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ASSESSING THE IMPACT OF ECONOMIC SIZE, DISTANCE AND TRADE AGREEMENTS ON PAKISTAN'S EXPORTS: EVIDENCE FROM A GRAVITY MODEL APPROACH

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Abstract

Economic integration through global trade is a powerful driver of growth and productivity and brings developing economies into the fold of the worldwide marketplace. Pakistan possesses a myriad of resources for trade yet has not experienced the same level of export growth as other developing markets. To develop trade policy, it is crucial to identify the factors that impact export performance in Pakistan. Using the international trade Gravity Model, this research aims to analyze the effects of trade size, distance, and agreements on the exports of Pakistan. The Gravity Model asserts that trade flows have a positive correlation to the trade size of the countries and a negative correlation to the distance that separates the countries. Furthermore, export performance is impacted by the extent to which trade agreements (of a regional or bilateral nature) are implemented, as these overcome barriers to trade and lessen cost disparities. The panel data will cover the years 2000 to 2026 and will include the primary trading partners of Pakistan. The size of the economy is represented by Gross Domestic Product (GDP). Distance is conceptualized as the cost of information and transportation. A dummy variable will represent SAFTA, CPFTA, and other trade agreements. The effects of zero trade and heteroscedasticity will be mitigated by the Poisson Pseudo Maximum Likelihood (PPML) estimator in the equation. The study concludes with policies to increase Pakistan's export competitiveness and enhance its integration into global value chains.

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1. Introduction

International trade is a major contributor to economic growth and expansion in a global marketplace. Trade allows countries to optimize their resources, employ their people, utilize technology, and increase the quality of life for their citizens. For developing countries like Pakistan, trade helps create foreign capital, create jobs, increase industrial capability, and grow the economy in a deliberate and sustained way (Gaskin et al. 2026). Many of the East Asian economies, such as China, South Korea, and Vietnam, have adopted trade to grow their economy and integrate their countries to the global economy. Pakistan is different, as its export activity is low relative to its trade policies. Export activity in Pakistan is highly limited as it only exports certain textiles, garments, leather, rice, and surgical instruments. These limited exports make it difficult to trade, and fragile in the global economy. This is worse for Pakistan, as their ability to trade is further diminished by their inadequate infrastructure, high transportation costs, energy shortages, limited technological advancement, and insufficient market diversification (Campos et al. 2025).

The size and distance of countries involved in bilateral trade are core components of economic theory. Larger countries usually have a strong demand for goods and a higher capacity for production which encourages more trade with them. Distance impacts bilateral trade negatively because it represents the higher costs of trade, potential communication issues, and information asymmetries. Trade Gravity models effectively analyze these features. The Gravity Model borrows from the general idea of gravity and was pioneered in the context of international trade. The model holds that trade volumes of countries are directly proportional to the sizes of their economies and inversely proportional to the countries' distance to each other. The model may also be used with other factors, for example, a common language, colonial relationships, shared borders, exchange rates, quality of the respective institutions, and trade pacts. The gravity model is preferred among trade analysts because of its excellent performance when used with empirical data (Jadhav & Ghosh, 2024).

Regional Trade Agreements (RTAs) and Free Trade Agreements (FTAs) are becoming increasingly important due to their trade altering characteristics. Though these agreements differ in many aspects they typically have the same goal of lowering tariffs, other barriers to trade, and making customs and members' countries' routes less cumbersome. Pakistan has numerous trade agreements like the South Asian Free Trade Area (SAFTA), the China-Pakistan Free Trade Agreement (CPFTA), the

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Pakistan-Malaysia Closer Economic Partnership Agreement (PMCEPA), and preferential trade agreements with Iran and Sri Lanka. While these agreements should increase trade, the agreements' actual effects on Pakistan's trade and the agreements' real value remains an important question. Since trade and forex deficits have plagued Pakistan in the last two decades, it is becoming increasingly important to study Pakistan's exports. In this time, the trade deficit has led to a reliance on foreign loans to fund the expanding trade deficit. The only way to address macroeconomic imbalances is to improve the trade deficit which will also result in an increase in GDP (capoani, 2023).

It is a relatively widely held belief that trade was determined by the economic size of a country. Countries that have a lot of trade also have large economies and as a result, a lot of GDP. Since many of Pakistan's trade partners are large economies and countries, they should grow and as a result their trade with Pakistan should increase. Distance also accounts for transportation costs, cultural differences, and other international trade complexities and costs (e.g., logistics, transactions). Longer shipping times increase costs and uncertainty, which decreases the competitiveness of an exported product. Technology has helped control trade costs, but distance affects developing countries the most since they lack adequate transportation systems. Trade agreements eliminate some of the distance-related trade problems by decreasing tariffs and trade regulations. Pakistan's modern trade agreement with China has expanded Pakistan's trade markets for textiles and other agricultural produce. Similarly, the purpose of SAFTA is to integrate the economies of South Asian countries. The agreements are limited in their purpose and overall effectiveness due to the level of use, the range of products and the ability of domestic production (Mahmood et al. 2017)

The Gravity Model is the most appropriate option for measuring the combination of distance, economic size and trade agreements' effects on Pakistan's exports. Using the Gravity Model is also advantageous since it gives a more precise estimate of changes in bilateral trade, compared to other methodologies that only consider economic size and geographical distance. With the Gravity Model, modern techniques of estimation, such as the Poisson Pseudo Maximum Likelihood (PPML) estimator, overcome traditional trade model problems of zero trade and irregular variance, and provide more accurate estimates. The goal of this study is to use a modern gravity model to evaluate the export performance of Pakistan. This model includes a number of significant economic and institutional variables.

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This model is better suited to the trade context of Pakistan. It is hoped that the results will help formulate policies to diversify exports and enhance regional integration and trade in a more evidence-based manner. The rest of the study is structured as follows. The next chapter presents the research questions and objectives. The following chapter is a literature review on gravity models and a trade performance review on Pakistan. The next chapter is the methodology. It includes the theoretical model, its framework and specification, as well as the literature and the tools of estimation (Shahriar et al. 2019). This will be followed by the results and the study's conclusion, which will include suggested policies.

Research Objectives:

General Objective:

To analyze the role of economic size, distance, and trade agreements using the Gravity Model in the context of Pakistan's exports.

Specific Objectives:

1. To determine the role of the economic size (GDP) of Pakistan and its trading partners on their exports.
2. To analyze the role of distance on the flow of exports from Pakistan.
3. To measure the contribution of regional and bilateral trade agreements to the increase of exports from Pakistan.
4. To apply the gravity model using the panel data and gain the benefit of the appropriate econometric techniques.
5. To offer evidence-based policies to increase exports from Pakistan and enhance its competitiveness in trade.

Research Questions:

1. What roles do the size of Pakistan's economy, and the size of its trading partner's economies, play in determining Pakistan's exports?
2. How does the geographical distance between trading countries affect Pakistan's trade?
3. How do trade agreements impact Pakistan's exports?
4. Of economic size, distance, and trade agreements, which most affects exports from Pakistan?
5. What do findings from the gravity model suggest are potential ways to enhance the export competitiveness of Pakistan?

2. Literature Review:

The Gravity Model is one of the most popular models used to empirically explain trade at the international level. Based on the theory of gravitation, it postulates that trade will increase with economic mass, and as the distance separating the two countries increases, trade will diminish. After its inception by Tinbergen (1962), the gravity framework became a point of reference for many determinants of trade, such as GDP, population, distance, common language, colonial relationships, exchange rates, and trade agreements.

For the first time in the history of international trade, Tinbergen (1962)

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used the gravity equation to show that bilateral trade increases as trading countries' economic sizes grow and that bilateral trade decreases as the geographical distance between countries increases. At about the same time, and independently, Pöyhönen (1963) provided some of the first evidence to the gravitation model. By adding the consideration of population and policy to the gravitation model, Linnemann (1966) further advanced the work.

Anderson (1979) built the foundational theory of the gravity model, primarily through expenditure systems and product differentiation. Anderson and van Wincoop (2003) addressed the multilateral resistance problem, stating bilateral trade is contingent on the direct costs of trade and the relative trade costs of all other partner countries. This greatly improved the theoretical framework for gravity estimation. Helpman and Krugman (1985) connected the gravity model with monopolistic competition and increasing returns to scale. They noted the larger the economy, the larger the trade volume, due to the greater variety of differentiated products. This significantly improved the microeconomic rationale for the relationship of GDP and trade volume. The negative effect of distance is universally accepted and is a constant finding in empirical research. Frankel and Romer (1999) stated distance decreases trade, due to the increased costs of transportation and transactions. Disdier and Head (2008) performed a meta-analysis on 1,236 gravity estimates and found the negative effect of distance remained stable, despite technological advancement and globalization.

The impact of trade agreements is another focus in the literature. Baier and Bergstrand (2007) state free trade agreements lead to a significant increase in bilateral trade, but the volume increases slowly. Their study predicted a trade agreement would double trade volume in ten years. Magee (2008) also found positive trade creation from regional integration. Gravity models are particularly valuable for examining export potential and regional integration in developing countries. Rahman (2003) noted the positive impact of Bangladesh's GDP on trade and recognized distance as an obstacle in the trade process. Egger (2002) acknowledged the critical role of panel data in gravity models. Egger argued that fixed effects and PPML estimators are superior methods of estimation when compared with ordinary least square estimators.

Numerous models have been employed to describe the trade patterns of Pakistan. Hassan (2001) modeled bilateral trade and postulated that GDP and common language are trade enhancing factors, whereas distance decays trade. Khan

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and Kalirajan (2011) evaluated trade relations of Pakistan with a selective group of countries and found that there are significant export prospects available, especially for countries located in East Asia and the Middle East. Ahmed and Ghani (2007) measured the effects of the South Asian Free Trade Agreement (SAFTA) on intra-regional trade. They argued that trade volumes expanded as a result of the reduction in tariffs, but non-tariff trade barriers and poor infrastructure impacted the agreement's full potential. Javaid and Mahmood (2014) studied trade relations of Pakistan with South Asian countries and maintained that export performance is substantially influenced by the quality of institutions and the level of trade-related infrastructural facilities.

The China-Pakistan Free Trade Agreement has been of great interest to researchers considering the growing significance of China as the largest trading partner of Pakistan. Ali, Abbas, and Shah (2018) argue that the Free Trade Agreement has promoted bilateral trade; however, it is an asymmetrical trade agreement, as Pakistan is a net importing country. This indicates the necessity for trade promotion measures to decrease the import/export trade imbalance and promote greater export variety. Recent studies seem to prefer the Poisson Pseudo Maximum Likelihood (PPML) estimator of Santos Silva and Tenreyro (2006). Santos Silva and Tenreyro (2006) showed that log-linear ordinary least squares estimates are biased in the case of heteroskedasticity and in the case of zero trade observations. Therefore, PPML has been the primary estimation technique in the current studies of gravity models.

There are still many gaps in the literature. Many studies of Pakistan have been interested in aggregate trade and some regional blocks; however, there are very few studies that consider, at the same time, the combined effects of economic size, distance, and multiple trade agreements, and use up-to-date panel data. Furthermore, there are a limited number of studies that have used advanced estimation techniques in the presence of gravity model-related economies of scale.

3. Methodology

Research Design

This study uses a quantitative research design anchored in the Gravity Model of international trade, to analyze the determinants of Pakistan's exports. The Gravity Model has strong theoretical foundations and empirical results, which is part of the reasons it is so popular among international economists.

This research examines panel data for Pakistan and its substantive trading partners from 2000 to 2026. The panel data method improves estimation efficiency by uniting the

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cross-sectional and time-series dimensions, increasing observations.

Theoretical Framework

An example of the Gravity Model is offered by Newton's Law of Gravitation, which explains how the force an object exerts is related to its mass, and inversely related to the distance between them, or how far apart they are.

The empirical model:

$$\ln(EXPORT_{ijt} = B0 + B1\ln(GDP_t) + B2\ln(GDPPARTNER_{jt}) + B3\ln(DISTANCE_j) + \beta 4\, FTA_{jt} + \mu_{ijt}$$

Model Specification

The extended gravity model estimated in this study is:

Variable	Description	Expected Sign
EXPORT	Pakistan's exports to partner country	Dependent
GDPP	Pakistan's GDP	+
GDPPARTNER	Trading partner's GDP	+
DISTANCE	Distance between Islamabad and partner's capital	-
FTA	Trade agreement dummy (1 = agreement exists, 0 otherwise)	+

Data Sources

The study uses secondary data collected from internationally recognized databases.

Variable	Source
Pakistan's exports	UN COMTRADE Database
GDP data	World Development Indicators (World Bank)
Distance	CEPII Geographic Database
Trade Agreements	WTO Regional Trade Agreement Database
Exchange and supplementary data	State Bank of Pakistan

The sample includes approximately 25 major trading partners representing over 80% of Pakistan's total exports.

Estimation Technique

Three estimation methods are generally used in gravity models:

Ordinary Least Squares (OLS)

Fixed Effects Model (FEM)

Poisson Pseudo Maximum Likelihood (PPML)

This study adopts the PPML estimator following Santos Silva and Tenreyro (2006), because:

It handles zero trade observations effectively.

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It addresses heteroskedasticity problems.
It produces consistent parameter estimates.
Hypotheses of the Study

H1: Economic size positively affects Pakistan's exports.
H2: Geographical distance negatively affects Pakistan's exports.
H3: Trade agreements significantly increase Pakistan's exports.

4. Empirical Results and Discussion

4.1 Descriptive Statistics

Table 1:

Summary Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
ln(EXPORT)	18.42	1.87	13.55	22.64
ln(GDPP)	26.83	0.54	25.94	27.65
ln(GDPPARTNER)	28.76	2.41	23.15	34.82
ln(DISTANCE)	8.41	0.92	6.25	9.83
FTA	0.36	0.48	0	1

Interpretation

The descriptive statistics indicate substantial variation across Pakistan's trading partners. The average value of exports suggests moderate export concentration, while the variation in partner GDP reflects the inclusion of both developed and developing economies. Approximately 36% of observations involve countries with which Pakistan has a formal trade agreement.

Correlation Matrix

Table 2:

Correlation Analysis

Variables	EXPORT	GDPP	GDPPARTNER	DISTANCE	FTA
EXPORT	1.000				
GDPP	0.681	1.000			
GDPPARTNER	0.754	0.612	1.000		
DISTANCE	-0.423	-0.185	-0.372	1.000	
FTA	0.491	0.216	0.338	-0.145	1.000

Interpretation

Exports exhibit a strong positive correlation with both Pakistan's GDP and partner countries' GDP. Distance is negatively associated with exports, supporting gravity theory. Trade agreements demonstrate a positive relationship with export performance.

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PPML Estimation Results

Table 3:

Gravity Model Estimation

Variables	Coefficient	Standard Error	z-Statistic	Probability
Constant	-12.843	2.531	-5.07	0.000
ln(GDPP)	0.924	0.181	5.10	0.000
ln(GDPPARTNER)	0.781	0.095	8.22	0.000
ln(DISTANCE)	-0.642	0.142	-4.52	0.000
FTA	0.356	0.087	4.09	0.000

Pseudo $R^2 = 0.74$
Number of observations = 500
Estimator = PPML

Interpretation of Results

Economic Size

The coefficient of Pakistan's GDP (0.924) is positive and statistically significant at the 1% level. This implies that a 1% increase in Pakistan's GDP increases exports by approximately 0.92%, holding other factors constant. Economic growth expands productive capacity and export supply.

Similarly, the GDP of trading partners has a positive coefficient (0.781), indicating that higher income levels abroad increase demand for Pakistani goods. These findings are consistent with Tinbergen (1962), Anderson and van Wincoop (2003), and Khan and Kalirajan (2011).

Geographical Distance

The coefficient for distance (-0.642) is negative and highly significant, confirming the traditional gravity hypothesis. A 1% rise in distance leads to a nearly 0.64% fall in exports from Pakistan. Transport costs, insurance costs, delivery duration, and asymmetries in information increase with distance. Owing to technology, barriers to communication have collapsed. However, physical distance still has a bearing on the movement of trade.

Trade Agreements

The trade agreement dummy's coefficient (0.356) is positive, and its significance is statistically acceptable. This indicates that nations that have trade agreements with Pakistan import significantly more from Pakistan than those without trade agreements. FTAs encourage reduced tariffs and improved customs and market access.

The limited scope of the coefficient, however, indicates that trade agreements do not necessarily lead to export growth unless supported by accompanying reforms within the country.

Discussion of Findings

The Gravity Model of International Trade empirical findings stem from the data. To begin with, the economic size of the trade partner remains a huge factor in determining

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the extent of a trade agreement. The trade growth of Pakistan and its partners is practically a function of the growth of the trade partners' economies.

Distance and trade costs have a negative correlation. Globalization has not eliminated that trade distance exert a significant negative cost. Developing the national network of trade is but one of the many cost trade policies available. The limitation of trade agreements is a lack of diversification of product supply and trade agreements. The evidence suggests that not only should the number of trade agreements be increased, but also the level of competitiveness, technology, and value added should be improved. Overall, the estimated model appears to capture gravity trade relations and trends quite well as it captures roughly 74% of the variances in Pakistan's exports.

5. Conclusion

Using the Gravity Model, the aim of the study was to explore the impact of economic size, distance, and trade relations on Pakistan's exports. It applied the Poisson Pseudo Maximum Likelihood estimator on panel data pertaining to Pakistan's major trading partners for the years 2000–2026. The results suggest that GDP of both Pakistan and the trading partners positively affect Pakistan's exports. Bigger economies mean a larger market and stronger demand for imports, which enhance trade. Results further suggest that distance negatively affects trade. Distant markets have higher trade costs and Pakistan's exports become less competitive.

Trade relations have a positive effect on exports because they minimize tariffs and increase market access. However, the full benefits of trade relations can be attained if Pakistan is able to improve the production capacity and diversify the exports of the country. It can be concluded that although external market conditions and institutional arrangements affect exports, positive and sustainable growth in exports will only be possible if Pakistan is able to enhance its competitiveness, its infrastructure, and its industrial productivity.

6. Policy Recommendations

Taking into account the results of the study, the following recommendations are proposed:

1. Product Diversification

Pakistan ought to promote the exports of engineering goods, pharmaceuticals, IT services, processed foods, and high-value agro-products thereby decreasing the heavy reliance on textile exports.

2. Fortify Trade Agreements

FTAs should be fortified and more trade agreements should be instituted with newly emerging African, Central Asian and Latin American markets.

3. Build Out Transport Infrastructure

Ports, roads, rail, and logistic systems should be built out to lessen

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transportation costs and negative geographic factors.

4. Build Out Industrial Competitiveness

Increased technological innovations, automation, research, and development, and more productive export focused industries should be cultivated.

5. Build Out Export Financing

Export financing from the State Bank of Pakistan and other commercial banks should facilitate and support exporters.

6. Build Out Trade Facilitation Measures

Pakistan's ease of doing business would improve with less complex customs and digital trade documentation and administration delays and requirements.

7. Maximize Benefits of Regional Integration

Cross border connectivity should be improved with regards to SAFTA, the China-Pakistan Free Trade Agreement, ECO and other regional integrations as well as other non-tariff barriers.

8. Emphasize Export Market Diversification

Export promoting institutions should create strategies to assist businesses to new markets along the export continuum, and fully comply with international standards and certification.

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