Received 16 June 2022
Revised 3 September 2022
29 December 2022
Accepted 31 January 2023

Does revealed comparative advantage matter in the gravity of FTAs?

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Abstract

Purpose – This study attempts to recognize the effects of the Pakistan–China free trade agreements (PCFTA) on promoting trade between the two economies.

Design/methodology/approach – Following the concept of revealed comparative advantage (RCA) and free trade agreements, the study first identifies those commodities in which Pakistan and China have a robust RCA and then analyze the effect of PCFTA on the export value of those commodities for the bilateral trade between Pakistan and China. The study used the panel data in which more than the top 150 importers (j) have been selected for each case of Pakistan and China for the period of 2003–2015.

Findings – The study concludes that even with the higher convergence rate, the good RCA does not guarantee a positive effect of the free trade agreement on the commodities.

Originality/value – The study contributes to the existing literature by integrating RCA with the gravity model by adopting a sequential mode for Pakistan–China free trade agreement.

Keywords Trade liberalization, Revealed comparative advantage, Gravity model, Pakistan–China free trade agreements

Paper type Research paper

Introduction

In 2021, the total value of trade among the countries was US $22.3tr which was just US $3.2tr at the start of the 21st century [1]. It shows that the trend of trade liberalization spread substantially over the last two decades throughout the world. However, this trade liberalization arises through various channels. Among them, the two major categories are multilateralism and bilateralism. Fundamentally, multilateral trade agreements are between three or more countries, whereas bilateral trade agreements consist of between two countries. These countries engaged in trade agreements while considering the contract

JEL Classification — F02, F10, F13, F15, F60, I30

Journal of International Logistics and Trade
Vol. 21 No. 2, 2023
pp. 84-107
Emerald Publishing Limited
e-ISSN: 2508-7592
p-ISSN: 1738-2122
DOI 10.1108/JILT-06-2022-0018

of General Agreement on Tariffs and Trade (GATT), which requires member countries to undertake trade liberalization on a most favoured nation (MFN) or nondiscriminatory basis, and permits a subset of World Trade Organization (WTO) members to pursue free trade agreements (FTAs) under which they can grant concessions to each other that they do not have to extend to others. According to the world trade organization, there are around 420 regional trade agreements in force globally. All these statistics highlight the colossal significance of trade liberalization, especially in the modern world. However, the theories about trade liberalization have been introduced in the literature long ago. The concept of trade openness (TOE) has been highlighted by many researchers in the existing literature, such as Adam Smith's (1776) pioneer work in "The Wealth of Nations," Richardo's (1817) idea of comparative advantage, Factor endowments, the Heckscher-Ohlin theory (1932), Leontief's (1953) patchy conclusion on factor abundant, and Vernon (1966) product life cycle theory. Among them, the majority of the studies focused directly or indirectly on the revealed comparative advantage (RCA). Yet; there is a lacking of amalgamation of the other theories of the free trade agreements with the theory of RCA. For instance, the gravity model has had a very significant impact on the empirical analysis of trade for more than three decades too. It generally explained the trade relationship between the countries based on their economic size, connectivity and distance among them. Although the gravity model holds a high acceptance among economists with some altercations, it ignores the comparative advantage between countries which is still one of the most important concepts in understanding international trade as it includes the trade structure and patterns of the country. Specifically, when the gravity model is used for the policy implication of trade potential and how to reduce the resistance of trade between the country, it should consider the comparative advantage because the countries which have complementary patterns of comparative advantage have high trade potential as compared to the countries which have the similar patterns of comparative advantage. Therefore, by combining the gravity model with the comparative advantage, this limitation of the gravity model can be eliminated. In addition to that, rather than apply the gravity model and comparative advantage together in one equation, this study suggests taking a two-filter approach. The intuition behind this approach is that each of these theories has its own set of assumptions, therefore it is better that firstly we filter out the trade between the countries with the comparative advantage and then quantify the effect of free trade garment on the trade between the countries by gravity model. Based on this idea, the study analyzed Pakistan–China Free Trade Agreement (PCFTA). Such that, this study first identifies the commodities in which the two counties have a RCA separately and then analyzes the effect of PCFTA on the export value of those commodities for the bilateral trade between these two countries.

Pakistan and China approved a free trade agreement to encourage development plus diversification of trade between the two economies at the end of 2006. This agreement was divided into two phases: Phase I, already concluded in 2011, China has lessened tariffs on almost 6,418 product lines, and Pakistan also presented the parallel on 5,686 product lines for five years (Table 1). China and Pakistan agreed to reduce the tariff gradually between 2007 and 2011. The tariff concessions given by China are on finished goods, while Pakistan commented on tariff reduction on raw materials and intermediary goods. Phase II of the PCFTA covering 2019–2024 was confirmed between the two economies at the beginning of 2019 and started execution on January 1, 2020. Though several studies have been done earlier on Pakistan–China FTA and provided the insides related to the topic, these studies were mainly conducted before the complete implementation of the agreement.

Based on the objectives, this study frames the following two hypotheses.

H1. PCFTA positively affects the export value of commodities from Pakistan to China in which Pakistan has a higher RCA.

Table 1.
Tariff reduction modality of China and Pakistan

Category no.	Track	Tariff reduction modality of China: No. of tariff lines	Tariff reduction modality of China: % of tariff lines at eight-digit	Tariff reduction modality of Pakistan: No. of tariff lines	Tariff reduction modality of Pakistan: % of tariff lines at eight-digit
I	Elimination of tariff (Three years)	2,681	35.5%	2,423	35.5%
II	0–5% (five years)	2,604	34.5%	1,338	19.9%
III	Reduction in margin of preference of 50% (five years)	604	8%	157	2%
IV	Reduction in margin of preference from 20% (five years)	529	7%	1,768	26.1%
V	No concession	1,132	15%	1,025	15%
VI	Banned item for trade			92	1.4%

Source(s): Authors' estimations based on the data at the website of the Ministry of commerce, China

H2. The export value of commodities from China to Pakistan in which China has a higher RCA increases substantially due to PCFTA.

This study is novel in its idea, as it contributes to the existing literature by combing the RCA and gravity model in the context of PCFTA. The study first identified the commodities in which both nations have higher RCA separately. Afterward, it will apply the gravity model to find the effect of the Pakistan–China FTA on those commodities. The paper is arranged in the manner of introduction, literature review, material and method, results and analysis, discussion and conclusion (ILMARD). The following section will be a literature review, which discusses the previous studies in detail. Then, the section on material and method presents the proposed methodology with the model specification, data description and estimation techniques. Later, the section on analysis and results provides the estimated results and analysis based on the results, and the last section discusses the conclusion, presents a summary of the study, and proposed policy recommendations.

Literature review

In the previous literature, several studies highlighted the notion of RCA such as Maqbool *et al.* (2020), Elsa and Gianluca (2014), Laursen (2015), Torok and Jambor (2016), Abbas *et al.* (2017), Mahboob *et al.* (2017), Deb and Sengupta (2018), Jagdambe (2019), Fakhrudin *et al.* (2019), Siddique *et al.* (2020). Maqbool *et al.* (2020) measured the cereal export competitiveness of Pakistan in the global economy by utilizing different indices of RCA and suggested that Pakistan needs to concentrate on the production and exports of cereals. Elsa and Gianluca (2014) present a new database of RCA measures based on the recent index of RCA proposed by Costinot *et al.* (2012). This study presents empirical distribution features of the new index in comparison with the traditional Balassa Index. Similarly, Laursen (2015) demonstrates an analysis of Balassa's 'revealed comparative advantage (RCA), and the proposed adjusted index is called 'revealed symmetric comparative advantage' (RSCA). Also, Torok and Jambor (2016) analyzed RCAs in European ham trade from 1999 to 2013 and identify its determinants by using the panel data econometrics. Moreover, Jagdambe (2019) explored the competitiveness of India's agricultural products in world markets through four indices of RCA at the four-digit level of the harmonized system (HS) of classification between 1996 and 2015. Their study proposed an ordinal interpretation of RCAs indices for better policy formulation. Also, Siddique *et al.* (2020) estimates the effects of devaluation and appreciation of real effective exchange rate (REER) on RCA at HS 2-digit level of exports in Pakistan and concluded that an increase in selected RCA's index values, world aggregated income and REER depreciation is useful to decrease in the deficit trade balance of Pakistan. The main focus of all these studies is to analyze the RCA, but are failed to amalgamate the other theories of the free trade agreements with the theory of RCA.

Moreover, several studies (Wilson and Mann, 2003; Longo and Sekkat, 2004; Paas and Tafenau, 2005; Kang and Fratianni, 2006; Kalirajan, 2007; Nowak-Lehmann *et al.*, 2007; Abedini and Péridy, 2008; Grant and Lambert, 2008; Henderson and Millimet, 2008; Kepaptsoglou *et al.*, 2010; Sheng *et al.*, 2012; Tang *et al.*, 2013; Barattieri, 2014; Narayan and Nguyen, 2016; Timsina and Culas, 2021) have considered the gravity model to explore the relations between the various economic-related variables and international trade. For instance, Wilson and Mann (2003) analyze the relationship between trade facilitation and trade flows in the Asia Pacific region with the gravity model. Similarly, Grant and Lambert (2008) finds that regional trade agreement (RTA) effects on member's trade depend substantially on different sectors and the length of the phase-in period. Also, Henderson and Millimet (2008) estimate gravity models in levels and logs using two data sets via nonparametric methods and stated that concerns in the gravity literature over functional form appear unwarranted, and estimation of the gravity model in levels is recommended. Moreover, Narayan and Nguyen (2016) demonstrate that the influence of trade gravity variables is dependent on trading partners and suggests that the trade policy should not ignore the other importance of the level of development and maintenance of close economic ties. Moreover, Timsina and Culas (2021) estimate the trade creation and export diversion effects of different Australia's free trade agreements (FTAs) using the panel data from 1996 to 2017. Still, all these studies are also short of combining RCA with the gravity model.

In addition, the existing literature exhibits few studies only that ponder to connect the RCA with the gravity model like Abdul Kamal *et al.*, 2021; Ariza Marin, 2020; Ciuriak and D.and Kinjo, 2006; Guglielmo *et al.*, 2015; Shakur and Tsang, 2017. However, there is a gap in the existing literature vis-à-vis the approach to integrate RCA with the gravity model. All these studies interleaved the indicator of RCA into the gravity equation instead of adopting a sequential mode, which will be more suitable to perform and join the RCA and gravity model together.

Furthermore, the works of literature about the Pakistan–China FTA remain inclusive of the effect of this FTA on Pakistan and China. Some studies suggest that Pakistan–China FTA is equally beneficial for both Pakistan and China (Kataria and Naveed, 2014; Farrukh *et al.*, 2013; Junaid and Manzoor, 2017; Kataria and Naveed, 2014; Irshad *et al.*, 2016; Liu, 2010; Kabraji, 2012; Ahmed *et al.*, 2021a, b). According to Kataria and Naveed (2014), Pakistan is the first country located in South Asia that have a free trade agreement with China. Farrukh *et al.* (2013) found out that PCFTA strengthens the economic relations of China–Pakistan. Junaid and Manzoor (2017) studied the dynamic of Pakistan's trade balance with China and advocate that PCFTA is a good opportunity to exploit the huge Chinese market. Similarly, Hamid and Hayat (2012) compared Pakistan's trade with China and other neighbors and proposed policies concerning China including gaining market access for Pakistan's exports and attracting Chinese investment to the export industries. Furthermore, Irshad *et al.* (2016) extend the free trade agreement between Pakistan and China with the context of the The Association of Southeast Asian Nations (ASEAN) free trade agreement. The study concluded that Pakistan's integration with China and ASEAN would be beneficial for enhancing the bilateral trade flows of all the members. In contrast, other studies argued that Pakistan–China FTA is more beneficial to China as compared to Pakistan (Musleh-ud-Din *et al.*, 2009; Chaudhry *et al.*, 2017; Qi and Irshad, 2015; Shaista, 2010; Ahmad, 2014). Musleh-ud-Din *et al.* (2009) argue that the short-term effect of the FTA between Pakistan and China is tilted towards China. Chaudhry *et al.* (2017) found out that in the sector in which the tariffs are reduced by Pakistan for Chinese commodities, productivity and the value-added per worker have fallen relative to other sectors. Qi and Irshad (2015) argued that from a Pakistan perception, FTA covering only goods trade will not be valuable to Pakistan. Shaista (2010) empirically examines the trade agreements of Pakistan with China, Sri Lanka, Malaysia, Iran, Mauritia and the South Asian Free Trade Area. The study found some evidence for product diversification under the PTAs with Malaysia and Mauritius, however in the case of Sri Lanka and China product diversification declined. Ahmad (2014) shows that FTA has enhanced bilateral trade but it has largely benefitted Chinese exporters. Hence, there is a substantial gap in the literature about the analysis of free trade agreements through RCA with the Gravity model. Also, most of the studies on PCFTA concentrated on finding whether PCFTA was equally advantageous for both nations or not. Therefore, this study will attempt to fill this gap. In the following section, the study will focus on the methods used for the estimation.

Material and method:

Revealed comparative advantage

Rendering to the international trade theory, trade advantages come when countries specialize in producing goods for which they have a comparative advantage. The RCA index can discover the products in which a country has a trade potential. It can also give helpful evidence about potential trade possibilities with new cohorts. The RCA index of a nation for commodity *j* is measured by the commodity's share in the nation's total exports concerning its share in world trade. The formula is:

$$RCA_{ij} = (x_{ij}/X_{it}) \,/\, (x_{wj}/X_{wt})$$

Where, x_{ij} and x_{wj} are the values of nation *i's* exports of commodity *j*, and world exports of commodity *j*, and where X_{it} and X_{wt} denote the nation's total exports and total world exports. If the value is less than unity, the country has a revealed comparative disadvantage in that product. Similarly, if the index exceeds unity, the country is said to have a RCA in that product. The more significant the difference between the country's RCA indices, the more suitable they are as FTA partners. Table 2 shows the HS commodity sections used in this study. The reason for such declassification is to get more focused results for each commodity group. Consequently, the study analyzed each commodity group, and provides policy recommendations for each commodity group separately.

Table 3 shows the RCA results of Pakistan and China for different groups of commodities. The results show that Pakistan has the RCA in the commodity group of HS code 06-15, 41-43, 50-63. While, China has the RCA in the commodity group of HS codes 41-43, 50-63, 64-67, and 84-85. Among all the measured commodities, Pakistan's RCA for the commodity group of HS codes 50-63 and 41-43 have comparatively high values compared to China's RCA.

Before going further to perform the empirical test, it is imperative to ascertain whether these commodity groups mentioned in Table 3 are included in the Pakistan–China FTA or

Table 2. Description of HS codes by sections

Group	Sections	HS codes	Description
1	SECTION I	01–05	Live animals
2	SECTIONS II AND III	06–15	Vegetable products
3	SECTION IV	41–43	Animal or vegetable fats and oils
4	SECTION XI	50–63	Textile and textile articles
5	SECTION XII	64–67	Footwear, headgear, umbrellas, sticks, whips, riding-crops
6	SECTION XV	72–83	Base metals and articles of base metal
7	SECTION XVI	84–85	Mechanical appliances and electrical equipment

Source(s): World Customs Organization (https://www.wcotradetools.org/en/harmonized-system)

Table 3. Revealed comparative advantages of Pakistan and China

Years	Pakistan's RCA				China's RCA				
	01–05	06–15	41–43	50–63	41–43	50–63	64–67	72–83	84–85
2003	0.80	3.06	7.35	11.78	2.73	2.32	3.45	0.72	1.13
2004	0.66	2.99	7.91	12.25	3.12	2.75	4.02	0.99	1.47
2005	0.71	4.16	9.00	12.66	2.96	2.80	4.02	1.00	1.53
2006	0.84	4.16	9.19	13.42	2.48	2.99	3.80	1.07	1.56
2007	0.85	3.86	9.87	12.98	2.20	2.94	3.59	1.07	1.61
2008	0.97	5.13	10.27	12.56	2.32	3.01	3.75	1.18	1.72
2009	1.03	4.20	8.37	11.86	2.40	2.90	3.69	0.91	1.73
2010	1.15	4.53	7.89	12.42	2.41	2.90	3.71	0.93	1.74
2011	1.25	5.18	7.41	12.57	2.58	2.98	3.74	1.01	1.79
2012	1.52	4.42	7.38	12.82	2.48	2.92	3.81	1.04	1.80
2013	1.49	4.51	7.50	12.63	2.33	2.88	3.61	1.06	1.80
2014	1.41	4.36	7.70	12.35	2.21	2.72	3.41	1.14	1.70
2015	1.60	4.31	6.98	12.13	2.13	2.49	3.09	1.14	1.60
2016	1.57	3.84	7.00	12.41	2.17	2.49	2.85	1.13	1.58

Source(s): Author's calculations based on data from trade map

not. Therefore, to identify the commodities included in Pakistan–China FTA, this study summarizes the Pakistan–China FTA convergence rate.

Convergence rate

This study quantifies the convergence rate (CR) for those commodities, which showed a higher RCA for Pakistan and China separately.

$$\text{Convergence Rate} = \frac{\sum_{t\epsilon F}(\text{IM})_t}{\sum_{t\epsilon M}(\text{IM})_t}$$

Where, t is a tariff line, $(IM)_t$ is the value of imports in the tariff line t from FTA members, M is the set of all tariff lines with dutiable imports from FTA members, and F is the set of all dutiable tariff lines that are eligible for preferences under the FTA. Also, dutiable imports are those on which the MFN tariffs are more than zero. According to the World Trade Organization [2], "MFN treatment requires Members to accord the most favorable tariff and regulatory treatment given to the product of any one Member at the time of import or export of similar products to all other Members. Imports with a zero MFN duty are disregarded because their preferences would be irrelevant."

Table 4 demonstrates the convergence rate results for China and Pakistan separately for different HS commodity sections. While considering Pakistan, the results indicate that there are 7,381 different kinds of commodities at HS 8 digits imported by Pakistan from China, in contrast only 4,808 various commodities at HS 8 digits lines are added in the PCFTA, so the convergence rate of Pakistan–China free trade agreement for imports by Pakistan from China during last year is 0.65. It shows that Pakistan cannot utilize at least one-third of the items (included in the FTA) as Pakistan does not export these commodities to China.

Besides, the results of the convergence rate for China illustrate that there are 6,219 different kinds of commodities at HS 8 digits lines imported by China from Pakistan, and almost 4,585 different kinds of commodities at HS 8 digits lines are added in PCFTA. Hence, the convergence rate for the exports of China to Pakistan is nearly 0.74. Thus, around one-fourth of the commodities for the case of China, and one-third of the commodities for the case of Pakistan have not been included in the tariff relaxation in the PCFTA for bilateral trade.

HS code	FTA	Pakistan MFN	C.R	MFN	China FTA	C.R
01-05	141	353	0.40	155	69	0.45
06-15	226	488	0.46	304	207	0.68
16-24	135	304	0.44	231	192	0.83
25-27	138	157	0.88	151	135	0.89
28-38	882	1,210	0.73	1,067	935	0.88
39-40	214	273	0.78	278	139	0.50
41-43	65	105	0.62	52	43	0.83
44-49	39	259	0.15	218	152	0.70
50-63	909	1,141	0.80	886	622	0.70
64-67	23	71	0.32	51	39	0.76
68-71	152	250	0.61	238	172	0.72
72-83	547	764	0.72	714	524	0.73
84-85	908	1,228	0.74	1,150	854	0.74
86-89	169	336	0.50	228	57	0.25
90-97	260	442	0.59	496	445	0.90
All	4,808	7,381	0.65	6,219	4,585	0.74

Source(s): Author's calculations based on data from trade map

Table 4.
Convergence rate for Pakistan and China

In addition, for the commodity sections 01-05, 06-15, 41-43 and 50-63 in which Pakistan has RCA, the convergence rates are 0.45, 0.68, 0.83 and 0.70 respectively. Similarly, for the commodity sections 41-43, 50-63, 64-67, 72-83 and 84-85 in which China has RCA, the convergence rates are 0.62, 0.80, 0.32, 0.72 and 0.72 respectively. It shows that these commodities sections do not have a very high convergence rate in RCA commodities, which could possibly dilute the positive effect of Pakistan–China free trade agreement on the bilateral trade between Pakistan and China.

Gravity model and FTA

The gravity model of trade proposes trade as a positive function of gross domestic product (GDP) and as a negative function of distance for the two economies. Such that, $Trade_{ij}$ as total trade between two economies, *i* and *j* is positively related to their gross domestic product *Yi* and *Yj,* and negatively related to the geographical distance between the two economies ($Distance^2_{ij}$). Hence, the gravity model for trade is:

$$Trade_{ij} = G\,(Y_i Y_j)\Big/ Distance^2_{ij}$$

Here, G is the gravitational constant. Also, expressing in logarithmic arrangement with the random error term (*uij*), the basic gravity equation specified as:

$$Ln(Trade_{ij} = \beta_0 + \beta_1 Ln(Y_i) + \beta_2 Ln(Y_j) + \beta_3 Ln(Distance_{ij}) + (U_{ij})$$

Where the β's are coefficients.

Given the hypothesized relationships in the gravity model, β_0 is constant, β_1 and β_2 are expected to be positive, while β_3 is to be negative.

In the literature, Tinbergen initially used the gravity model in 1962 to describe international trade configurations, and economists have constantly instituted it to justify a considerable proportion of the variant in global trade flows, constructing the model preferring to test the marginal influence of other hypothesized variables on international trade. Later, the work of Linnemann (1966), Anderson (1979), and Deardorff and Stern (1998) have been given the theoretical rationalization for the gravity model in the literature.

Gravity models can also be applied to measure FTAs by introducing a binary variable in the baseline specification. It can determine whether or not an FTA has had a statistically significant effect on trade flows using this variable. If it is found positive and significant, one can assume that FTA has had a positive impact on trade flows, along with a magnitude associated with the size of its coefficients. The study used the following two gravity equations for the estimation. Equation (1) illustrates the exports of China, while equation (2) depicts the exports of Pakistan. The study used panel data in which more than the top 150 importers (j) have been selected for each case (Pakistan and China), and the period is 2003–2015. These equations are further used in each commodity section for detailed analysis.

$$\begin{aligned} \ln(EX)cjt = {} & Constant + \beta_1 * Ln(GDPct * GDPjt) + \beta_2 * \ln(DIScjt) \\ & + \beta_3 * Ln\,(GDPPCDIFcjt) + \beta_4 * Ln\,(TOEct) + \beta_5 * Ln(TOIjt) \\ & + \beta_6 * \ln(EXcjt) + \beta_7 * Ln(PoPct * PoPjt) + \beta_8 * D\_COLcj + \beta_9 * D\_CONcj \\ & + \beta_{10} * D\_LLcj + \beta_{11} * (D_{ASEANFTA}) + \beta_{12} * (D_{PCFTA}) \end{aligned} \tag{1}$$

$$\begin{aligned} \ln(EX)pjt = {} & Constant + \alpha_1 * Ln(GDPpt * GDPjt) + \alpha_2 * \ln(DISpjt) \\ & + \alpha_3 * Ln\,(GDPPCDIFpjt) + \alpha_4 * Ln\,(TOEpt) + \alpha_5 * Ln(TOIjt) \\ & + \alpha_6 * \ln(EXpjt) + \alpha_7 * Ln(PoPpt * PoPjt) + \alpha_8 * D\_COLpj \\ & + \alpha_9 * D\_CONpj + \alpha_{10} * D\_LLpj + \alpha_{11} * (D\_PCFTA) \end{aligned} \tag{2}$$

Where, EX is the exports value, "GDP" is gross domestic product, "DIS" is the distance between the capital cities of the trading countries, "GDPPCDIF" is the difference in per capita GDP between the trading countries, "TOE" is the ratio of total exports with the total GDP of the exporter, "TOI" is the ratio of total imports with the total GDP of the importer, "EX" is the exchange rate between the trading countries, dummy variables are included for common official language (COL) "D_COL", contiguity (CON) "D_CON" and landlocked (LL) "D_LL", which takes the value of 1 if the trading country's official language is the same, sharing the border and LL; otherwise, it assumes as zero. The ASEAN FTA dummy is for the China-ASEAN trade, which takes the value of 1 if trading countries are in ASEAN otherwise zero, PCFTA dummy[3] takes the value of 1 for China–Pakistan Trade otherwise zero, "*p*" is for Pakistan, "*c*" is for China, "*t*" is for the time, "*j*" is for the importer.

Speciation in the gravity model

Cross-sectional data is often considered to calculate bilateral trade flows via the gravity model for a specific time. However, it is not easy to justify it over panel data; Baltagi and Kao (2001), Arellano (2003), Hsiao (2005), Nerlove (2005) and M'aty'as and Sevestre (2008). In contrast, panel data evaluation indicates more advantages over time series and cross-sectional data due to its control nature for discrete heterogeneity, data availability, increased efficiency of econometric estimations by minimizing collinearity among independent variables through a significant degree of freedom, and challenging methodology.

Given the scenario, where the assumptions of autocorrelation and homoscedasticity are rarely converged in analysis, the expected error component over individuals causes correlation across the composite error terms, inducing odinary least square (OLS) estimation ineffective. It calls for considering feasible generalized least squares (GLS) measures for fixed and random effects (Martinez-Zarzoso, 2013). In the same way, while estimating the trade data with the gravity model, the two fundamental difficulties that need to deal with are log modeling and zero trade flows. To resolve these issues Poisson pseudo-maximum likelihood (PPML) estimator could be considered the best fit. In the presence of heteroscedasticity, the PPML approach is a robust tactic, and this approach can be used for the different levels of trade, hence estimating the nonlinear form of the gravity model directly and avoiding falling zero trade. The dependent variable is "exports," but not the log function of "exports") whereas, the explanatory variables may still be in log forms (Santos Silva and Tenreyro, 2006; Soren and Bruemmer, 2012; Head and Mayer, 2014; Eaton *et al.*, 2012). We used panel data from 2003 till 2015 and used both the GLS method and PPML for the analysis. Also, to choose between random and fixed effect model the study adopted the Hausman test, basis on the previous studies (Behera and Sethi, 2022; Ali *et al.*, 2017; Rahman and Miah, 2017; Ayoub, 2019; Uddin *et al.*, 2020). The study set the period from 2003–2015 because it covers the three major subperiod, before PCFTA, during PCFTA implementation and After PCFTA implementation was completed. Correspondingly, it did not exceed the period after 2015 to avoid the effects of other factors. Moreover, the PPML method constructs the baseline results, and the GLS model will be employed to run the robustness test.

Result and Analysis

Empirical results for the case of China

Table 5 reports the aggregate results of the gravity equation for exports of China. The R-squared value for the PPML model is 0.96, indicating the model is highly significant. Moreover, the findings of the Hausman test indicate that the fixed effect model is preferred over random effect models whenever the result of both fixed and random effect models are statistically significant. However, when the coefficient of fixed effect is insignificant then the study considers the coefficient of random effect. Keeping all the other variables constant, the gross domestic product GDP is statistically highly significant, and the value is nearly 0.69. This result implies that a one per cent growth in the GDP of trading countries will increase China's exports by 0.69%. The finding is in line with the primary hypotheses of the gravity model, which states that trade volume will rise with an increase in economic volume.

Moreover, the findings of the Hausman test indicate that the fixed effect model is preferred over random effect models. Likewise, the variable distance is also statistically highly significant and showed a negative sign. The movement of the distance variable is consistent with the gravity model and implies that the result is in line with the primary hypotheses of the gravity model, which states that geographical distance is an imperative resistance factor in trade flow. The absolute difference in per capita GDP (GDPPCDIFijt) exhibits the technological inequalities between China and other trading countries. This variable is statistically significant in the PPML (random effect model (REM)) model and positive. The positive sign indicates that China's exports to its trading countries do not follow the Linder hypothesis, which states that the country exports more to those economies that have the same level of income per capita as China. The variable TOE is statistically highly significant, and the positive sign implies that the TOE significantly contributes to the exports of China. Similarly, the variable exchange rate is statistically significant and positive, this finding translates that the deprecation of currency benefits the total exports of China. Also, the dummy variable of COL, CON and landlock is highly significant in the PPML model. The expected signs of these dummy variables are consistent with the theory. The coefficients of dummy variables used for ASEAN-FTA and Pakistan–China FTA are found to be insignificant.

Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
Ln (GDPct * GDPjt)	0.7771***	0.7947***	0.7366***	0.6968***
	(0.0164)	(0.0150)	(0.0271)	(0.0165)
Ln (GDPPCDIFcjt)	0.0328**	0.0270 *	0.1639***	0.0184
	(0.01543)	(0.0152)	(0.0257)	(0.0155)
Ln(TOEct)	0.6964***	0.6635***	0.9462 ***	0.7694***
	(0.07683)	(0.0732)	(0.1585)	(0.0595)
ln(TOIjt)	0.2934***	0.1975***	0.3722***	0.0125
	(0.0446)	(0.0334)	(0.0655)	(0.0461)
ln(DIScjt)	(omitted)	−0.1497	0.2137***	−0.4294***
		(0.1625)	(0.0352)	(0.0626)
ln(EXcjt)	−0.1873 ***	−0.0187	0.0297***	0.1370***
	(0.0475)	(0.0243)	(0.0103)	(0.0487)
(D_ASEANFTA)	(omitted)	0.4132	0.4318 ***	−0.7229
		(0.3092)	(0.0874)	(0.4393)
(D_PCFTA)	−0.2554	−0.2951*	0.0678	−0.0981
	(0.1767)	(0.17734)	(0.1006)	(0.0651)
D_COLcj	(omitted)	0.9107	0.6022***	3.1245***
		(0.5734)	(0.1015)	(0.7237)
D_CONcj	(omitted)	0.7974***	−0.0912	0.9428 ***
		(0.2912)	(0.0778)	(0.3884)
D_LLcj	(omitted)	−0.1725	−0.1588	−0.5002***
		(0.2401)	(0.1268)	(0.1656)
ln(PoPct * PoPjt)	0.5043***	0.1385***	0.2289***	0.2386**
	(0.1190)	(0.0520)	(0.0351)	(0.1029)
constant	−38.0443 ***	−24.6884***	−25.0570***	
	(4.0265)	(2.2461)	(1.1956)	
No. of obs.	1,146	1,146	1,146	1,146
R-sq: within:	0.8815	0.8789		
R-sq: between:	0.7051	0.8052		
R-sq: Overall:	0.7106	0.8107	0.9436	0.9959
Pseudo-log-likelihood:			−1170000000000	−120000000000
F-Stats/Wald Chi	F (71,045) = 1,110.99	Wald χ^2 (12) = 7,821.31		
corr (u_i, Xb)	corr (u_i, Xb) = −0.6357			
Prob > F	Prob > F = 0.0000			

Source(s): Author's own estimations (Here *** = 1%, ** = 5% and * = 10% significance level)

Table 5.
Exports of China (aggregate level)

Subsequently, the study utilized the gravity model for different sectors at disaggregate levels to examine the results of each HS commodity separately. Table 6, reports the disaggregate results of exports of China for HS commodity sections. The findings of R-square value are higher in all PPML models for HS commodity sections 41-43, 50-63, 64-67, 72-83, 84-85, which demonstrates that the overall PPML model is highly significant to explain the results accurately. The result for the variable of gross domestic product and distance is statistically significant and exhibits positive and negative signs, respectively. This outcome implies that the sign of these variables is consistent with the gravity model.

Moreover, the absolute difference in the per capita GDP (GDPPCDIFijt) variable demonstrates the technological inequalities between China and trading countries. This variable is statistically significant in 50-63, 64-67, 72-83 and 84-85 but insignificant for 41-43. Also, the positive sign of this variable implies that China's exports to its trading countries do not follow the Linder hypothesis. Similarly, the variable of TOE for China is statistically highly significant in the PPML fixed effect model with a positive sign in all the HS commodity

Table 6.
Exports of China (disaggregate level)

	HS commodity 41-43				HS commodity 50-63			
Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
Ln (GDPct * GDPjt)	0.6357***	0.6734***	0.9417***	0.3314***	0.6601***	0.6614***	0.4494***	0.6047***
	(0.0297)	(0.0257)	(0.0771)	(0.0962)	(0.0334)	(0.0292)	(0.0391)	(0.0441)
Ln (GDPPCDIFcjt)	0.0778***	0.0851***	0.0398	0.0128	0.0063	0.0288***	0.2912***	0.0681**
	(0.0268)	(0.0259)	(0.0590)	(0.0352)	(0.0314)	(0.0301)	(0.0415)	(0.0327)
Ln(TOEct)	0.0177	−0.1001	1.4534***	0.0401	0.8613***	0.6337***	0.2533	0.7912***
	(0.1369)	(0.1275)	(0.3041)	(0.1933)	(0.1519)	(0.1414)	(0.2239)	(0.1461)
ln(TOIjt)	0.2627***	0.2745***	−0.0192	0.0654	−0.1023	0.0265	0.0965	−0.0841
	(0.0817)	(0.0537)	(0.0732)	(0.1474)	(0.0889)	(0.0591)	(0.0610)	(0.0820)
ln(DIScjt)	(omitted)	−0.0090	−0.0849**	−0.4131**	(omitted)	−0.4187	−0.3112***	−0.1606
		(0.2139)	(0.0497)	(0.1869)		(0.2285)	(0.0545)	(0.0987)
ln(EXcjt)	−0.0584	−0.0420	−0.0091	0.1614	0.1590*	0.0477	0.0109	0.1651**
	(0.0844)	(0.0370)	(0.0162)	(0.1570)	(0.0921)	(0.0414)	(0.0160)	(0.0824)
(D_ASEANFTA)	(omitted)	−0.5591	−0.0158	9.7602***	(omitted)	−0.7211*	0.2389*	−1.0154
		(0.3769)	(0.1231)	(2.6039)		(0.3973)	(0.1207)	(0.5176)
(D_PCFTA)	0.0897	−0.0025	−1.2550***	0.4323*	0.3465	0.3202	−0.2939**	0.3208***
	(0.2675)	(0.2630)	(0.2510)	(0.2308)	(0.2953)	(0.2917)	(0.1318)	(0.1131)
D_COLcj	(omitted)	1.2341*	1.0086***	−7.2927***	(omitted)	1.0237	−0.0996	2.5888***
		(0.6768)	(0.1792)	(2.7310)		(0.7307)	(0.1937)	(0.8864)
D_CONcj	(omitted)	0.7021*	0.9218***	−7.0664***	(omitted)	0.7468*	0.2993***	−1.0917
		(0.3762)	(0.1529)	(2.3389)		(0.3976)	(0.1138)	(0.7212)
D_LLcj	(omitted)	−0.5837	−0.5679***	3.3554***	(omitted)	−0.7922*	−0.1780	0.1852
		(0.3829)	(0.17311)	(0.9332)		(0.4140)	(0.1647)	(0.5932)
ln(PoPct * PoPjt)	0.8970***	0.1840**	−0.0904	2.1437***	0.5135*	−0.0483	0.1845***	0.2846
	(0.2443)	(0.0823)	(0.0872)	(0.6905)	(0.2860)	(0.0953)	(0.0511)	(0.2192)
constant	−58.2586***	−33.4325***	−35.1194***		−41.7130***	−16.6923***	−17.2597***	
	(8.3963)	(3.4478)	(1.7041)		(9.8763)	(3.7910)	(1.7733)	
No. of obs.	836	836	837	837	841	841	841	841
R-sq: with in:	0.7579	0.755			0.6395	0.6365		
R-sq: between:	0.6098	0.7543			0.4099	0.5509		
R-sq: Overall:	0.6074	0.7498	0.8905	0.9685	0.4249	0.5622	0.8199	0.9719

(*continued*)

HS commodity 41-43					HS commodity 50-63			
Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
Pseudo log-likelihood:			−41598268	−8033518.2			−398000000	−64855577
F-Stats/Wald Chi	F (7,763 = 341.32	Wald χ^2 (12) = 2,533.53			F (7,768) = 194.61	Wald χ^2 (12) = 1,397.61		
corr (u_i, Xb)	corr (u_i, Xb) = −0.6187				corr (u_i, Xb) = −0.6312			
Prob > F = 0.0000	Prob > F = 0.0000				Prob > F = 0.0000			
HS commodity 64-67					HS commodity 72-83			
Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
Ln	0.6292***	0.6984***	0.7003***	0.5056***	1.0601***	1.0648**	0.8114***	0.8941***
(GDPct * GDPjt)	(0.0352)	(0.0309)	(0.0659)	(0.0340)	(0.0263)	(0.0242)	(0.0313)	(0.0325)
Ln (GDPPCDIFcjt)	0.0619**	0.0757**	0.1601**	0.0492	−0.1091***	−0.1165***	0.0525**	0.0022
	(0.0327)	(0.0317)	(0.0620)	(0.0351)	(0.0238)	(0.0233)	(0.0262)	(0.0251)
Ln(TOEct)	0.0567***	−0.2033	0.5695	0.2201 *	1.6953***	1.7028***	1.6172***	2.0630***
	(0.1593)	(0.1501)	(0.3375)	(0.1226)	(0.1231)	(0.1175)	(0.2480)	(0.1278)
ln(TOIjt)	0.1358	0.1120	0.0281	0.0420	0.1848***	0.1064*	0.6289***	−0.1317
	(0.0929)	(0.0638)	(0.0803)	(0.0897)	(0.0730)	(0.0571)	(0.1138)	(0.0742)
ln(DIScjt)	(omitted)	0.0093	0.0799	−0.2123	(omitted)	−0.7371**	−0.3197***	−0.2131 **
		(0.2681)	(0.0629)	(0.1501)		(0.3471)	(0.0558)	(0.1021)
ln(EXcjt)	−0.1467	−0.0567	−0.0393**	0.0513	−0.1567**	−0.0494	0.0631***	0.2647***
	(0.0956)	(0.0453)	(0.0197)	(0.1018)	(0.0763)	(0.0508)	(0.0130)	(0.0717)
(D_ASEANFTA)	(omitted)	−0.6920	0.1586	5.5513***	(omitted)	0.5541	0.4381***	2.5875***
		(0.4705)	(0.1275)	(1.2390)		(0.6041)	(0.1046)	(0.9331)
(D_PCFTA)	−0.4934	−0.5137	−0.8883***	−0.1736	0.0714	0.0505	0.2548	0.2437
	(0.3097)	(0.3096)	(0.2202)	(0.1793)	(0.2414)	(0.2401)	(0.1601)	(0.1454)
D_COLcj	(omitted)	1.0132	0.5295**	−2.3813***	(omitted)	0.3961	0.1032	−0.5998
		(0.8450)	(0.2162)	(0.7110)		(1.1079)	(0.1384)	(0.8198)

(*continued*)

Table 6.

Table 6.

HS commodity 64-67					HS commodity 72-83			
Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
D_CONcj	(omitted)	0.8437*	0.5439***	−4.1696***	(omitted)	0.6014	0.0384	1.6163**
		(0.4602)	(0.1174)	(0.8779)		(0.6259)	(0.0912)	(0.7598)
D_LLcj	(omitted)	0.0220	0.4653**	1.9781***	(omitted)	0.1885	−0.2572	−0.1834
		(0.4731)	(0.1912)	(0.6294)		(0.6856)	(0.1659)	(0.3511)
ln(PoPct * PoPjt)	1.5535***	0.0412	0.1201	1.1534***	0.0198	−0.0671	0.0804**	0.3577*
	(0.3097)	(0.1021)	(0.0771)	(0.2530)	(0.1799)	(0.1067)	(0.0382)	(0.1981)
constant	−81.6252***	−28.8109***	−32.3885***		−42.4133***	−33.4472***	−29.7631***	
	(10.6868)	(4.3658)	(1.9499)		(6.0858)	(4.6215)	(1.6909)	
No. of obs.	844	844	845	845	829	829	830	830
R-sq: with in:	0.7128	0.7032	–	–	0.84	0.8395		
R-sq: between:	0.407	0.5807	–	–	0.3663	0.5272		
R-sq: Overall:	0.3799	0.5956	0.8906	0.9891	0.4502	0.5953	0.8307	0.9594
Pseudo log-likelihood:				−128000000	−12535662		−132000000	−27367129
F-Stats/Wald Chi	F (7,770) = 273.07	Wald χ^2 (12) = 1878.76	–	–	F (7,756) = 567.09	Wald χ^2 (12) = 4,007.24		
corr (u_i, Xb)	corr (u_i, Xb) = −0.8495	–	–	–	corr (u_i, Xb) = −0.4273			
Prob > F = 0.0000	Prob > F = 0.0000				Prob > F = 0.0000			

Exports of China HS Commodity 84-85 Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
Ln (GDPct * GDPjt)	0.8778***	0.8513***	0.8368***	0.7347***
	(0.0180)	(0.0160)	(0.0358)	(0.0236)
Ln (GDPPCDIFcjt)	0.0010	−0.0206	0.1600***	0.0220
	(0.0169)	(0.0165)	(0.0329)	(0.0194)
Ln(TOEct)	0.6050***	0.7579***	1.2996***	0.6369***
	(0.0837)	(0.0795)	(0.1747)	(0.0924)

(*continued*)

Table 6.

Exports of China HS Commodity 84-85 Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
ln(TOIjt)	0.2822***	0.1417***	0.6360***	0.1086*
	(0.0489)	(0.0354)	(0.0770)	(0.0588)
ln(DIScjt)	(omitted)	−0.3513**	−0.1800***	−0.6201***
		(0.1661)	(0.0412)	(0.0821)
ln(EXcjt)	−0.2342***	−0.0582**	0.0392***	0.1327**
	(0.0504)	(0.0286)	(0.0134)	(0.0553)
(D_ASEANFTA)	(omitted)	0.5030*	0.3095***	0.4548
		(0.2958)	(0.1058)	(0.3569)
(D_PCFTA)	−0.2102	−0.2421	0.4238***	−0.1095
	(0.1559)	(0.1564)	(0.1098)	(0.0757)
D_COLcj	(omitted)	1.1562**	0.8594***	0.7475
		(0.5215)	(0.1233)	(0.8059)
D_CONcj	(omitted)	0.3490	−0.4542***	1.8279***
		(0.2949)	(0.0913)	(0.5523)
D_LLcj	(omitted)	0.0650	0.0684	−3.6180***
		(0.2655)	(0.1655)	(1.1238)
ln(PoPct * PoPjt)	−0.4634***	0.1122*	0.3354***	−0.4108***
	(0.1551)	(0.0624)	(0.0424)	(0.1599)
constant	−14.7324***	−32.6035***	−42.3291***	
	(5.3697)	(2.6853)	(1.2330)	
No. of obs	762	762	762	762
R-sq: within	0.9087	0.9052		
R-sq: between	0.2668	0.8546		
R-sq: Overall	0.359	0.8582	0.9539	0.9951
Pseudo-log-likelihood			−360000000	−46347239
F-Stats/Wald Chi	F (7,693) = 985.10	Wald χ^2 (12) = 6,949.83		
corr (u_i, Xb)	corr (u_i, Xb) = −0.4686			
Prob > F = 0.0000	Prob > F = 0.0000			

Source(s): Author's own estimations (Here *** = 1%, ** = 5% and * = 10% significance level) sections except 41-43, which suggests that the TOE of China's economy is significantly contributing to the exports of China.

Furthermore, the dummy variables for Pakistan–China FTA are statistically significant in the PPML fixed-effect model for HS commodity sections 40-41 and 50-63 with a positive sign. Also, the results suggest that due to PCFTA the exports of China to Pakistan are 43.23% in the HS commodity section 40-41 and 32.08% in the HS commodity section 50-63. In addition, the dummy variables for Pakistan–China FTA are found to be statistically insignificant for the HS commodity sections 64-67, 72-83 and 84-85. Interestingly, the coefficient of the dummy variable for ASEAN-FTA is not only found significant in these HS commodities, but the values of the coefficients are very high. It indicates that although China has the comparative advantage in these HS commodity sections and Pakistan and China reduced the tariff in these commodity sections significantly through the Pakistan–China FTA, the exports of these commodities are more toward ASEAN countries rather than Pakistan. Therefore, even if a country has the RCA and signs a free trade agreement, the exporters will be more focused on the countries that have a more developed free trade agreement, as the China-ASEAN FTA is more mature than the Pakistan–China FTA in term of the implementation period and coverage of commodities. Also, this direction of research can be explored more in future studies.

Empirical results for the case of Pakistan

Table 7 reports the aggregate results of the gravity equation for exports of Pakistan. The *R*-Square value for the PPML model was observed at 0.96, which specifies that the overall model is highly significant and fit for further analysis. Also, the Hausman test indicates that the fixed-effect model is desirable over random-effect models. The variable gross domestic product, keeping other variables constant, is a statistically highly significant variable. It suggests that if the GDP of Pakistan rises by 1%, the exports of Pakistan will upsurge by 0.68%. The results demonstrate the adequacy of the method for the gravity model, which states that trade volume will grow with a surge in economic volume. Similarly, the coefficient of the distance variable is statistically significant and exhibits an expected negative sign, which illustrates that this result of the distance variable is also consistent with the gravity model. The results of the methods appear to tally with our expectations of the primary hypotheses of the gravity model, which states that geographical distance is an imperative factor in the resistance of trade flow. Additionally, The absolute difference in per capita GDP (GDPPCDIFijt) exhibits the technological inequalities between Pakistan and the trading country. This variable is statistically insignificant in the estimated model of PPML (fixed effect). It indicates that this study cannot conclude anything about whether Pakistan's exports to its trading countries follow the Linder hypothesis or not. In contrast, the variable TOE is statistically highly significant, and the positive sign implies that the TOE significantly contributes to the exports of Pakistan. Moreover, the estimates of the COL, CON, and LL are not significant for HS 01-05, and significant for 06-15, 41-43, and 50-63. Also, the signs of the COL and LL are different across HS code groups, such that it is positive for 06-15 but negative for 41-43 & 50-63. Hence, not all signs of these variables are consistent with the theory. The dummy variable Pakistan–China FTA is statistically significant and demonstrates a positive sign. The coefficient of the variable suggested that Pakistan–China FTA increases the exports from Pakistan to China by 61.60%.

Subsequently, the study also applies the gravity model at different sectoral-disaggregated levels to examine the results of each HS commodity separately. Table 8 reports the disaggregated results of exports of Pakistan for HS commodity sections 01-05, 06-15, 41-43 and 50-63, respectively. The result of the R-square is high in the PPML model for all HS commodity sections. This means that the overall PPML model is highly significant to explain

Table 7. Exports of Pakistan (aggregate level)

Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
Ln(*GDPpt* * *GDPjt*)	0.6555***	0.4834 ***	−0.7452***	0.6845***
	(0.0591631)	(0.0503227)	(0.1237692)	(0.0674967)
Ln(*GDPPCDIFpjt*)	0.1021999 **	0.0653038 *	1.186263 ***	0.0362
	(0.0369704)	(0.035269)	(0.1259552)	(0.0504615)
ln(*TOEpt*)	0.3957	0.3687	−1.0539 **	1.0312***
	(0.2520477)	(0.2260447)	(0.4806069)	(0.2173854)
ln(*TOIjt*)	0.1976***	0.1674 ***	0.3996 ***	0.0149
	(0.0626892)	(0.0582908)	(0.1297785)	(0.0940363)
ln(*DISpjt*)	(omitted)	−0.8022***	−1.3361***	−1.0318 ***
		(0.1786207)	(0.1059093)	(0.1157194)
ln(*EXPpjt*)	−0.0431	−0.0086	−0.0896***	−0.0431
	(0.0301425)	(0.0243346)	(0.0164324)	(0.0933156)
(*D_PCFTA*)	0.324324	0.5256426	0.3127157	0.4813***
	(0.3552652)	(0.3506386)	(0.2587975)	(0.1174585)
D_COLpj	(omitted)	0.9473246 ***	1.132369 ***	4.1871***
		(0.2626063)	(0.0834482)	(0.6128612)
D_CONpj	(omitted)	0.7507114	−0.698053 **	3.390632 ***
		(0.6306613)	(0.2906049)	(0.697193)
D_LLpj	(omitted)	−1.325915***	0.2800368	0.5115161
		(0.3023017)	(0.1851578)	(0.5925246)
Ln(*PoPpt* * *PoPjt*)	−0.8298365***	0.0502976	1.586282 ***	−0.6315412 ***
	(0.2100047)	(0.0895825)	(0.1372828)	(0.2093814)
constant	13.75627 **	−1.715604	−0.4924939	
	(5.758952)	(2.534368)	(1.744573)	
No. of obs.	1,253	1,253	1,253	1,253
R-sq: within:	0.3073	0.2939		
R-sq: between:	0.0285	0.6346		
R-sq: Overall:	0.0484	0.5893	0.63648652	0.96363105
Pseudo-log-likelihood:			−84200000000	−6380000000
F-Stats/Wald Chi	F (7,1144) = 72.50	Wald χ^2 (12) = 648.57		
corr (u_i, Xb)	corr (u_i, Xb) = −0.5097			
Prob > F = 0.0000	Prob > F = 0.0000			

Source(s): Author's own estimations (Here *** = 1%, ** = 5% and * = 10% significance level)

Table 8.
Exports of Pakistan (disaggregate level)

HS commodity 01-05						HS commodity 06-15		
Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
Ln(*GDPpt* * *GDPjt*)	1.189866 ***	1.000751 ***	0.410461 ***	0.4649574 ***	1.0791***	0.6126***	0.3158***	1.0860***
	(0.1867832)	(0.1683414)	(0.1486673)	(0.1429467)	(0.1483)	(0.1174)	(0.0870)	(0.1007)
Ln(*GDPPCDIFpjt*)	0.1213865	0.0839763 ***	0.2087655 **	0.5024713 ***	0.1376*	0.0697	−0.0527	−0.0151
	(0.1468507)	(0.1380832)	(0.1253155)	(0.1450184)	(0.0750)	(0.0714)	(0.0603)	(0.0614)
ln(*TOEpt*)	1.855195 **	0.9274192	−0.5582319	0.7073578 *	0.1987	−1.0896*	−0.9697**	0.4975
	(0.7488216)	(0.6827863)	(0.615009)	(0.3709777)	(0.6588)	(0.5646)	(0.4556)	(0.4196)
ln(*TOIjt*)	0.6544716 **	0.1558249	1.399348 ***	0.2305714	0.1863	−0.0961	0.4787***	0.1905
	(0.2631528)	(0.14366)	(0.1649034)	(0.1899002)	(0.2206)	(0.1182)	(0.0950)	(0.1542)
ln(*DISpjt*)	(omitted)	−1.335139 ***	−1.683194 ***	−6.596203 ***	(omitted)	−0.8332**	−0.9654***	−0.7707***
		(0.5335903)	(0.1104267)	(2.355887)		(0.3938)	(0.1204)	(0.2578)
ln(*EXPpjt*)	−0.7321223 ***	−0.0347542	0.0324668	0.3807828	−0.3138	0.2163***	0.0939***	−0.4954
	(0.28583)	(0.09873)	(0.0321012)	(0.3484319)	(0.2372)	(0.0786)	(0.0254)	(0.3066)
(*D_PCFTA*)	−1.315534 *	−0.8289009	−0.0936152 ***	−0.9090734 ***	0.6988	1.1626*	1.1580***	1.5432***
	(0.688339)	(0.6776776)	(0.2772971)	(0.2841848)	(0.6685)	(0.6528)	(0.4175)	(0.3276)
D_COLpj	(omitted)	−1.276098 *	−3.243248 ***	5.511021	(omitted)	0.4058	0.0813	2.4643***
		(0.7361531)	(0.3958881)	(5.240572)		(0.4724)	(0.1415)	(0.6950)
D_CONpj	(omitted)	0.6746695	−0.2080078 ***	2.081689	(omitted)	0.2523	−0.0474	4.6824***
		(1.128637)	(0.2505976)	(2.144077)		(0.9208)	(0.2693)	(1.8016)
D_LLpj	(omitted)	−0.2538307	0.1060007	−6.400892	(omitted)	0.9529	1.1022***	3.5810***
		(1.07258)	(0.2469407)	(4.955741)		(1.0524)	(0.2367)	(0.4433)
Ln(*PoPpt* * *PoPjt*)	−0.3001257	−0.4675261 **	0.4270096 ***	0.9348708 ***	−1.2653***	−0.4561***	−0.2058**	−1.4832***
	(0.5393945)	(0.2325515)	(0.1581621)	(0.3104253)	(0.4890)	(0.1781)	(0.0950)	(0.2772)
constant	−37.99121 ***	−15.01107 **	−15.68926 ***		7.6397	4.9297	15.2036***	
	(14.38023)	(6.08166)	(2.039659)		(13.3164)	(4.9498)	(1.5213)	
No. of obs.	470	470	532	532	595	595	595	595
R-sq: with in:	0.2939	0.2799			0.2737	0.25		
R-sq: between:	0.0493	0.3136			0.0123	0.1694		
R-sq: Overall:	0.0515	0.3558	0.60689704	0.92749732	0.0232	0.1782	0.5904	0.8857
Pseudo log-likelihood:			−2028798.2	−419951.76			−1.25E+10	−3.48E+09
F-Stats/Wald Chi	F (7,422) = 25.10	Wald χ^2 (11) = 175.50			F (7,542) = 29.18	Wald χ^2 (11) = 176.30		
corr (u_i, Xb)	corr (u_i, Xb) = −0.7903				corr (u_i, Xb) = −0.8737			
Prob > F = 0.0000	Prob > F = 0.0000				Prob > F = 0.0000			

(*continued*)

HS commodity 41-43					HS commodity 50-63			
Variables	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM	GLS-FEM	GLS-REM	PPML-REM	PPML-FEM
Ln(*GDPpt* * *GDPjt*)	0.8550***	0.5824***	0.1556	0.5601***	0.3111***	0.1298*	0.1606	0.5533***
	(0.1132)	(0.1076)	(0.2204)	(0.1327)	(0.0777)	(0.0712)	(0.1729)	(0.0964)
Ln(*GDPPCDIFpjt*)	−0.0041	0.0690	0.4912***	0.1815**	0.4062***	0.3981***	0.3408**	0.2087**
	(0.1024)	(0.0989)	(0.1781)	(0.0897)	(0.0624)	(0.0611)	(0.1624)	(0.0972)
ln(*TOEpt*)	0.5593	1.7003***	1.6049***	−0.0712	0.4782	0.8218***	1.3718***	0.8008***
	(0.4335)	(0.4132)	(0.5959)	(0.2840)	(0.3188)	(0.3009)	(0.4412)	(0.2816)
ln(*TOIjt*)	0.7060 ***	0.3355***	0.3605***	0.2816	0.5863***	0.3806***	0.1160	0.1730
	(0.1477)	(0.0918)	(0.1097)	(0.2128)	(0.1090)	(0.0743)	(0.0711)	(0.1501)
ln(*DISpjt*)	(omitted)	−0.6253**	−0.8367***	−1.9955***	(omitted)	−0.4468	−0.9990 ***	−0.3772***
		(0.2786)	(0.1499)	(0.2482)		(0.3011)	(0.1354	(0.1330)
ln(*EXPpjt*)	−0.4521***	0.0022	0.0838***	−0.2097	−0.3832***	−0.1232**	−0.1483***	0.0688
	(0.1516)	(0.0582)	(0.0235)	(0.2223)	(0.1125)	(0.0597)	(0.0233)	(0.1431)
(*D_PCFTA*)	−0.3700	0.0996	1.5182***	−0.2916**	0.5022	0.7355**	2.6839***	0.6024***
	(0.4739)	(0.4784)	(0.5024)	(0.1264)	(0.3339)	(0.3343)	(0.6153)	(0.1878)
D_COLpj	(omitted)	0.7843*	1.1595***	−2.7062***	(omitted)	0.3633	1.0787	−1.5354***
		(0.4289)	(0.1899)	(0.5955)		(0.4722)	(0.1196)	(0.2297)
D_CONpj	(omitted)	−1.0342	−1.6860***	12.9102***	(omitted)	−0.3010	−3.5730***	6.1287***
		(0.7599)	(0.4425)	(1.9793)		(0.8373)	(0.6624)	(1.2281)
D_LLpj	(omitted)	−1.0946**	−1.0926***	−12.6983***	(omitted)	−2.1877***	−0.0569	−5.4412***
		(0.5160)	(0.1633)	(1.5661)		(0.7968)	(0.2178)	(0.8852)
Ln(*PoPpt* * *PoPjt*)	−2.1488***	0.1439	0.6046***	−2.1045***	−0.7115**	0.5381***	0.8943***	−1.1868***
	(0.3397)	(0.1554)	(0.2214)	(0.4095)	(0.2898)	(0.1414)	(0.1781)	(0.2689)
constant	43.4698***	−19.2668***	−15.2672***		19.2738**	−12.7607***	−21.0623***	
	(9.3642)	(3.6059)	(2.6745)		(8.2224)	(4.2110)	(1.8045)	
No. of obs.	705	705	715	715	660	660	661	661
R-sq: within:	0.2018	0.1306			0.2603	0.2279		
R-sq: between:	0.0519	0.6981			0.0165	0.6092		
R-sq: Overall:	0.0335	0.5767	0.7017	0.9092	0.0218	0.5642	0.9163	0.9732
Pseudo-log-likelihood:			−2357606.6	−481005.36			−24741019	−3073256.1
F-Stats/Wald Chi	F (7,641) = 23.14	Wald χ^2(11) = 197.90			F (7,601) = 30.21	Wald χ^2(11) = 249.66		
corr (u_i, Xb)	corr (u_i, Xb) = −0.9175				corr (u_i, Xb) = −0.7637			
Prob > F = 0.0000	Prob > F = 0.0000				Prob > F = 0.0000			

Source(s): Author's own estimations (Here *** = 1%, ** = 5% and * = 10% significance level)

Table 8.

the results accurately. First of all, the coefficient of GDP is found to be statistically significant and positive in all four HS commodity sections, which is consistent with the theory of gravity model. In comparison among these HS commodity sections; the effect of GDP is highest in 06-15. Similarly, the results indicate a negative sign of distance's variable statistically significant coefficient in all four HS commodity sections, which is consistent with the standard hypothesis of the gravity model. Meanwhile, the negative effect of distance is highest in 01-05 as compared to the other three HS commodity sections. The reason for the highest coefficient is that 01-05 are highly sensitive agriculture products that have a low shelf life. Therefore, longer distance creates higher exports cost for these products.

The absolute difference in the per capita GDP (GDPPCDIFijt) variable demonstrates Pakistan's technological inequalities concerning its trading countries. The coefficient of this variable is positive and statistically significant in all the HS commodity sections except 06-15. The positive sign of this variable implies that Pakistan exports more to those economies which do not have a similar level of income per capita as Pakistan for HS commodity sections or it translate that Pakistan export to its trading countries but does not follow the Linder hypotheses. Moreover, the variable of the population is also statistically significant in PPML fixed-effect models in all four HS commodity sections. However, the sign of this coefficient is only positive in 01-05. It indicates that the higher population of the trading partner did not benefit the Pakistani exports except in the agricultural products. The reason behind this is that agricultural products are the staple products for any country, therefore a higher number of people could lead to higher demand for agricultural products, hence the high population benefits the exporters only in this HS commodity section. Moreover, for Pakistan, the dummy variable Pakistan–China FTA displays a positive sign for HS commodity code sections 06-15, 50-63, implying export growth through Pakistan–China FTA by Pakistan in these commodities. The coefficient of the variable suggested that Pakistan–China FTA increases the exports from Pakistan to China by 366.45% in 06-15 and 90% in 50-63. However, the dummy variable for Pakistan–China FTA confirms a negative sign for HS commodity sections 41-43 and 01-05. These results demonstrate that even with the higher RCA it could not guarantee an increase in the exports of trade between the two countries after signing the free trade agreement. This result is very interesting as it indicates that free trade agreements should look beyond the fundamental trade indicator like comparative advantage between the countries. In the future, dual margins of exports can also be explored to extend the results of this study.

Discussion and conclusion

The free trade agreements allow economies to provide a favored mode for trade between the partner economies within a specific period. This study intends to fill the gap in the literature on trade liberalization by integrating RCA with the gravity model. As mentioned earlier in the section literature review, previous studies (Abdul Kamal *et al.*, 2021; Ariza Marin, 2020; Ciuriak and D.and Kinjo, 2006; Guglielmo *et al.*, 2015; Shakur and Tsang, 2017) interleaved the indicator of RCA into the gravity equation instead of adopting a sequential model, which will be more suitable to perform and join the RCA and gravity model together for the FTA agreement. The objective of this study was to identify the commodities in which the two countries have a robust RCA separately and then analyze the effect of FTA on the export value of those commodities for the bilateral trade between the two countries.

The study concludes that the tariff arrangement between Pakistan and China in PCFTA shows a visible improvement in the bilateral trade between the two countries. However, the empirical analysis and its findings did not support the study's hypothesis.

Although PCFTA substantially increases commodities export with higher RCA. This statement is valid only for some commodity groups. There is a commodity group in which Pakistan holds an RCA, but they did not positively affect the PCFTA. Similarly, the study observed the same conclusion for China; therefore, this study rejects the null hypothesis.

Interestingly, these conclusions open up a new dimension of research for free trade agreements, suggesting that free trade agreements are more complicated than export between two countries. Moreover, the relevance of RCA while establishing a free trade agreement in the context of the current economic system is also questionable. One can argue that the effect of RCA could be invalidated because the commodities included in the FTA do not have a decent convergence rate in the agreements. Nevertheless, this study has analyzed it and concluded that even with the higher convergence rate, the good RCA does not guarantee a positive effect of the free trade agreement on the commodities. One plausible argument for these results could be the asymmetries of countries participating in the FTA. As the exports and import value of one country is much bigger than another country, the effect of FTA on RCA commodities could not be transferred properly for each country in the free trade agreement. Therefore, this could be used as a direction for future studies, such that to explore the same study for symmetric countries.

In light of the findings of this study, it is recommended that countries should look deeper into their trading agreements for increasing bilateral trade. The exports between the countries can be amplified if they go beyond the traditional method of including the commodities in the free trade agreements. Furthermore, to accelerate export by using improved tariff reductions, exporters should now have to focus on tackling nontariff barriers to export; particularly capability issues in the business community. For that purpose, the government has to improve the regulating system and provide a conducive business environment for local businesses too, as these factors affect the capability of delivering orders of scale on time to exporting market. Finally, this study focuses on commodity-level data; future studies can consider firm-level data and test the theoretical assumption of this study and extend the findings in the context of dual margins of trade.

Notes

1. https://stats.wto.org/
2. https://www.wto.org/index.htm
3. For the independent variable not in logs (such as PCFTA dummy), the semielasticity is concluded by 100*(exp(coefficient) − 1) %.

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