pulse demand is expected to increase in future. Relative price also having a positive relationship with import demand but is insignificant. Income and urbanisation are significant determinants for chickpea demand. Therefore market for chickpea import is having good scope for trade expansion. Lentil does not fall in the platter of urban consumers due to their preferencs and tastes. Urbanisation is leading to decline in lentil demand indicating that urban food pattern does not mainly include lentil as a source of protein. Income is influencing lentil demand directly indicating that it is not an economic factor leading to decline in demand. It is psychological factors mainly taste and preference which mainly determining factor.

Conclusion

This paper has analysed the import demand for total pulses, chickpea and lentil in India from 1980-81 to 2013-14 and identified its major determining factors. The findings of this study indicate that the response of import demand for pulses to key determinants differ substantially from one product to another. The aggregation of pulse import demand data could potentially cloud the dynamic interrelationships that exist between pulse varieties and key determinants. Given that the import demand for total pulses, chickpea and lentil with respect to relative price is inelastic, ceteris paribus, the result suggests that lowering of tariff rates would not increase total pulse imports substantially. It is important for policymakers to understand that abolishing the existing constraints on imports will not have a major impact on pulse imports, because the pulse economy is rather weak to respond to market signals in India. The findings of this study are important from the

viewpoint of pulse exporting countries that are developing marketing policies to strategically position themselves in the Indian pulse market under recent changing economic conditions, and for policymakers who wish to develop and manage macroeconomic policies.

Acknowledgement
The paper is based on the M.Sc. thesis entitled "Econometric Analysis of Import Demand for Pulses in India" submitted to PG School, ICAR-IARI, New Delhi, by the first author under the chairmanship of the second author.

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