

# **An empirical examination of import demand for pulses in India**

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Paper presented at the 47<sup>th</sup> Annual Conference of the Australian Agricultural and Resource Economics Society, 11-14 February 2003, Fremantle, Australia

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## **Abstract**

India is the largest producer and importer of pulses in the world. Since 1970, the Indian food economy has undergone major policy reforms, including trade liberalisation, that had the effect of opening up its domestic pulse market to international trade. This market is very lucrative and of major significance to the world pulse economy. Therefore, given the increasing evidence linking import demand and economic variables, an understanding of the impact of these variables on import demand for pulses in India is warranted. The import demand functions for total pulses, chickpea and lentils were estimated by autocorrelation regression procedure using time-series data for the period 1970 through to 2000. Empirical results indicate that real GDP, population, urbanisation, exchange rate and relative price are key determinants of import demand for pulses in India.

*Key words:* India, pulses, import demand, unit root.

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## **1. Introduction**

India has emerged as a major player in the world pulse market. There is a sizeable market for pulses in India, the largest pulse producing and importing country in the world. India's pulse imports as a proportion of world pulse imports has dropped from about 10.08% in 1990 to 4.33% in 2000 (FAO, 2002). Pulses account for 12% total gross cropped area in India. Recent economic liberalisation and domestic agricultural policy reforms in India, as well as global trade reform in compliance with the WTO, are likely to have a major impact on pulse trade. Over the years, pulse imports to India have been brought in largely to offset domestic shortfalls. Trade prospects for pulses in India depend to a large extent on sustained growth in demand for pulses, where pulses are a traditional component and integral part of the human diet (Kelley, 1999). In response to the continuing demand for pulses, the Government of India embarked on a series of policy reforms, namely, the reduction in import tariffs, liberalisation of pulse trade, the removal of production controls and deregulation of the pulse economy. However, the import duty on pulses was increased from 5% to 10% India's Union Budget 2002-2003 (MANAGE, 2002). In addition, pulse imports to India are subject to agricultural permit and phytosanitary certification. These import restrictions will continue to have an unfavourable effect on the importation of pulses into India. The transition towards a fully liberalised pulse marketing system in India is still underway and this opens opportunities for pulse exporting countries to strategically position themselves in one of the most lucrative markets, the Indian pulse economy.

Total pulse production in India had been more or less stagnant in the 1990s when it fluctuated between 12 and 15 million MT. In 1990, domestic production of total pulses in India was almost 13 million MT, rising to 14.3 million MT in 1991. As Kelley (1999) notes, this gave some hope that the Five Year Plan target of 22 million MT of domestic pulse production by 1995-96 might actually be achieved, bringing sentiments among policymakers in India that imports would not be required. In reality, production fell by 2 million MT in 1992 to about 12 million MT, but thereafter climbed back only slowly to between 13 and 15 million MT where it currently stands. Table 1 shows India's total pulse production and its share in world pulse production for the period 1990-2000. To Kelley (1999), the failure to see significant increases in imports was due to unexpectedly higher domestic production. That, if anything, domestic production in India fell far short of most people, and especially the government's expectations.

From the above, a major conclusion reached about India was that the gap between production and consumption was widening and this would ensure the importance of pulse imports in the future (AGLC 1991). As Kelley (1999) notes, this echoed the sentiments of other experts including pulse scientists and traders that tremendous opportunities lay open for producers. For example, Siddique, on a visit to the (ISC) predicted that pulse imports would rise by 3 to 6 million MT by the year 2000 (Siddique, 1993). Others shared similar views expressed by Siddique. Brouwer (1995), at the conclusion of a study tour, predicted that imports of chickpeas to India would have to increase by a significant 1.3 million metric tonnes (MT) from current levels to meet internal demand. This was based on the fact that domestic chickpea production was likely to grow only marginally during the 1990s, as indicated by past trends in area and productivity.

**Table 1.** India's total pulse production, world pulse production and India's share in world pulse production, 1990-2000

YEAR	TOTAL PULSE PRODUCTION (MILL TONNES)	WORLD PULSE PRODUCTION (MILL TONNES)	INDIA'S SHARE IN WORLD PULSE PRODUCTION (PERCENT)
1990	13	58	22.05
1991	14	54	26.28
1992	12	51	23.69
1993	12	55	22.68
1994	13	56	23.75
1995	15	56	26.82
1996	13	54	24.47
1997	14	55	25.68
1998	13	56	23.53
1999	15	57	26.15
2000	13	55	24.53

*Source:* FAO (2002)

In the last two decades, the relatively higher and rising living standards in urban areas drew people from rural areas in search of work. The rising disposable incomes of the Indian population will stimulate food consumption, which in turn will induce food import demand into India, including pulses (FAO, 2002). The urbanisation, defined as the proportion of urban

residents in total population, taking place in India is likely to have a significant impact on food consumption patterns. Regmi and Dyck (2001) summarise the impact of urbanisation on food consumption patterns. First, the differences in calorie requirements for urban and rural residents may lead to lower calorie consumption in urban areas during a period of urbanisation. The effect being a change in the composition rather than the overall level of per capita food consumption. Second, the differences in individuals ability to purchase food in rural and urban areas could lead to an increase in demand for more value-added products and less of traditional foods. As Kelley (1999) observed, in the last two decades, there appears to be a shift away from traditional foods towards value-added products in India; per capita consumption of pulses appear to have declined, while that of cereal, milk and meat products appear to be on the rise. Third, the increased opportunity cost of women's time in the urban areas relative to those in rural areas stimulates increased demand for non-traditional food products during periods of urbanisation. The effect being the substitution of marketed staples for basic rural staples, such as pulses.

While several studies have been undertaken to examine import demand of food products in both developed and developing countries, to our knowledge, to date, no detailed econometric analysis of import demand in India has been undertaken. With domestic production in most of India failing to keep up with internal demand, as has been the case over the last two decades, an understanding of the determinants of import demand for pulses in India is pertinent. This study is an exploratory work and aims to bridge the knowledge gap by empirically analysing the determinants of import demand for pulses in India. Specifically, this study aims to examine the impact of key economic variables of real GDP, population, urbanisation, exchange rate and relative price on import demand of total pulses, chickpea and lentils in India, and to derive import demand elasticities. The understanding of the impact of key determinants will enable policymakers to properly evaluate the impact of economic policy reforms in India on world pulse trade.

The rest of this paper is organised as follows. The next section describes the model and data sources. This is followed by a discussion of empirical results. Finally, the concluding section presents some implications of the results and suggestions for future research.

## 2. The Model

### *Empirical model*

This study postulates that the import demand for a product depends on a small number of economic variables. Following the literature (Apostolakis, 1991; Anaman and Buffong, 2001), it is assumed that the demand for imports (IMP) is related to relative price of product (RP) (derived as the ratio of import price to producer price of product), exchange rate (EXR), real Gross Domestic Product (RGDP), and population (POP) and urbanisation (URB). The import demand function is specified as

$$IMP_{jt}^d = \alpha_0 + \alpha_1 RGDP_t + \alpha_2 POP_t + \alpha_3 URB_t + \alpha_4 EXR_t + \alpha_5 RP_{jt} + u_t \quad (1)$$

where  $u$  is the error term assumed to have a mean of zero and constant variance,  $\alpha$ 's are parameters to be estimated, and where  $j=1, 2, 3$  for total pulses, chickpeas and lentils.

The choice between linear and log-linear models is somewhat arbitrary. Following the parametrisation of Rijal *et al.* (2000), the selection of the best functional form was based on the Box-Cox test. The general form of the Box-Cox regression equation is specified as

$$\left( \frac{IMP_t^\lambda - 1}{\lambda} \right) = \alpha_0 + \alpha_i \sum_{i=1}^5 \frac{X_i^\lambda - 1}{\lambda} + u_t \quad (2)$$

where  $\lambda$  is a parameter used to obtain estimates of  $\alpha$  in equation (1),  $i = 1, \dots, 5$  for RGDP, POP, URB, EXR, RP, respectively, and  $u_t$  is a random-error term.

The expression in Equation (2) can be re-specified as

$$Y^\lambda = X\beta + \varepsilon_t \quad (3)$$

where  $Y$  is IMPORTS (IMP),  $X$  is a  $(N \times K)$  matrix of observations of the independent variables and  $\varepsilon$  is a  $(N \times 1)$  vector of random disturbances.

Following Whistler *et al.* (2001), the log-likelihood function is given by

$$L(\lambda, \beta, \sigma^2; Y, X) = -\frac{N}{2} \ln(2\pi\sigma^2) - \frac{1}{2\sigma^2} (Y^{(\lambda)} - X\beta)' (Y^{(\lambda)} - X\beta) + \ln J \quad (4)$$

where

$$J = \det \left[ \frac{\partial Y^{(\lambda)'}}{\partial Y} \right] = \prod_{t=1}^N Y_t^{\lambda-1} \quad (5)$$

is the Jacobian of the transformation of the dependent variable.

From Equation (2), a value of  $\lambda=1$  gives a linear model and a value of  $\lambda=0$  gives a log-linear model. Now, if  $L^{(i)}$  is the value of the log-likelihood function and  $\tilde{\lambda}^{(i)}$  is the estimate of

$\lambda$ , the gradient of the log-likelihood function with respect to  $\lambda$  can be approximated as (Whistler, *et al.* 2001)

$$\frac{(L^{(i)} - L^{(i-1)})}{(\tilde{\lambda}^{(i)} - \tilde{\lambda}^{(i-1)})} \quad (6)$$

The Box-Cox test can be performed to test hypothesis about the values of  $\lambda$ . For a test of the linear model, the test statistic is given by  $2[L(\tilde{\lambda}) - L(\lambda - 1)]$ . The test statistics is then compared with a  $\chi^2_{(1)}$  distribution. For  $\lambda = -0.05$ , the test statistic is computed as 57.06 and the 5% critical value is 3.84 and the 1% critical value is 6.64. Given that the test statistic exceeds these critical values, we reject the null hypothesis of a linear model and adopt the log-linear model. This finding of a log-linear import demand function is consistent with earlier studies such as those by Anaman and Buffong (2001), Rijal *et al.* (2000), Sinha (1997) and Boylan *et al.*, (1980), who also found import demand model to be characterised by log-linear functional form.

The natural logarithm of the variables in Equation (1) implies instantaneous adjustment on the part of importers to changes in explanatory variables. In order to introduce dynamics into the import demand function, we follow the partial adjustment model proposed by Khan and Ross (1997) and Doroodian *et al.* (1994) and espoused by Rijal *et al.* (2000). The partial adjustment model is given by

$$IMP_t - IMP_{t-1} = \gamma [IMP_t^d - IMP_{t-1}] \quad (7)$$

where  $0 \leq \gamma \leq 1$ , and  $IMP$  and  $IMP^d$  are actual import demand and desired import demand, respectively, at period  $t$ . Substituting Equation (1) into Equation (7) and simplifying yields

$$IMP_t = \alpha_0 + \alpha_1 RP_t + \alpha_2 EXR_t + \alpha_3 RGDP_t + \alpha_4 POP_t + \alpha_5 URB_t + \alpha_6 IMP_{t-1} + u_t \quad (8)$$

where the variables are as defined above.

### *Data Sources and Description*

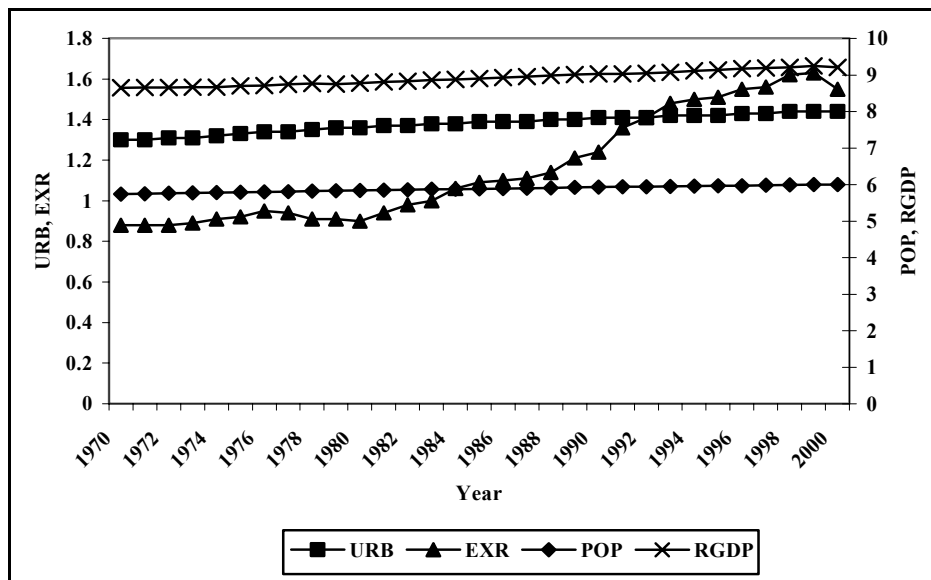
The data used in this paper are annual observations and are obtained primarily from the Food and Agriculture Organization database (FAO, 2002) and International Financial Statistics of the International Monetary Fund. The data covers the period 1970 through to 2000. The logarithmic values of import quantity, import and producer price of product, urbanization, exchange rate, population, and real Gross Domestic Product are employed in the analysis. Figures 1-3 show the movement in variables employed in the analysis.

### 3. Results and Discussion

#### Unit root tests

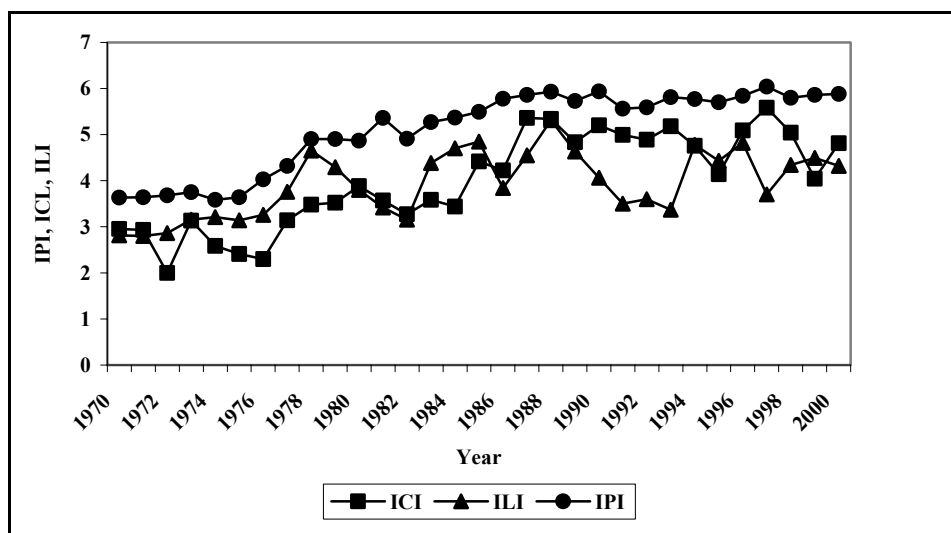
Before proceeding to estimate the import demand functions, a unit root test was performed to determine the time-series properties of the data employed in the analysis. The testing procedure used is the augmented Dickey-Fuller test (ADF test) (Dickey and Fuller, 1979).

**Figure 1.** Log of Real GDP (RGDP), Population (POP), Urbanisation (URB) and Exchange Rate (EXR), 1970-2000



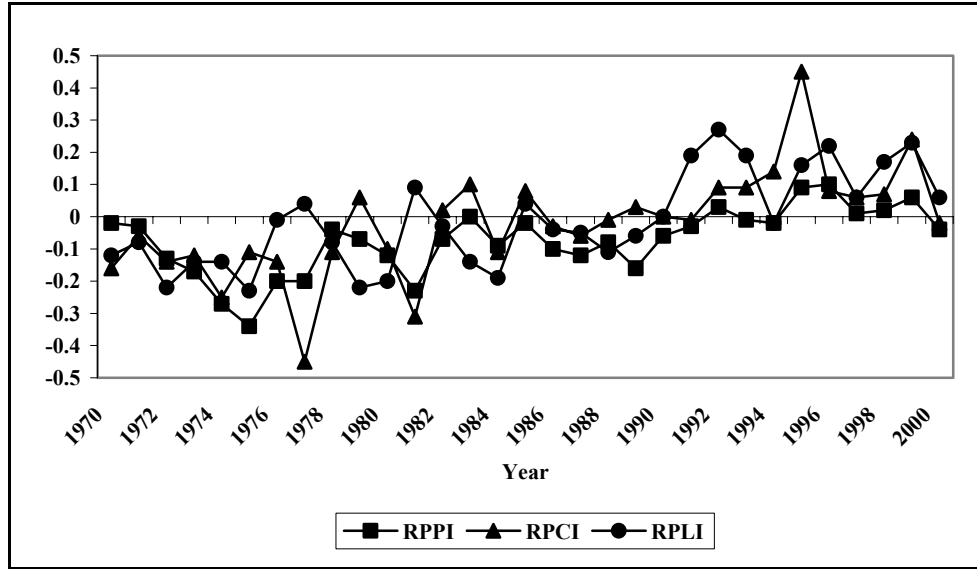
Source: Data from FAOSTAT (2002)

**Figure 2.** Log of Chickpea (ICI), Lentil (ILI) and Total Pulses (IPI) Imports, 1970-2000



Source: Data from FAOSTAT (2002)

**Figure 3.** Log of Relative Price of Chickpeas (RPCI), Lentils (RPLI) and Total Pulses (RPPI), 1970-2000



Source: Data from FAOSTAT (2002)

Following Whistler *et al.* (2001), the auxiliary regression is run with an intercept and a time trend and is specified as

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^p \gamma_j \Delta Y_{t-j} + \varepsilon_t \quad (9)$$

where  $Y_t$  is the variable whose time-series properties are being investigated,  $\Delta$  is the difference operator, and where  $\varepsilon_t$  is the random error term with  $t = 1, \dots, N$  is assumed to be Gaussian white noise. As Hamori and Matsubayatsi (2001) note, the augmentation terms are added to convert the residuals into white noise without affecting the distribution of the test statistics under the null hypothesis of a unit root. The test statistic for a unit root is the t-ratio.

Table 2 shows the results of the unit root test for first difference. The results indicate that the null hypothesis of a unit root is accepted for all variables at the 10% level. The implication of the finding is that the variables are non-stationary in their levels. The results of the unit root tests indicate that the null hypothesis can be rejected for the first difference of the variables. Hence, the difference of natural logarithms of variables in the import demand functions of pulses, chickpea and lentils for India are estimated and discussed.

**Table 2.** Results of the Augmented Dickey-Fuller unit root test for India

SPECIFICATION	VARIABLE	TOTAL PULSES	CHICKPEA	LENTILS
		Test statistic*	Test statistic*	Test statistic*
Difference	ln IMP <sub>t</sub>	-4.101	-5.569	-4.261
	ln RP <sub>t</sub>	-4.273	-7.537	-6.685
	ln RGDP <sub>t</sub>	-3.871	-3.871	-3.871
	ln EXR <sub>t</sub>	-3.247	-3.247	-3.247
	ln URB <sub>t</sub>	-3.370	-3.370	-3.370
	ln POP <sub>t</sub>	-3.492	-3.492	-3.492

\*Critical value at the 10% level is -3.13.

### *Discussion*

Table 3 reports the empirical results of estimation of the import demand equation using autocorrelation regression procedure in SHAZAM econometric package. The R<sup>2</sup>-adjusted (goodness-of-fit measure) is 0.92 for total pulses equation, 0.64 for chickpea equation and 0.53 for the lentils equation. We perform a test for serial correlation using Durbin *h*-test to detect the absence of autocorrelation. The Durbin *h*-statistic is -1.327, -0.387 and -0.614 for the total pulses, chickpea and lentils equations, respectively. Given that the Durbin *h*-statistics are below the critical value of 1.645 in a one-tail test at the 5% level of significance, the results indicate no presence of serial correlation in the estimated equations.

The coefficients of the real GDP variable is positive and significant at a 10% level in the estimated total pulses and lentils equation. Although positive, the coefficient of the real GDP variable is statistically non-significant at a 10% level in the estimated chickpeas equation. This empirical result suggests that an increase in real GDP could stimulate an increased import demand for total pulses and lentils in India.

Population is negatively related to import demand for total pulses and lentils, and is statistically significant at a 10% level. The implication is that an increase in population will lead to a reduction in import demand for total pulses and lentils in India. The negative relationship between population and import demand for pulses and lentils may be attributed to shifting consumption food patterns away from pulses and lentils, as observed by Kelley (1999). This result highlights the importance of population growth in affecting import demand

for total pulses and lentils. The population coefficient for chickpeas is negative and non-statistically significant.

**Table 3.** Import demand function for total pulses, chickpea and lentils in India

VARIABLE	TOTAL PULSES		CHICKPEA		LENTILS	
	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
IMP <sub>t-1</sub>	-0.033	-0.651	-0.090	-0.803	0.021	0.157
lnRGDP	4.945	2.151	0.025	0.004	13.959	2.071
lnPOP	-16.875	-2.560	1.062	0.119	-20.179	-2.015
lnURB	46.062	2.142	-0.782	-2.051	0.191	0.445
lnEXR	-2.097	-2.196	-4.248	-1.751	-2.487	-0.849
lnRP	0.169	0.402	-1.052	-2.022	-1.326	-1.649
CONSTANT	-0.100	-0.535	0.466	2.142	0.032	0.134
R <sup>2</sup> -adjusted	0.91		0.64		0.53	
s.e.	0.41		1.13		1.19	
Durbin- <i>h</i> statistic	-1.32		-0.39		-0.69	
Log-likelihood	-16.39		-47.73		-49.44	

Urbanisation is positively related to the import demand for total pulses, but negatively related to the import demand for chickpeas. It is statistically non-significant in influencing the import demand for lentils in India. The negative relationship between import demand for chickpeas and urbanisation may be related to the findings of H-Rao and Gulati (1998) and Kelley (1999), who found that urbanisation has given rise to changing consumer tastes and preferences; a consequence of the increasing availability of a wide range of food items other than food grains. The reason for the positive sign of the coefficient of the urbanisation variable in the imported demand for total pulses equation is not clear given that chickpeas constitutes a large proportion of pulses consumed by households in India. Perhaps, those migrating to urban areas tend to consume other pulses such as dry broad beans, dry peas and dry beans. This is an interesting finding which requires further investigation but not explored in this paper.

Consistent with prior expectations, the coefficient of the exchange rate variable in the estimated import demand equations for total pulses, chickpeas and lentils are all negative, although the coefficient of the exchange rate variable in the import demand for lentils equation

is statistically non-significant at a 10% level. This empirical result suggests that a depreciation of the Indian Rupee would cause a drop in the import demand for pulses in India. This result might be related to the findings of Kelley *et al.* (2002) which suggested that in periods where the Indian Rupee depreciated against currencies of major pulse exporting countries there was a major decline in imported pulses into India.

Relative price of chickpeas and lentils is also significant and negative in the estimated import demand for chickpeas and lentils equations. These findings suggest that an increase in the import price of chickpeas or lentils, holding the producer price of these goods constant, would lead to a decrease in import demand for these goods, as expected. On the other hand, a rise in producer price of chickpeas or pulses, holding the import price constant would cause the import demand for chickpeas and lentils to fall but at a slower rate. Surprisingly, the relative price of total pulses is statistically non-significant in influencing import demand for total pulses, although positive.

The coefficients of the lagged import demand variable, which incorporates dynamics in the models, is statistically non-significant in all estimated import demand equations for total pulses, chickpeas and lentils. The results suggest that consumers of imported pulses in India respond instantaneously to changing economic conditions.

#### **4. Summary and Implications of the Study**

India's pulse production is faced with some constraints, which provides opportunities for the importation of pulses into India. For example, pulse production in India is largely dependant on the monsoon, it is mainly labour-intensive and highly susceptible to insect-pests. To keep up with changing trends in the demand for imported pulses in one of the most lucrative pulse markets, the Indian pulse economy, an understanding of the key determinants of import demand is important for international trade policy. As the Government of India moves toward a fully liberalised pulse marketing system, which opens opportunities for pulse exporting countries, a careful analysis of the impact of changing economic conditions on import demand is pertinent. The information provided in this study is particularly useful for international trade policymakers in pulse exporting countries, such as Australia, Canada and Myanmar, who want to anticipate future market changes in response to these changing economic conditions.

This study investigates time-series properties of variables employed in the analyses. Test for appropriate functional form was conducted using the Box-Cox testing procedure. Results indicate that the log-linear formulation is more appropriate. Next, we investigated the

time-series properties of the variables. Results indicate that the variables in levels are non-stationary, however the first differences of variables are stationary. Consequently, the model was estimated in differenced form. The elasticity of import demand for total pulse with respect to real GDP is estimated to be 4.95, population elasticity of demand was  $-16.88$ , urbanisation elasticity was 46.06 and exchange rate elasticity was  $-2.10$ . For chickpea, the import demand with respect to urbanisation is  $-0.78$ , exchange rate elasticity is  $-4.25$  and import demand for chickpeas with respect to relative price is  $-1.05$ . The elasticity of import demand for lentils with respect to real GDP and population are 13.96 and  $-20.18$ , respectively, while that with respect to relative price of lentils is estimated to be  $-1.32$ . Results of this study reveal that the key factors influencing the import demand for total pulses are real GDP, population, urbanisation and exchange rates. For chickpeas, the factors influencing import demand are urbanisation, exchange rates and import price relative to domestic producer price. Real GDP, population and import price of lentils relative to domestic producer price are the key factors influencing the import demand for lentils in India.

The results imply that the government of India should strive to sustain sound macroeconomic policy to achieve strong real GDP growth and maintain a stable local exchange rate to support aggregate import demand, including import demand for pulses. More specifically, regarding international trade policy, India should seek the removal of non-tariff barriers and further reduce import duties on pulses in order to induce a drop in import prices relative to domestic prices that it may have favourable influences on import demand. However, this might pose challenges for India's pulse market since such a move will mean that India will no longer be protected from competing with major pulse exporting countries.

This study is an exploratory work. Further research is need to examine the dynamics of import demand in India and to extend the analysis to other importing countries in the Indian sub-continent in order to provide useful information for exporting countries to develop and implement marketing strategies that would strategically position oneself in the largest pulse importing region in the world, the Indian sub-continent pulse economy.

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