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Finding Impact of Pakistan-China Free Trade Agreement (PCFTA) on Agricultural Exports of Pakistan- Gravity Model Approach

Majid Lateef[1], GuangJi Tong[1*], Muhammad Abdullah[2], Mazhir Nadeem Ishaq [3], Zeeshan Ahmad[4] and Muhammad Usman Riaz[5]

[1]*College of Economics & Management, Northeast Forestry University, China*
[2]*Department of Business Administration, University of Sargodha, Lyallpur Campus, Faisalabad, Pakistan*
[3]*College of Economics and Management, Northeast Agriculture University, China*
[4]*Department of Management Sciences, Preston University, Pakistan*
[5]*School of Management, Harbin University of Science & Technology, China*
majidonweb@foxmail.com, tonggj63@126.com

Abstract

China and Pakistan have years long history of friendly relations. Two countries decided to get fruit of these friendly relations for mutual economic development and cooperation in terms of trade relations by signing Pakistan-China free trade agreement (PCFTA) in 2006. Pakistan normally exports different agricultural products to China while imports high-tech products, chemical products and household appliances. Agriculture sector is backbone of Pakistan's economy and a major source of employment and export earnings. Exports of Pakistan are highly concentrated in agricultural products like sugar, cotton, rice and fruits. This study contains ex post facto analysis of Pakistan-China free trade agreement (PCFTA) on agricultural exports of Pakistan using theoretically justified gravity model. Panel data set containing disaggregated trade data of 110 trade partners of Pakistan for the period dating from 2001 to 2014 analyzed using Poisson Pseudo Maximum-Likelihood (PPML) version of gravity model by using Stata software 14.0. Data on export of all agricultural products of Pakistan were collected from United Nations Commodity Trade Statistics (UN Comtrade) database while the data regarding different macro economic factors like GDP, Population, Exchange rate etc. was extracted from World Bank Development Indicators (WDI) database. Data regarding distance, common border, common language and colonial ties was obtained from website of Centre d'Etudes Prospectives et d'Informations Internationales. The results suggest that PCFTA has very strong trade creation effect on agricultural exports of Pakistan. It has helped in exponential increase in agricultural exports of Pakistan to China and paved the way to promote friendly relations of two countries for further economic cooperation.

Keywords: *agricultural trade; Free Trade Agreements; Gravity Model; trade creation; trade diversion*

1. Introduction

China and Pakistan have a long history of cooperation, as the diplomatic relations were established as far back as 1950s and started nurturing in 1951 when Pakistan opened its mission in Beijing. Pakistan was one of the first countries and the first Muslim country to recognize People's Republic of China. The two countries have developed strong bilateral relations because of their proximity and interests in international matters. They are actively involved in economic cooperation by forming Joint Economic Commission, Economic Cooperation Group, Joint Energy Working Group and a Joint Investment Company. To

* Corresponding Author

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boost trade between two countries they agreed and entered into Framework Agreement on Expanding and Deepening Bilateral Economic and Trade Cooperation, Free Trade Agreement and the extended Joint Five Year Economic Plan in 2006 [1].

Agriculture sector has very important contribution in the economy of Pakistan in terms of providing raw materials, employment, export earnings and poverty alleviation. It has 19.8 percent contribution in GDP and provides employment to 42.3 percent labor force of Pakistan. The agriculture mix of Pakistan consists of important crops (rice, cotton, wheat, maize and sugarcane), other crops (gram, barley, tobacco, lentils etc.), livestock, forestry and fishing, and it accounts for 23.55 percent, 11.36 percent , 58.55 percent, 2.06 and 2.17 percent respectively to agricultural value addition. Agricultural exports are major part of export mix as only textile sector accounts about 60 percent of overall exports of the country. Other important agricultural exports include rice, sugar, fruits, vegetables, spices, meat and meat preparations. Government of Pakistan is pursuing export-led growth strategy. Recently, they have launched strategic trade policy framework (STPF) 2015-18 that is focused on enhancement of annual exports, improving trade competitiveness, moving towards efficiency-driven and innovation-driven economy and increasing share of Pakistan in regional trade [2].

Recently there has been an exponential growth of economic regionalism around the world which is also evident from the increased number of regional trade agreements (RTAs). One of main reasons of proliferation of RTAs is that it is difficult to get global trade agreement through WTO [3]. As per regional trade agreement (RTA) database of world trade organization (WTO), about 635 RTAs had been notified by July 2016, out of which 423 were in force [1]. However, welfare impact of regionalism remained a controversial issue among trade economists. Some researchers found the impact of RTAs to be positive [4, 5] while some found it to be negative [6, 7].

In this study, we have analyzed the impact of Pakistan-China Free Trade Agreement (PCFTA) on agricultural exports of Pakistan. PCFTA was signed on November 2006 and came into force on July 2007. Economists find impact of free trade agreement (FTA) by measuring its trade creation and trade diversion possibilities, the concept that was first introduced by Viner [8], which explains that when the trade among member countries increases because of reduction in trade barriers; it is called trade creation, on the other hand, when the imports shift from low cost non member country to higher cost member country because of reduction in trade costs; it is called trade diversion. Trade creation is presumed to have good welfare effects while trade diversion is presumed to have loss of welfare.

Finding the impact of PCFTA on agricultural trade is of vital importance and has not been explored earlier. In this study, we have analyzed effects of PCFTA on agricultural trade of Pakistan using disaggregated trade data and by using Poisson Pseudo-Maximum-Likelihood (PPML) version of gravity model. Sun and Reed [9] analyzed the impact of major regional trade agreements on agricultural trade using PPML and OLS estimation, they proved that PPML estimation must be preferred over OLS in case of agricultural trade. Most of the existing studies in this regard have analyzed the impact of trade agreements that involve more than two countries, while we have analyzed impact of a bilateral trade agreement on agriculture trade using PPML estimator. As per our literature research, no earlier study has tried to find the impact of a bilateral trade agreement on agricultural trade using PPML estimator.

The rest of study is organized as follow. Section 2 explains basics of gravity model of global trade, model specification, regression equation specification error test (RESET) and description of data used in this study. Section 3 describes and discusses empirical results, section 4 explains policy implication and section 5 gives final conclusions.

[1] The website is http://rtais.wto.org/ui/publicsummarytable.aspx

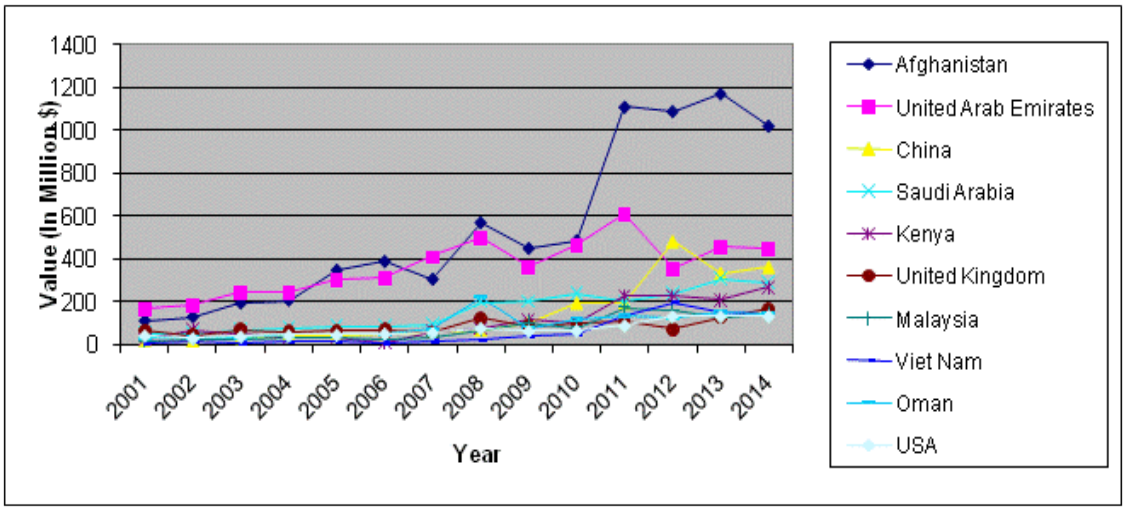

Figure 1. Agricultural Export Patterns of Pakistan to its Top Partner Countries

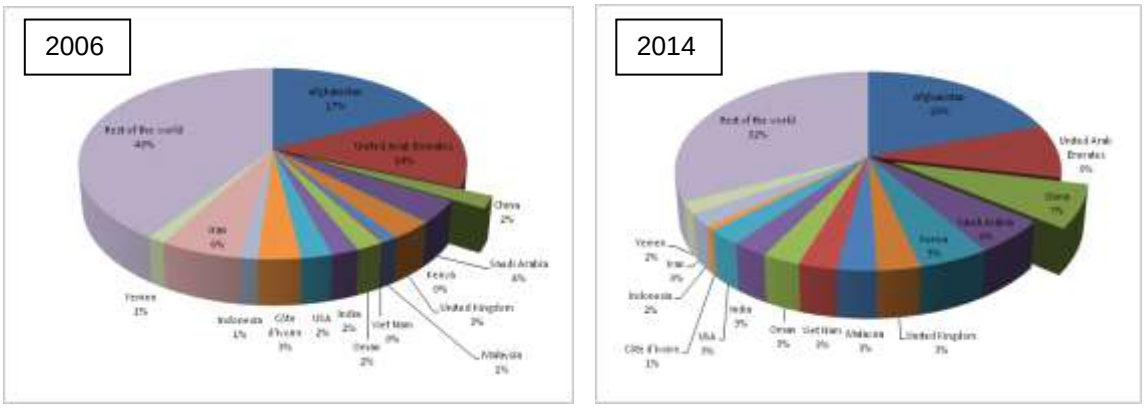

Figure 2. Direction of Agricultural Exports of Pakistan 2006 vs 2014

2. Materials & Methods

2.1 The Model

Since last many decades, gravity model remained very powerful tool for analyzing global trade [10]. First time gravity model was used by Tinbergen [11] and Pöyhönen [12] for *ex* post facto analysis of global trade using Newton's law of gravity. International trade between two countries is directly proportional to their economic size while inversely proportional to trade costs. Economic size of the country that is normally measured by Gross Domestic Product (GDP) is widely considered as proxy for economic size to attract trade between two countries. However, mutual distance of trading partners is considered as trade cost that forms resistance in trade. Thus, theory of gravity model advocates that countries with stronger GDPs and which are geographically closer to each other tend to experience high trade volumes. Conversely, smaller GDP and larger geographic distance acts as major factor for lower international trade. Some recent studies have proved that as long as the trade partners have stronger GDPs distance is not very important resistance term and it can be offset by economic size of partners and stronger partners can have high trade volume despite they are not in the close proximity [13, 14]. Many researchers augmented gravity model with different other variables to explore different determinants of trade and enhance its explanatory power. For example, Bergstrand [15, 16] augmented

gravity equation with population while Mátyás [17] and Thai [18] also augmented gravity model with exchange rate.

Many potential shortcomings in specification of gravity model were pointed out by subsequent researchers including potential endogeneity problem [19, 20], zero trade values problem [21-23] and heteroskedasticity issues [24]. Solution to endogeneity problem was suggested by researchers [25, 26] by introducing different type of fixed effects in gravity model. Silva and Tenreyro [27] proposed Poisson Pseudo-Maximum-Likelihood (PPML) estimator for gravity model and argued that it behaves very well in the presence of hetroskedasticity in trade data. Afterwards, Silva and Tenreyro [28] proved that PPML estimator also has consistent results in the presence of zero trade observations.

The basic theory of gravity model states that trade among countries is proportional to the economic size of the countries and inversely proportional to the trade costs.

In equation form it can be written as:

$$\boldsymbol{X_{it} = e^{(\sum \alpha_i DUM_i)} \; GDP_{it}^{\alpha_1} POP_{it}^{\alpha_2} DIST_i^{\alpha_3} ER_i^{\alpha_4} AL_i^{\alpha_5} v_{it}} \quad (1)$$

Where X_{it} is dollar value of agricultural exports of Pakistan to country *i* at time *t*, GDP_{it} is gross domestic products of country *i* at time *t* and represents economic size of the trader partner, POP_{it} is population of country *i* at time *t*, $DIST_i$ is the distance between Islamabad (capital of Pakistan) and capital of country *i*, ER is exchange rate, AL is agricultural land of country *i* which is also a proxy for economic size for our case and v_{it} is error term. The DUM_i is the values of different dummy variables that capture the information regarding specific interest and that can significantly impact the bilateral trade among Pakistan and its trade partners.

By taking logarithm of equation (1) and including specific variables for our case, the gravity model equation can be written as:

$$ln\boldsymbol{X_{it}} = \alpha_0 + \alpha_1 \boldsymbol{lnGDP_{it}} + \alpha_2 \, ln\boldsymbol{POP_{it}} + \alpha_3 \, ln\boldsymbol{DIST_i} + \alpha_4 \, ln\boldsymbol{ER_i} + \alpha_5 \, ln\boldsymbol{AL_i} + \alpha_6 \, \boldsymbol{COML_i} + \alpha_7 \, \boldsymbol{CONTIG_i} + \alpha_8 \, \boldsymbol{COMCOL_i} + \alpha_9 \, \boldsymbol{PCD_i} + \alpha_{10} \, \boldsymbol{FTAD_i} + \boldsymbol{\varepsilon_{it}} \; \ldots\ldots \quad (2)$$

In equation (2) α_0, α_1, α_2, α_3, α_4, α_5, α_6, α_7, α_8, α_9 and α_{10} are the coefficients to be calculated. PCD_i is Pakistan-China dummy variable that captures differences in trade patterns of Pakistan with China and the rest of world, it gets value of 1 in the case where trading partner is China and zero otherwise, its coefficient explains how much greater or lower were Pakistani exports to China as compared to other trading partners, $FTAD_i$ is free trade agreement dummy variable that gets value of one if trade partner is China for the years in which free trade agreement is effective and zero otherwise, its coefficient will measure the impact of PCFTA on agricultural exports of Pakistan, it will be positive and significant in case of trade creation, negative and significant in case of trade diversion, and insignificant in case PCFTA have no effect on agricultural exports of Pakistan. $COML_i$ represents common language dummy variable, English is the official language of Pakistan so $COML_i$ takes value of one when official language of trade partner country is English and 0 otherwise, coefficient of this variable will explain impact of common language on agricultural trade of Pakistan, $CONTIG_i$ represents common border, it takes value of 1 in case of neighbouring countries that share common border with Pakistan and zero otherwise, this will help us to assess role of common border in bilateral trade of agricultural products in case of Pakistan and $COMCOL_i$ represents colonial ties among trade partners, while $\ln v_{it} = \varepsilon_{it}$ represents error term.

2.2 Estimation Technique

Equation (2) is valid only in the case $X_{it} > 0$ and problematic when $X_{it}=0$ because log of zero is not defined. Practically, there are many instances of $X_{it}=0$ as it represents that two countries have zero trade for a specific period and/or for a specific sector. Recently, many

studies advocated not to use log-linear model and preferred to choose Poison models [9, 13, 27-29].
So, we have specified our model as follows:

$$X_{it} = e^{\{\propto_0+\propto_1 lnGDP_{it}+\propto_2 lnPOP_{it}+\propto_3 lnDIST_i+\propto_4 lnER_i+\propto_5 lnAL_i+\propto_6 COML_i+\propto_7 CONTIG_i+\propto_8 COMCOL_i+\propto_9 PCD_i+\propto_{10} FTAD_i+\varepsilon_{it}\}} \quad \ldots\ldots (3)$$

In order to cope up endogeneity problem, we have estimated the equation (3) with time fixed effects; it will also help to control different other macroeconomic factors like global economic boom or recessions [30]. To deal with zero trade observations we have used the technique as used in studies [31, 32], they added a value equal to one in the case where observed bilateral trade is zero. So that the dependant variable $X_{it}= X_{it} + 1$ for every case where $X_{it}=0$. To deal with heterosketdasticity, that is also a big problem in trade data, we used Poisson Pseudo-Maximum Likelihood (PPML) method as suggested by Silva and Tenreyro [27]. The same method was also used by other researchers [9, 32] specifically for agricultural trade and, Sun & Reed (2010) also proved that PPML method performs very well as compared to OLS model in case of agricultural trade. We, therefore, selected PPML method for this study.

2.3 Regression Equation Specification Error Test (RESET)

We also performed regression equation specification error test (RESET) to check conditional expectation of correct specification [33], It reconfirm and prove that the model specified in PPML format is appropriate and better as compared to OLS model. Table 1 show p-values of RESET test which is 0.2535 for PPML and 0.000 for OLS, it proves that PPML model is correctly specified and OLS estimation is not adequate for our model. Earlier studies by some researchers [9, 27, 32] had similar results for PPML and OLS model when they performed RESET on their models.

Table 1. RESET Test (p-values)

Test (null hypothesis)	p-values
For PPML	0.2535
For OLS	0.0000

2.4 Data

We used panel data of 110 countries including Pakistan & China dating from 2001 to 2014 (14 years). We have selected these years based on the reason that China joined WTO in 2001 and Pakistan-China free trade agreement (PCFTA) taken effect in 2007. Taking data for these years will give fair assessment of impact of PCFTA by taking seven years before and seven years after the enforcement of free trade agreement, and all years included are after China's accession to WTO. The Trade data regarding agricultural exports of Pakistan is collected from United Nations Commodity Trade (UN COMTRADE) Statistics database (http://comtrade.un.org), trade data of agricultural products were extracted by following WTO's definition of agricultural products i.e. Section 0, Section 1, Section 2 (excluding Divisions 27 & 28) and section 4 and by selecting standard international trade classification (SITC) Rev. 3.0 for all products. Data regarding GDP, Population, exchange rate and agricultural land were collected from World Bank Development Indicators (WDI) database. Data regarding distance, common language, common border and colonial ties were obtained from website of Centre d'Etudes Prospectives et d'Informations Internationales [34].

Table 2. Poisson Maximum Likelihood Estimate for Agricultural exports of Pakistan as the Dependant Variable (With time Fixed Effects)

Explanatory Variable	Parameter	Standard error
Intercept	15.1827	0.9617
lnGDP	0.2836***	0.0469
lnPOP	-0.3529**	0.0722
lnDIST	-1.1667***	0.0925
lnER	0.0766***	0.0198
lnAL	0.1872***	0.0354
COML	-0.5245***	0.1751
CONTIG	0.2553	0.2559
COMCOL	1.0353***	0.1358
PCD	0.6250**	0.2559
FTAD	0.8521***	0.2061
R^2	0.47	

Note: ***0.01, **0.05, *0.1 level of significance

3. Results & Discussion

We have used PPML technique to estimate effect of PCFTA on agricultural exports of Pakistan. We used Stata 14.00 software to run the model and table 2 represents the estimation results. Estimation results show that traditional gravity variables also have significant impact on agricultural exports of Pakistan. Higher GDP of importer must have positive and statistically significant effect on trade because it depicts higher demand potential of importing country. On the other hand, higher GDP of exporter indicates higher production potential that may lead to higher exports. Our results found this to be true for agricultural exports of Pakistan at 1% level of significance. It shows statistically significant and positive relationship between bilateral trade and income of country and indicates that, if other things remain constant, bigger countries in terms of GDP (like USA, China, U.K etc.) will import more agricultural products from Pakistan.

Population of a country may have positive or negative effect on its trade with other countries. Many studies tried to explore this and found that we cannot predefine whether the population has positive or negative effect on trade[35, 36]. A large local population may strengthen local market and increase local consumption which in turn cause decline in exports of that country [37]. On the other hand, a large population of a country can encourage and boost local production levels which eventually become the reason to higher export volumes. So, coefficient of population may show different signs for different cases[38].

In our empirical analysis of agricultural trade, we have found that population of importer have negative effect on its imports. A statistically significant and negative parameter for population explains that larger countries will import less agricultural products from Pakistan by substituting it for domestic trade. This is also because of the fact that countries with larger populations have abundance of rural population that is involved in agricultural production and causing decrease in export demand for agricultural products of that country.

The distance between the trade partners is considered as trade cost and traditionally has negative impact on volume of the trade. Likewise, distance coefficient for our study is found negative and statistically significant at 1% level of significance. It explains that Pakistan have more agricultural trade with countries for which transportation costs are

lower as compared to countries for which transportation costs are higher. In our case, because China and Pakistan are neighboring countries, distance proved to be very important determinant of trade of agricultural products. Our results for this variable are consistent with the previous studies regarding trade of agricultural products [9, 32].

A higher exchange rate normally has a positive effect on exports. In our case it explains that if there is depreciation of Pakistani Rupees causing higher exchange rate, it will lead to increase in exports of Pakistan. On the other hand, if there is appreciation of Pakistani Rupees, it will cause decrease in exports of the country. Our results have also proved that and we have found exchange rate to have positive and significant effect on agricultural trade of Pakistan with its trade partners.

We have taken Agricultural land of the importer into our gravity equation because it depicts production capability of importer and it is an important determinant of agricultural trade between countries just like Gross Domestic Product (GDP) of a country. We were expecting that being proxy for economic size of a country its coefficient will also show the similar results as of GDP and we have found the same. It is found to be positive and statistically significant at 1% level for agricultural trade.

The coefficient of common language is found negative and statistically significant at 1% level of significance. This may look odd may look odd but keeping in mind that our dependent variable is agricultural exports not the overall exports of Pakistan, this explain that common language is not an important factor in case of trade of agricultural products. Negative sign of estimated coefficient for common language dummy also implies that Pakistan have more trading relations (for agricultural trade) with countries that do not speak English as official language like China, Afghanistan, United Arab Emirates and European countries, it is also evident from Figure 2.

The dummy variable for common border is found to be non significant, this non significant dummy variable for common border explains that most of trade partners of Pakistan for agricultural exports are not its neighboring countries as Pakistan do not have significant trade relations with its neighboring countries except Afghanistan and China. This may also be attributed to political tensions with bordering countries as explained in earlier studies specifically for the case of Pakistan[39, 40]. Estimation result of COMCOL dummy variable is positive and statistically significant which explains that Pakistan have more agricultural trade with countries for which it have colonial relationships.

The estimated coefficient for Pakistan-China dummy have positive value of 0.62 and it is statistically significant at 5% level of significance; it explains that Pakistan already exported 85 percent[2] more to China than to the average trade partner during 2000-2014. The coefficient estimate for free trade agreement is 0.85 and it is significant at 1% level of significance, this positive and statistically significant value explains that free trade agreement have strong trade creation effect and caused exports of average Pakistani agriculture sector to China increased by 133 percent as a result of free trade agreement. Pakistan-China free trade agreement has proved to be a positive contributor to improve the agricultural exports of Pakistan.

4. Policy Implications

In South Asia, China only has free trade agreement with Pakistan. Two countries also attained currency swap agreement. It is in the great benefit for both countries to continue mutual economic cooperation. Impact of free trade agreements on economy of a country still remained a controversial issue and these effects vary from country to country. Sometime, free trade agreement and trade liberalization policies may also adversely impact local industry of a country. Successful implementation of free trade agreement would lead to reduction or elimination of import tariffs that could have negative impact on employment in agricultural sector and agro-allied industries of Pakistan. It has been proved

[2] Exp(0.62)-1=0.85

that Pakistan-China free trade agreement has increased exports of agricultural sector of Pakistan to China and both countries must continue their policies to further improve bilateral cooperation. Pakistan-China free trade agreement is helpful in achieving export-led growth policy of Pakistan. However, protection and improvement of local market must be considered at the same time as agriculture sector is the largest sector to provide employment to the people of Pakistan.

5. Conclusions

This paper estimates the impact of Pakistan-China free trade agreement (PCFTA) on volume of agricultural trade of Pakistan using PPML estimator which is a proven method for conducting empirical analysis of international trade. We also applied RESET test to confirm that PPML is better than OLS for our specific case. We used disaggregated trade data regarding agricultural exports of Pakistan to its 110 partner countries from 2001 to 2014. The trade of agricultural products was found to be significantly increased since the implementation of PCFTA in 2007. It is proved that Pakistan & China have very good trade relations for the trade of agricultural products. PCFTA is found to have a positive and significant estimation results which advocates that PCFTA have exponentially increased the agricultural exports of Pakistan to China. Positive and statistically significant estimates for GDP and agricultural land were found which confirm that incomes of trading partners also play important role in international trade. Dummy variable for common border is found to be insignificant which also reveals that Pakistan do not export much agricultural products to its neighboring countries and export more to the rest of the world, while at the same time distance variable proved to have negative impact on trade of agricultural products. Our findings suggest that Pakistan must maintain its trade policy with China as agriculture sector is the biggest sector in terms of export earnings and providing employment to a considerable population of Pakistan.

During April 2015, China and Pakistan have launched China-Pakistan Economic Corridor (CPEC) project worth $46 billion which will further deepen and broaden linkage between two countries. This mega project consists of a network of about 3000 Kilometers long highways, railways and pipelines. It will connect China's Xinjiang province to rest of the world through Pakistan's Gwadar port. This study has only explained impact of PCFTA on agricultural exports of Pakistan by using data dating from 2001 to 2014. China-Pakistan economic corridor will also have huge impact on trade between two countries. We recommend further research which explains impact of CPEC on trade of agricultural products of Pakistan.

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Authors

Majid Lateef, is Ph.D. scholar at College of Economics & Management, Northeast Forestry University, Harbin, China. He is working on impact of trade liberalization policies on China and Pakistan.

Guang Ji Tong, is supervisor of doctoral degree students and also dean faculty of Agricultural Economics & management at College of Economics and Management, Northeast Forestry University, Harbin.

Muhammad Abdullah, is assistant professor at Department of Business Administration, University of Sargodha, Lyallpur Campus, Faisalabad, Pakistan.

Mazhir Nadeem Ishaq, is Ph.D. scholar at College of Economics & Management, Northeast Agriculture University, Harbin, China.

Zeeshan Ahmad, is assistant professor at Department of Management Sciences, Preston University, Islamabad, Pakistan.

Muhammad Usman Riaz, he is Ph.D. scholar at School of Management, Harbin University of Science & Technology, Harbin, China.

