

Determinants of Agricultural Exports of Pakistan: An Application of Gravity Model

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Abstract

This study is examined the rice and cotton trade potential for Pakistan for the period of 1984 to 2014 by using the gravity model and random effect model. The objective of this study is to find the components that affect the rice and cotton trade in Pakistan. The empirical results for rice and cotton suggest that Pakistani exports are positively affected through production, common boarder and GDP of partner countries. The results show that the distance has negative impact on exports and gross domestic product as well. The findings also suggest that higher trade flows are attributed to the country that shares a common border with Pakistan.

Keywords: Economic Growth, Rice, Cotton, Gravity Model, Pakistan

Introduction

Trade is an important factor of economic growth and developmental of a nation. Indeed, it is also playing a role for the provision of consumable goods, as there are two ways by which the food availability is possible in a country, first one is the production of food by itself and the second is through trade. Now a day, at global level the 2nd way has become more popular and useful. From the last two decades, in order to provide food available to those countries, which are facing problems in their domestic production, the world agriculture export has been increased with high rate. From last four decades, the growing average of world export is 7% and world agriculture production growth rate have been slow down. This situation raised a question and a fear for the future population. World may not be capable to produce food and other goods according to the demand.

This decelerate situation of agriculture food is not only because of shortage of land but also because of lack of demand for agriculture production. One of the biggest reasons is that food consumption per person is very high and most of the world population remains in absolute

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poverty. Cotton is the most important textile in the world, and the top six consumers of the world's cotton are Brazil, China, India, Pakistan, Turkey and USA (USDA)¹. In the last two decades, China has increased the imports of cotton because of industrialization.

Agriculture is an important sector which contributes to GDP and labor employment in rural areas. It is also playing as an accelerating factor to the industry as it provides the raw material to the industry. During 2012-13, agriculture sector exhibited a growth of 3.3 % on the back of nominal growth in agriculture related sub sectors, Crops grew at 3.2 %, Livestock 3.7 %, Forestry 0.1 % and fishing 0.7 %.

The agriculture subsector which included important crops, other crops, grew by 2.3% and 6.7%, cotton ginning declined by 2. %. Important crops accounted for 25% of agricultural value added and has experienced a growth of 2.3% in fiscal year 2012-13 against growth of 7.4% in 2011-12. The lower growth in important crops is attributed to decline in production of rice and cotton by 10% and 4.2% respectively (Economic survey of Pakistan).²

As in Pakistan agriculture sector is the largest sector but its share in GDP decrease day by day. Its main reason is electricity shortage, decrease in foreign direct investment, unavailability of agriculture credit to every farmer and low export due to low productivity. Four main crops (cotton, rice, wheat, and sugarcane) contribute 28% in agricultural growth and 5.9% in country GDP. Rice total production in 2010-11 was 4,823 thousand tons. There was 29% decrease in rice production as compare to last years. Its main reason was flood of July 2010. Pakistan is one of the largest producers of cotton as almost 40% production of the cotton use domestically and remaining 60% is used for exports.³

Pakistan's export has been swaying around US\$ 24-25 billion since various years. In July-April 2014-15, fare was hoping for increment, however tragically it demonstrates decay of 5 percent than a year ago. Pakistan needs to investigate new markets and expand the number of exports base items on the grounds that just cotton bunch contribute 55 percent and other rice, calfskin, engineered made ups add to 14 percent in the export. New markets ought to be investigated in Africa, Eastern Europe, Russia and South American nations. Right now, our export destination is just couple of nations, for example, Center East, European Union and North America. In July-April 2014-15 every single significant gathering of exports recorded unfriendly development two percent decay records by Nutritional category in this period. In Sustenance class primary decay is because of export of Basmati rice which watched 22.5 percent decrease as far as amount, however different

assortments of rice demonstrate a development of 7.1 percent. In Pakistan cotton is the main cash crop. Cotton is contributes a significant role to the national economy of Pakistan. Cotton crop is the basis of Pakistan economy.

It is not only a major source of the survival of many farmers' families in Pakistan but it also contributes a significant share of almost 65% in earning foreign exchange.⁴

Rice industry has distinctive needs and interest, since agriculturists need early development and better returns which give them high benefit and enough time for sowing next harvests. While the other side, brokers and mill operator's demand good quality of production in term of shape, size and whiteness.⁵

Pakistan is an agricultural country and Agricultural sector is the backbone of its economy. Agriculture sector provides food availability, raw material for industry, foreign exchange earnings and job opportunity etc. From last few years the export of our major crops falls due to natural disasters, population burden and financial crises. Because of fall in exports of these crops Pakistan economy suffers a lot. This study investigates the determinants that influence the exports of the cotton and rice in Pakistan over the period of 1984 to 2014. Our study will be helpful to policy makers and Government to maintain and increase the export of the rice and cotton. This investigation may be also beneficial for the agricultural growth in Pakistan.

Literature Review

The exports play a vital role in economic growth of an economy. In Asian countries like Pakistan the exports mostly depend on agricultural products. Here are some reviews, which show the effects and determinants of rice and cotton exports. Kannan, M. examined the contributing factors of production and exports of rubber in case of India for 1991-92 and 2010-11, employing OLS. It is concluded that the natural rubber should be increased for economic growth.⁶ Amoro and Shen investigated the determinants of agricultural export in China 1970-2005. The results exposed that rubber export is influenced by domestic consumption and exchange rate.⁷

Faridi, M. worked on agricultural exports and economic growth in Pakistan over the period of 1972 to 2008. The results show that the agricultural exports negatively affected economic growth, and two way causal relationships between real GDP and agricultural exports.⁸ Idsardi, E. found three main determinants of exports that explain the variation in agriculture export of South Africa for 2002-2009 by using the

Augmented Gravity Model. The empirical results suggest that South Africa should try to export their products to neighbor countries that minimize their transportation cost.⁹

Abolagba et al. tried to discover the factors that useful to raise the export level of cocoa and rubber of Nigeria for 1970-2005. The findings show that output, exchange rate, producer price, domestic consumption and interest rate play an important role in the export of cocoa and rubber in Nigeria. The cocoa export can increase by value addition and rubber's export by checking of rubber plants and trees regularly.¹⁰

Hatab et al. found that the currency of Egypt depreciates in last few years, the country's population increase at high level which raises the demand for all normal goods. They also mention that transportation cost has negative impact on Egyptian agriculture exports.¹¹ Daramola et al. also observed the agriculture export potential in Nigeria for 1971-2004. He found that from last decade the agriculture exports of Nigeria were fallen and it has also lost world market share in agriculture exports. The results show that low level of investment is the cause of low exports in agriculture sector.¹²

Kumar and Rai estimated the impact of trade liberalization on export performance of tomato in India for two time periods before WTO commencement 1985-1994 and after WTO commencement 1995-2004. The results suggest that India has comparative advantage in tomato exports and its product through socialization of improved technique of production and processing.¹³

Aurangzeb find out the relationship between exports and economic growth in Pakistan for 1973-2005, and suggest that an export oriented approach is required for fast economic growth in Pakistan.¹⁴ Tharakan et al. found the determinants the exports of India for 1996-2001 by using Gravity Model. The results show that English language and knowledge about internet connection are the key determinants of Indian software exports, distance was not an important determinant for the Indian's software export. They also found that software exports expand the level of total export of the India.¹⁵

Bhattacharyya and Banerjee found that Indian traders export their products to developed countries instead of developing countries, and domestic policies, WTO, liberalization and distance are the key factors that affect the trade level. The results also show that the cost of distance and transport decrease the trade transactions among developed countries.¹⁶ Edwards and Alves estimated the South Africa's exports performance over 1971-2001. The results show that in 1990s the manufacturing export level become low also showed the factors that

affect the profitability of export in South Africa. Such factors are exchange rate, tariff and tax, roads, and skilled labor.¹⁷

Mouna and Reza found that real exchange rate and export diversification are the significant determinants of export in Tunisia and Morocco, whereas insignificant determinants of exports in Algeria.¹⁸ Parsad, S. estimated the determinants of exports in Fiji for 1968-1998 by using the ECM. The findings show that trading partner income largely drives movement in Fiji's export in the long run, while in short run the exports are influenced by factors which affect the output of agriculture production.¹⁹

All of the above reviews regarding determinants of agricultural exports concluded that there are different factors which are involve in lowering the exports are high transportation cost, population burden, fluctuations in prices and role of international markets.

Methodology

To determine the factors of cotton and rice export we use the Gravity Model which is related to the Newton's Law of Gravity in physics. This states that two substance attract each other proportionally to the product of the each object's mass (kg) divided by the distance between their respective center of gravity (meters). This Law first time used in 1962 by Tinbergen in international trade. The basic form of the model in trade is as follows;

$$F_{ij} = G \frac{M_i M_j}{D_{ij}}$$

Where, F shows the flow of trade, M is mass of economy of country *i* and country *j* and D is the distance between countries. In econometric form we can write this model as follow;

$$F_{ij} = G (M_i^{\beta_1} M_j^{\beta_2} / D_{ij}^{\beta_3}) \eta_{ij} \quad (i)$$

$$\ln(F_{ij}) = \beta_0 + \beta_1 \ln(M_i) + \beta_2 \ln(M_j) - \beta_3 \ln(D_{ij}) + \epsilon_{ij} \quad (ii)$$

Eq. (i) shows the Gravity Model in econometric form. Where F_{ij} is the total trade in country *i* and *j*, M_i and M_j is the GDP of country *i* and *j*, D_{ij} represent the distance between the two countries and ϵ is the error term. Eq. (ii) is the log form of the equation (i).

Traditional gravity models usually use in panel data to find out the trade relationships for a specific time period. However, panel data predict several advantages such as: panel data analysis can cover the

significant associations among variables with the passage of time. Consequently, we have used panel data approach and the general form of our Gravity model is as follows;

For Cotton:

$$Cx_{ij} = f(GDP_{ij}, Pop_i, Prod_i, dist_{ij}, CB_{ij}) \dots\dots\dots (1)$$

For Rice:

$$Rx_{ij} = f(GDP_{ij}, Pop_i, Prod_i, dist_{ij}, CB_{ij}) \dots\dots\dots (2)$$

Where;

Cx_{ij} = Cotton export from country i to country j

Rx_{ij} = Rice Export from country i to country j

Gdp_i = Gross domestic product in country i

Pop_i = Population in country i

$Prod_i$ = Production in of cotton/rice in country i.

$Dist_{ij}$ = Distance from country i to country j

CB = Common border between country-i and country-j

These equations show the Gravity model of Cotton and rice export from Pakistan, Eq.1 indicates the cotton exports, Eq.2 shows the rice exports from Pakistan.

$$Cx_{ij} = \alpha_0 + \alpha_1 \ln(GDP_i) + \alpha_2 \ln(Pop) + \alpha_3 \ln(Prod_i) + \alpha_4 (CB_{ij}) + \alpha_5 (Dist_{ij}) + \mu_{ij}$$

$$Rx_{ij} = \beta_0 + \beta_1 \ln(GDP_i) + \beta_2 \ln(Pop) + \beta_3 \ln(Prod_i) + \beta_4 (CB_{ij}) + \beta_5 (Dist_{ij}) + \varepsilon_{ij}$$

This is the econometric form of the model with log values. Equation one shows the determinants of cotton export and equation two belong from rice export. We have used pooled OLS and random effect model to analyze the results.

In our study, the REM of panel estimation is the suitable model. The model further classified in two groups, basic and augmented gravity model will be estimated using panel data. Furthermore, twin gravity model specifically focuses on emerging agricultural export products (rice and cotton) it will be estimated in models.

A substantial body of literature used this approach e.g. Eita, J. examined the determinants of Namibian Exports using A gravity model approach for 38 countries over 1998-2006. He used three models, pooled OLS, FEM and REM.²⁰

Data

To analyze the factors that influences the rice and cotton export of Pakistan from 1984-2014. For rice export, we have selected ten countries within different regional groups; Sri Lanka and Bangladesh from SAARC, Singapore and Malaysia from ASEAN, UK and Italy from EU, Canada and USA from NAFTA, and Iran and UAE from Middle East. For cotton exports, the countries are selected according to the trading relations with Pakistan on the basis of availability of data. The major ten cotton importer countries from Pakistan have been selected. These are Bangladesh china, Indonesia, Italy, Korea, Portugal, Sri Lanka, Thailand, USA and UK. Data on all variables used in this study is taken from different sources over the period of 1984 to 2014. The data on rice and cotton exports is measured in million US\$ and taken from Pakistan Bureau of Statistics,²¹rice production in tones from Food and Agricultural Organization (FAO),²²data on cotton production is taken from All Pakistan Textile Mills Association (APTMA). The variable Gross Domestic Product and Population is taken from WDI. The distance (km) is used as a proxy of transport cost and taken from CEPII (Research and expertise on the world economy). The distance between two trading countries is measured through the great circle formula (Head, 2000). We have also used dummy variable 'common border' in our analysis as if a country is sharing a border with Pakistan is assigned D=1, and 0 otherwise.

Results and Discussion

This section contains the estimation results and discussion of our model for rice and cotton exports in Pakistan.

Table 1 contains the results of basic and augmented random effect model which implies that rice exports increase the GDP of Pakistan. Similarly, partners country GDP mostly use as size as economics is also positive significant relate with Pakistani rice export. The variable of distance shows that if Pakistan's distance from major importing markets is high, the agricultural exports would be reduced, so it is statistically negative effect on the Pakistani rice export. The column 2 of Table 1 shows that Pakistan's rice export is positively correlated with GDP. The key determinants of Pakistan's Rice exports are: The GDP, rice production and border share of the Pakistan's economy. All three factors influence the Pakistan's rice exports positively. Border distance is found significant factor in influencing the Pakistan's rice exports. This implies Pakistan's rice exports would do enhanced if the country trades

more with neighbor countries. The results also show that an increase in partner GDP also causes exports to enhance. Augmented form of gravity model in rice export shows that Domestic production of rice is significant and has positive impact on the rice exports of Pakistan. The coefficient of distance is negative and significant; the distance between Pakistan with its trade partner is taken in miles. Despite of having trade potential with the countries, Pakistan has low trade with them which would otherwise have high distance. In case near country, Pakistan has international political issues that are major concern such as, Iran nuclear power plant etc. Currently, however, the expected possible reduction in both tariff and non-tariff barriers may lead to expansion in the trade between these two countries. The model identifies trade potentials with common boarder like china, Iran, UAE; whereas Pakistan is exporting either close to or in some cases above the trade potentials with rest of the selected countries such as UK, Afghanistan. However, these estimates are based on some values for control variables (common border, tariffs, common language, conflict and geographical location etc.) prevailing in 2002 and 2003. Indeed, any change in these variables (say reduction in tariff or resolution of conflict) is likely to change the estimates of the trade potential.

Table 1: Pakistan's Rice export and Gravity Model

Independent Variable	Dependent Variable: Rice Export	
	Basic Random effect	Augmented Random Effect
GDP _i	5.57*** (0.67)	0.87 (3.63)
GDP _j	1.05*** (0.10)	1.04*** (0.89)
POPULATION	---	2.16 (2.79)
RICE PRODUCTION	---	2.68*** (1.07)
DISTANCE	-0.2*** (0.3)	-0.1*** (0.3)
BORDER	---	2.95*** (0.35)
R ²	0.41	0.53
CONSTANT	-42.7*** (4.97)	-47.8*** (17.61)
OBSERVATIONS	310	310
WALDI-CHI SQUARE	216.2** *	326.3** *

Notes: Significance of coefficients at the 10%, 5%, and 1% levels are shown by *, **, and ***, respectively.

Table 2 shows the results of basic and augmented gravity model of cotton export's base on the domestic GDP, partners GDP, and distance are determined significant. While domestic GDP have no impact on dependent variable. While the basic form of the gravity model shows that only partners' GDP and distance are significant. These findings are engage with arguments presented by previous studies that a large number of international countries like Pakistan's cotton have undoubtedly contributed to an increase in exports.

The column 2 of Table 2 shows the results of augmented gravity model. The empirics imply that Pakistan would do better if the country trades more with neighbors countries. The results also show that the coefficients of domestic GDP, border and cotton production are insignificant in case of Pakistan cotton export. The coefficient for distance is significant negative in cotton cases. Similarly strong reason that, cotton mostly exported to non-boarder country. That is why, common boarder is insignificant and distance is negatively relationship with trade.

The lastly, NAFTA, SAARC, OECD countries are not uniting together for the trade purpose particularly for Pakistan. The second approach would be to establish augmented REM and treat the data as a whole as recommended by, the revised regression results do not illustrate any significant improvements over the segregated regressions. The R-squared for both equations are 0.826 and 0.839 respectively which indicates that the overall performance of the model is really good. Significance of both models reveals that the rice and cotton export of Pakistan is better explained by gravity model.

Table 2: Pakistan's Cotton export and Gravity Model

Independent Variable	Dependent Variable: Cotton Export	
	Basic Random Effect	Augmented Random Effect
GDP _i	1.05 (0.97)	4.35 (6.71)
GDP _j	0.76*** (0.06)	0.76*** (0.06)
Population	----	-0.02 (0.03)
Cotton Production	----	0.33 (1.004)
Distance	-0.01*** (0.002)	-0.01*** (0.002)
Border	---	-0.12 (0.59)

R ²	0.45	0.55
Constant	- 11.14*** (7.27)	- 13.40*** (41.38)
Observations	295	295
Waldi-Chi Square	213.01** *	214.01** *

Significance of coefficients at the 10%, 5%, and 1% levels are shown by *, **, and ***, respectively.

Conclusion and Policy Implications

The empirical results suggest that the exports of Pakistan are explain by the GDP of trade partners, higher the GDP of trade partners will lead to higher export level of Pakistan. This suggest that Pakistan’s trade pattern pursue a GDP pattern, focused on the production and export of quantity-based products and depending on generally market size, rather than a per capita GDP pattern centering on the export of quality-based high value added products in a both agro export. Pakistan exports more to boarder countries than non-boarder, increasing the export market to boarder and non-boarder countries and extending trade with also union countries like NAFTA, ASEAN, and SARRC can enlarge exports and limit imports improving in general trade position of Pakistan.The empirics show that Pakistan has the maximum trade potential with allies in boarder and non-boarder.The maximum trade potential exists for china, UAE, Iran, Indonesia, Bangladesh,

Therefore, Pakistan should discover ways and resources to develop its trade relationships as economic and physical market size play an important role in agricultural export growth, so those markets should be targeted first whether it’s a bulk or niche product. The stage of development of an export market is not of trivial importance to agricultural export growth. Thus export diversification should focus on markets in all stages of economic development: developing, emerging and developed. In further, Pakistan-china economic corridor provide a new look of Pakistani and world international trade.In the last, the results of the gravity model to Pakistani rice and cotton are relatively helpful to design of policies which can progress the performance of the international markets.

Notes & References

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²¹Pakistan Bureau of Statistics: Agriculture Statistics of Pakistan 2015

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