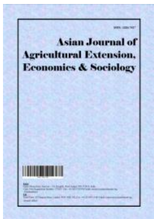

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Cotton Imports and GDP of Indonesia- Cointegration Analysis

P. Soumya[1*] and R. A. Yeledhalli[1]

[1]Department of Agribusiness Management, College of Agriculture, UAS Dharwad, India.

Authors' contributions

This work was carried out in collaboration between both authors. Author PS designed conducted the study, involved in data collection, analysis, tabulation and writing the research paper. Author RAY is the chairman of the advisory committee involved in planning, constant monitoring throughout the study, analyzing and interpreting the results. Both authors read and approved the final manuscript.

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ABSTRACT

The study examines the impact of cotton imports on the real GDP (Gross Domestic Product) of Indonesia for a period from 1992 to 2018 using ARDL approach and Granger causality analysis. Results of the study indicated that cotton imports have negative effect on economic growth. For every 1% increase in cotton imports the real GDP decreased by 0.107% in the long run. Any disequilibrium in the model is adjusted with a high speed of adjustment of 107.7% in less than a year. Shocks and the trend are adjusted in less than one year. There is no causality between imports of cotton and the real GDP. The study suggested effort should be taken by the government to increase yield of cotton by the use of technology and also a need to initiate farmers to take up cotton farming.

Keywords: Cotton imports; GDP; cointegration.

**Corresponding author: E-mail: soumyapasupuleti@gmail.com;*

1. INTRODUCTION

Indonesia is one of the leading agricultural importers in the world. Wheat, soybeans, rice, beef, fresh fruits, dairy and various feed ingredients were the major agricultural products imported by Indonesia. In the year 2018, Indonesia imported animal products worth of USD 2.79 billion, food products worth of USD 8.47 billion, vegetable products worth of USD 8.75 billion and textile and clothing products worth of USD 10 billion. The major share in agriculture related imports is contributed by textile and clothing products. The shares of animal, vegetable, food products are 1.48, 4.64 and 4.49 per cent of total imports by Indonesia, respectively. Whereas textile and clothing products share is 5.31 percent.

Indonesia imports raw cotton, processes and produce garments. For the production of these textile products, Indonesia mainly depends on imported cotton as significant amount of cotton is not produced domestically. Indonesia is ranked fifth in the world in case of cotton imports. It imported 650 thousand bales of raw cotton approximately with a value of USD 2,396 million in the year 2018. The countries like China, United States, Hong Kong, Australia, Brazil, India, Greece, South Korea, Vietnam and Argentina are the major cotton suppliers to Indonesia. The purpose of the present study is to know whether there is presence of cointegration between imports of cotton and the real GDP of Indonesia or not.

2. METHODOLOGY

2.1 Nature and Sources of Data

The present study completely based up on the secondary sources of data. The required data procured from UNCOMTRADE accessed through the World Bank's World Integrated Trade Solution (WITS) software. Data for a period of 27 years i.e., from 1992 to 2018 has been considered for analysis.

2.2 Cointegration technique – ARDL approach

Though Autoregressive distributed lag (ARDL) models have been in use for decades, recently they have gained popularity. ARDL models are used to test the presence of long-run relationships between economic time series. ARDL model consists of lagged values of dependent variable, current and lagged values of explanatory variables. Data of total exports, cotton imports, imports other than cotton and GDP (Gross Domestic Product), all at constant prices are considered for analysis for the period from 1992 to 2018.

The model is specified as follows

The Augmented production function, including both exports and imports is expressed as

$$\text{Real GDP}_t=f(\text{Exports},\text{Imports}) \quad (1)$$

The function can also be represented in a natural log econometric format thus:

$$\ln(\text{Real GDP})_t = \beta_0 + \beta_1 \ln(\text{Exports})t + \beta_2 \ln(\text{Imports})t + \varepsilon_t \quad (2)$$

$$\text{Imports} = \text{Imports of commodity X} + \text{Imports other than commodity X} \quad (3)$$

Where X is an agricultural commodity

By substituting (3) in (2) we get

$$\ln(\text{Real GDP})_t = \beta_0 + \beta_1 \ln(\text{Exports})_t + \beta_2 \ln(\text{Imports of X})_t + \beta_3 \ln(\text{Imports other than X})_t + \varepsilon_t \quad (4)$$

Equation(4) can be rewritten as

$$\ln(\text{Real GDP})_t = \beta_0 + \beta_1 \ln(\text{Exports})t + \beta_2 \ln(\text{Imports of cotton})t + \beta_3 \ln(\text{Imports other than cotton})_t + \varepsilon_t \quad (5)$$

where

β_0: The constant term.
X: Major agricultural commodity considered under the model i.e., Cotton (HS code:52)
β_1: coefficient of variable (Exports)
β_2: coefficient of variable (Imports of cotton)
β_3: coefficient of variable (Imports other than cotton)
t: The time trend.
ε: The random error term which is normally, identically and independently distributed.

The methodology consists of several steps:

- In the first step, we test for stationarity of variables. There are several methods of unit root tests. Since these methods may give different results, we selected the Augmented Dickey-Fuller (ADF) test [1,2].

In this test, the null hypothesis represents non stationarity of variables. The optimal lag length used to remove autocorrelation in the residuals. The ARDL bounds test is apt if variables are I(0) or I(1), and if any series are integrated of order I(2) or higher, then the calculated F-statistic is not suitable. Therefore, before applying this test, we determine the order of stationarity of variables. There should not be any variable stationary at I(2). F statistics values used are provided by Pesaran et al. [3] and Narayan [4] and they are suitable for variables stationary at I(0) and I(1).

- In the second step, a particular type of ARDL model is formulated and we will derive unrestricted error correction model (ECM) or "conditional ECM". This is according to Pesaran et al. [3]. Before the estimation of the model, we determine the optimum lag length for the model using EViews 11.
- In the next step we conduct Bound test. The F test is used to test whether there is long run relationship between variables or not. The values of F-test depend on
  1. whether variables integrated at I(0) or I(1) included in the model
  2. the number of explanatory variables and
  3. whether there is presence of intercept and/or a trend in the model.

There are two bounds one is lower bound and another one is upper bound. Lower bound assumes variables integrated at zero order whereas upper bound assumes variables integrated at first order. If the F-statistic calculated is less than the lower bound then their absence of cointegration. If it is between lower and upper bounds then that is inconclusive. If the F-value is greater than upper bound then there is presence of cointegration between variables. Besides that, a Bound t-test of H_0: $\mu_{11} = 0$, against H_1: $\mu_{11} < 0$ can also be conducted for the purpose of cross check. If the value of t-statistic for the lagged levels of the explained variables is greater than the upper bound, then there is a cointegration between the variables. If the t-statistic is less than the lower bound, there is no cointegration.

- If there is presence of cointegration between variables then in the next step we will determine the long run relationships between variables. With the help of linear transformation, an Error Correction Model (ECM) is derived from the ARDL bounds test. The short-run dynamics associated with the long-run estimates are obtained. The value of ECM, the error correction term should be negative and statistically significant as it indicates the speed of adjustment, i.e., how quickly the variables return to the long-run equilibrium.
- If there is cointegration between variables then we have to check the stability of coefficients using cumulative sum (CUSUM) and as cumulative sum of squares (CUSUMSQ) (Pesaran[5], Stamatious and Dritsakis[6]) tests. The graphs of the CUSUM and CUSUMSQ are represented by blue lines. If these blue lines are within the limit of red lines, then the model is stable. Red lines represent critical values at 5% level of significance. Diagnostic tests examine the model for serial correlation and heteroscedasticity.
- In the last step, after the determination of long-run relationship between variables, the direction of causality using the Granger causality is analyzed.

3. RESULTS AND DISCUSSION

Unit root test results are presented in Table.1. Augmented Dickey-Fuller (ADF) test was used to check the stationarity of variables. All the variables considered under the model are nonstationary at level and stationary at first difference for both without trend and with trend. All the variables which are stationary are significant at first difference. So, we can conclude the ARDL model can be used for analyzing data.

Results of VAR lag order selection criteria are presented in Table. 2. From the table, it can be observed that optimum lag length is 1 according to final prediction error (FPE), the Hannan and Quinn information criterion (HQ) and Schwarz's Bayesian information criterion (SC) whereas optimum lag length according to Akaike's information criterion (AIC) is 3.

Table 3 represent bound test of cointegration. The bound test is run for data without trend. The value of F-statistic is 7.61 which is greater than upper bound critical value (I(1)) at 1% i.e., 5.61 which in turn implies presence of long run relationship or cointegration between real GDP and cotton imports in case of Indonesia.

Table 1. Unit root test results

Variables	ADF test			
	Intercept		Trend and Intercept	
	Level	First Diff.	Level	First Diff.
In Real GDP	-0.695	-5.301**	-1.952	-5.230**
In Total Exports	-1.099	-4.666**	-1.696	-4.607**
In Cotton Imports	-1.525	-5.329**	-2.078	-5.209**
In Imports Other than Cotton	-0.638	-4.638**	-1.774	-4.551**

*Note: **represent significant at 1% probability level*

Table 2. Optimum lag length selection criteria

lag	LogL	LR	FPE	AIC	SC	HQ
0	14.048	NA	5.09e-06	-0.837	-0.641	-0.785
1	69.015	87.031*	2.03e-07*	-4.085	-3.103*	-3.824*
2	76.775	9.699	4.58e-07	-3.398	-1.631	-2.929
3	102.459	23.544	2.95e-07	-4.205*	-1.652	-3.528

*Note: sample: 1992-2018. Num. obs.: 27. * indicates lag order selected by the criterion*

Table 3. Bound test of cointegration

Variables	Optimal lag	F statistic	HQ
Dependent variable: In real GDP **Explanatory variables**: In Cotton Imports In Imports other than Cotton In Total Exports	(1,1,0,0)	7.61	Cointegration

Level of significance	Critical value	
	I(0)	I(1)
10%	2.72	3.77
5%	3.23	4.35
1%	4.29	5.61

As there is presence of cointegration, long run relationship coefficients for the model are estimated. Table 4. represents estimated long run coefficients for the model using ARDL approach. The long run coefficient estimated is significant only for imports other than cotton at 5% probability level. The coefficient of cotton imports is -0.107 which implies that for every 1% increase in cotton imports the real GDP decreased by 0.107 % in the long run [7].

Short run dynamics of the respective long run coefficients of the model are presented in Table.5. In short run, coefficient of cotton imports is significant at 5% probability level. A 10% increase in cotton imports decrease the real GDP by 3%. The ECM coefficient is negative and found to be significant at one per cent. The negative ECM represents the model converges towards equilibrium. ECM represents speed of adjustment. Any disequilibrium in the model is adjusted with a high speed of adjustment of 107.74% in less than a year. Shocks and the trends are adjusted in less than one year. Fluctuations in GDP helps in achieving equilibrium, with the amplitude getting smaller until the final extinction of the shock. Which implies some of explanatory variables easily absorbs external shocks [8-10].

The stability tests CUSUM and CUSUMSQ tests are represented in Fig.1 and Fig. 2 respectively. The plots of CUSUM and CUSUMSQ lies within 5% critical limits which implies the structural stability of model.

Results of diagnostic tests are presented in Table 6. The null hypothesis for heteroskedasticity and serial correlation LM tests are “Homoskedasticity” and “No serial correlation”. There is absence of heteroskedasticity and serial correlation at probability level of 5%.

Table 4. Estimated long-run coefficients for ln real GDP

Variables	Coefficient	Standard Error	t-Statistic
ln Cotton Imports	-0.107	0.133	-0.809
ln Imports other than Cotton	1.059**	0.172	6.175
ln Total Exports	-0.150	0.219	-0.685

*Note: ** represent significant at 1% probability level*

Table 5. Short run dynamics

Variables	Coefficient	Standard Error	t-Statistic
C	6.859**	1.151	5.957
D(ln Cotton Imports)	-0.302*	0.134	-2.257
ECM (-1)	-1.077**	0.182	-5.918

*Note: ** represent significant at 1% probability level   * represent significant at 5% probability level*

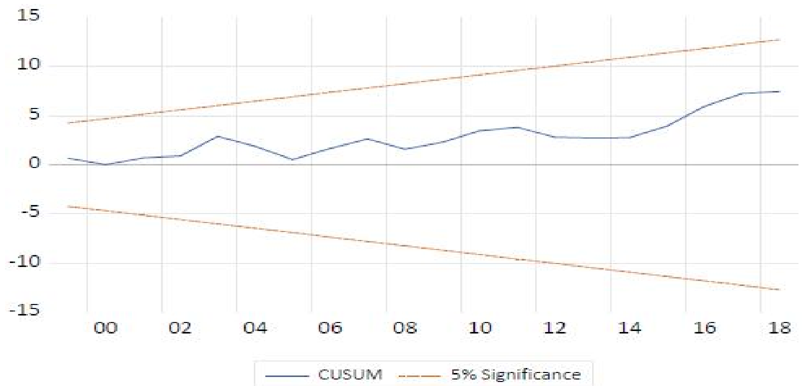

Fig.1. Plot of CUSUM test

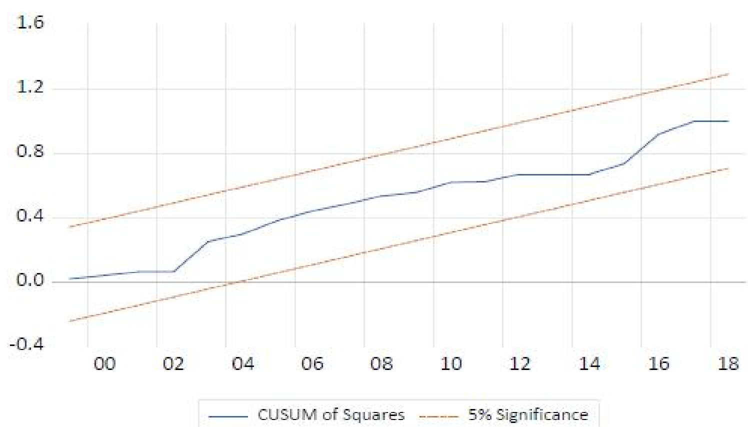

Fig. 2. Plot of CUSUMSQ test

Table 6. Diagnostic tests

Test	F-statistic	Observed R-squared	Probability of Chi-Square
Heteroskedasticity Test: Breusch-Pagan-Godfrey	2.691	10.456	0.063
Breusch-Godfrey Serial Correlation LM Test	0.481	1.319	0.517

Table 7. Pairwise granger causality tests

Null Hypothesis	F-Statistic	Probability
COTTON IMPORTS does not Granger Cause REAL GDP	0.475	0.629
REAL GDP does not Granger Cause COTTON IMPORTS	2.857	0.081

Granger causality results are presented in Table 7. Results reveal there is no causality between the real GDP and imports of cotton at 5% probability level.

4. CONCLUSION

The results indicate cointegration between Cotton imports and the real GDP of Indonesia. The results reveal that cotton imports have long term negative impact on real GDP i.e., for every 1% increase in cotton imports the real GDP of Indonesia decreased by 0.107% in the long run. To increase GDP there is a need to decrease cotton imports. The cotton imports are increasing because of increased global demand of cotton yarn and also expansion of mills which are larger in size. The cotton production in Indonesia is decreasing due to conversion of land to non-agricultural use and also farmers are interested in growing high margin crops such as rice and corn. The study suggested effort should be taken by the government to increase yield of cotton by the use of technology and also a need to initiate farmers to take up cotton farming.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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