Research article

The effects of trade cost components and uncertainty of time delay on bilateral export growth

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ABSTRACT

This paper measures the trends, specifically for exporters, in bilateral trade costs and more specifically for costs associated with policy barriers. The study further examines the effects of different trade cost components on bilateral export flows via the dynamic panel gravity model. Empirical evidence shows that trade costs generally have a declining trend globally, however, in the case of emerging countries, this rate of decline is very low. The costs associated with non-tariff barriers in emerging countries have a greater role in the continuation of higher trade costs, in comparison to tariff barriers' costs. Likewise, the two-steps system GMM model's results suggest that the infrastructure quality, transportation costs, volatility of exchange rate, and uncertainty in time (days) delay are major hurdles in the sustainable growth of exports and indeed have rendered the exports uncompetitive in the world market, those are also sturdily supported by the prediction of the theory.

1. Introduction

Export-led growth is still a preferred strategy of mainstream economic development practitioners. In the context of the present liberal trading system, emerging economies have become more crucial in increasing productivity, capacity, efficiency, and sustainability of exports. Due to the policies of the World Trade Organization (WTO) and the conditions of the lending institutions, many developing countries have liberalized their trade. Resultantly, total exports have responded favorably, but the challenge remains in maintaining this development. The world has thus seen a dramatic decline in tariff rates, while a host of non-tariff barriers remain, penalizing the export flows (Escandon-Barbosa et al., 2019). It is therefore pertinent to awareness the major supply-side barriers and factors that limit the exportability of developing countries in the international market.

The massive trade costs faced by exporters and producers are one of the main reasons for slow and sometimes falling exports, particularly in the context of developing countries. According to Obstfeld and Rogoff (2000), trade costs imposed by countries are the relative transfer costs of products of every country. The main components of bilateral costs of trade that adversely affect exports include ineffective infrastructures, documentation, administration, customs, storage and port procedures, inadequate trade facilitation technology, quality control costs, etc. Such factors by raising costs of exporting, in turn, reduce overall export capacity.

Supply-side barriers to trade are huge and it is challenging to calculate them directly because of the data availability limitations. Over the years, countries have suffered from trade-related costs, but due to the non-availability of adequate information could not pay the right attention to reducing these costs. To address this problem, we use Novy's (2013) theory-based model of gravity, for measuring the costs of trade to capture effects for all trade barriers. This allows us to examine declining or rising trends in costs of trade worldwide. One of the benefits of this approach is that it also includes the factors of multilateral resistance and all those unobserved variables for which that are not easily available; these include variables such as informational costs, language barriers, political and border sharing issues, etc. All in all, this approach has a solid theoretical foundation and assists to gauge the magnitudes and trends in trade costs.

The study finds that globally, trade costs demonstrate a declining trend. The rate of decrease is, however, very low in emerging economies. This leads to enhanced trade costs for exporters in international markets. There has not been much research to investigate the problem of higher trade costs faced by developing countries owing to the reduced rate of trade costs decline in these countries. Moreover, the paucity of governmental support in terms of legislation, regulations, and institutionalization, etc., adversely affects the growth of exports in the developing world.

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Huge trade costs due to poor trade policy have become a major hurdle in accessing the world markets and thus a critical obstruction for exports growth. Ferrantino (2012) said that the policy obstacles, accompanied by weak supply chains, have created obstructed trade flows. Based on the worldwide trade liberalization experience in the aftermath of the establishment of the Bretton-Woods system in 1947, he suggested that government needs to lower barriers for the promotion of international trade. Ironically, the trade costs arising from trade policy barriers have not been comprehended well by the policymakers (Alvi et al., 2021). Over the years, whereas economies, especially developing economies, have seriously suffered from these costs, but they did not pay any heed to reduce them. Since the research of trade costs related to policy barriers was not studied with the growing hurdles of trade, it has led to creating a knowledge gap. The lack of empirical knowledge on this issue is because the available literature is confined to pure theoretical studies dealing with trade costs, consequently, the deleterious effects of trade costs could not be appreciated in the policy circles. Therefore, trade costs are important in the perspective to represent the country's competitiveness and trade policy.

Within the above perspective, this study conducts a comprehensive empirical investigation of various aspects of trade costs from the viewpoint of Pakistan. According to the World Bank report in 2019, Pakistan's trade policy barriers are five times higher compared to top-70 world economies. Pakistan’s export is trapped in a slow growth path since 2011. The volume of exports was $29.83 billion in 2011 which has $28.22 billion in 2018, at the same time export to GDP ratio has declined from 13.97% in 2011 to 8.97% in 2018 (GoP, 2018). The main reason for this trade deficit of Pakistan is biased/unsatisfactory monetary and trade policy (Bahmani-Oskooee et al., 2020), lack of competitiveness, higher trade costs compared with the competitors in the international market, inefficient trade facilitation system, etc. This makes Pakistan a worthy candidate to study for empirically analyzing trade costs barriers and their trends faced by developing countries. This contribution of the paper will help to understand the role of bilateral trade costs analysis in redefining bilateral trade policies keeping in mind all the necessary trade cost aspects. So that bilateral trade policy can be modified in such a way that they repress the contribution of that barrier which is uplifting the trade costs. It is going to help the policymakers to devise the correct trade policy which can strengthen their capacity to conduct more efficient trade with the trading partners and enhance the export-led growth.

By using the gravity model, in line with Noy (2013), we find that the growing trend in trade costs associated with non-tariff barriers eventually leads to a less/smaller net decreasing rate of total trade costs. This increasing trend of non-tariff barriers-related costs diminishes the opportunities for new trade and investment. Higher trade costs associated with non-tariff barriers have become an economic hurdle for exporters in accessing the world market. Our study results, therefore, imply that reducing non-tariff trade cost barriers will lead to an increase in bilateral exports.

An important question to explore would be which component of costs for trade has the more significant impact on the bilateral exports of the developing countries? In the case of developing countries, this question is not usually answered with accuracy. Many studies have examined the barriers of trade policy but the effects of these barriers on the bilateral export flows have not been quantified. Therefore, this study tries to fill the gap by quantifying and assessing the effect of different components of trade costs on bilateral export flows. To study the role of trade cost components in falling the bilateral export flows, we applied the dynamic panel data model of gravity using the two-step system generalized method of moments (GMM). We find that the poor quality of infrastructure, volatility of exchange rate, the uncertainty of time (day) delays, and transport costs are the major obstacle for exporters by making the export process slow and costly. These factors inflict high costs and translate into hindered opportunities of emerging economies for global connectivity in the present context. This work is expected to facilitate policymakers in appreciating the role of bilateral trade costs in reformulating trade policies for export growth.

The next section explains the theoretical framework for quantifying the impact of trade cost components. A method to model the components of trade costs in the gravity equation framework is followed in section 3. Section 4 represents results and discussion. And section 5 gives the conclusion with the implications of policies.

2. Theoretical foundations

The gravity model of international trade is often used for ex-post assessments of export flows as a standard model for estimating the impact of a variety of barriers of bilateral trade. It is built on the concept that total trade levels between the two trading-partner countries depend on their economic size and distance (as a proxy for costs of trade), Tinbergen (1962) and Poyhonen (1963) are the first two authors who develop the bilateral international trade model of gravity.

The central role played by the gravity model has several reasons. The first with its higher explanatory power for bilateral export flows allow us to include bilateral trade costs barriers effects between partner countries. Secondly, it gives a way to capture the role of other variables other than economic sizes play in affecting the bilateral export flows (Egger, 2002). As the equation of gravity relates the bilateral flows of export to economic size and costs of trade between partner countries, which not only captures the trade barriers, also has one of the sturdiest empirical effects in economics (Novy, 2013). The typical form of gravity model is obtainable as below:

\[ T_{ij} = \frac{GDP_i GDP_j}{D_{ij}} \]  

where \( T_{ij} \) shows a bilateral flow of trade from nation \( i \) to \( j \), \( GDP_i \) is the economic size of partner countries, \( D_{ij} \) indicates the distance (as a proxy for costs of transportation) between two states. The restrictions, \( \alpha \), \( \beta \), and \( \delta \) are frequently determined in the form of log-linear. The model is extensively used in the observed study because of its larger descriptive control and durable theoretical details. This model can integrate the additional variables to control the factor endowments differences that could obstruct exports between partner states (Yamarik and Ghosh, 2005). As the goal of this study is to measure the effect of trade costs’ components on bilateral export flows, therefore these are included in the gravity model as follow:

\[ Exp_{Pakj} = \beta_0 GDP_{Pak} GDP_{j}^{\beta_1} TTC_{Pakj}^{\beta_2} C_{Pakj}^{\beta_3} \epsilon^{VD} \epsilon^u \]  

where \( \beta \)'s are model’s parameters, Pak and \( j \) are Pakistan (exporting) and importing state, \( Exp_{Pakj} \) is Pakistan’s bilateral export flows, GDP indicates the gross domestic product of Pakistan and partner countries, \( TTC_{Pakj} \) stands for transportation costs between Pakistan and partner countries. \( C_{Pakj} \) represents the other components of trade costs’ those impose the costs on Pakistani exporters, for capturing the specific factor we use \( \epsilon^{VD} \) as a vector of dummy variables and \( \epsilon^u \) is the error term.

Although the augmented gravity model is developed in the multiplicative term and to estimate the parameters it can be linearized by using the natural logarithm of the model (Eq. (2)):

\[ \ln \left( Exp_{Pakj} \right) = \beta_0 + \beta_1 \ln GDP_{Pak} + \beta_2 \ln GDP_{j} + \beta_3 \ln TTC_{Pakj} + \sum \ln C_{Pakj} + \ln VD + \ln U_{Pakj} \]  

where, \( U_{Pakj} \) is the idiosyncratic disturbance error term. Baldwin (1988), Egger (2002), Nguyen (2010), and Krugman and Obstfeld (2009) found that the presence of sunk costs borne by exporters to establish the sales and service networks in the partner nation may produce inertia in bilateral trade flows, and states will trade more at time \( t \) + 1 those trading with each other at time \( t \). By integrating the dynamics in the basic gravity model of trade can be written as follows:
In \( \text{Exp}_{pajt} = \beta_0 + \beta_1 \ln \text{Exp}_{pajt-1} + \beta_2 \ln \text{GDP}_{pajt} + \beta_3 \ln \text{GDP}_{j} + \beta_4 \ln \text{TTC}_{pajt} + \sum \ln \text{CP}_{pajt} + \sum \text{VD} + \text{Un}_{pajt} \) \hspace{1cm} (4)

So, Eq. (4) indicates that export flows performing attained in the previous year gives a starting point for the export flows changes in the current year (Baltagi, 2005; Krugman and Obstfeld, 2009; Nguyen, 2010).

3. Methodology

3.1. Empirical model

This study used Pakistan’s bilateral export flows data with 141 trading partners from 2003 to 2018. The countries were considered in the analysis for those trade costs can be assessed for all years in the sample. The panel data is efficient and presents more degree of freedom, flexibility and reduces the issue of multicollinearity along with the independent variables, enhancing the consistency of empirical results of the regression (Baltagi, 2005). The analysis used an econometric description of dynamic gravity panel model (Dlamini et al., 2016) to assess the effect of trade cost components on bilateral export flows and included the following variables:

\[
\ln \text{Exp}_{pajt} = \beta_0 + \sum_{i=1}^{p} \delta_i \ln \text{Exp}_{pajt-1} + \beta_2 \ln \text{GDP}_{pajt} + \beta_3 \ln \text{GDP}_{j} + \beta_4 \ln \text{TTC}_{pajt} + \sum \ln \text{CP}_{pajt} + \sum \text{VD} + \text{Un}_{pajt} \]

where, \( \text{Exp}_{pajt} \) is the bilateral export flows, taken at constant US$, GDP indicate gross domestic product proxy for the economic size of partner countries, taken in real terms at constant US$. A positive sign is expected for the coefficients of GDP as the larger income of partner countries indicates the higher demand for the exports of Pakistan. A negative sign is expected with all the components of trade costs as they put the costs on the exporters to export to the partner countries. \( \text{TTC}_{pajt} \) stands for bilateral tariffs (ad valorem equivalent form) related trade costs, \( \text{TTC}_{pajt} \) stands for transportation costs at US$ as an expenditure of the exporters, \( \sigma \) is the quality of country’s infrastructure, estimated by making an index, \( \text{ER} \) is the volatility of real exchange rate, estimated by the standard deviation of the monthly real exchange rate values for each year, \( \text{UT} \) is uncertainty of time (days) delays, measured through the Monte Carlo simulation, \( \text{Un}_{pajt} \) is an unobservable error term that encapsulates unobserved country-specific factors that affect (trade between Pakistan and importing country) those that don’t change over time like distance, use of similar language and contiguity, etc., \( \text{Un}_{pajt} \) is the time fixed effect term that used to monitor variables/factors that may affect Pakistan’s trade with all trading partners at time \( t \) and \( \text{Un}_{pajt} \) is the idiosyncratic disturbance error term.

3.2. Infrastructure quality measurement

To measure the effect of infrastructure facilities, this research constructs an Infrastructure Index (II), including nine infrastructure factors for all separate countries. The II constructed a base on Principal Component Analysis (PCA). It is used to measure a position (relative) of the country (considering a set of observables). This technique is useful because it not only reduces the large dataset dimensionality, decreasing the information loss also maximizes variance for uncorrelated variables. It plays the important role in the statistical method (Jolliffe and Cadima, 2016). The II represents a linear mixture of unit free values of separate amenities like that:

\[
\text{II}_{pajt} = \sum \text{W}_{exp} \times \text{Exp}_{pajt} \]

where, \( \text{II}_{pajt} \) = infrastructure quality index of Pakistan in \( j \)th country at time \( t \). \( \text{W}_{exp} \) = the weight of export facility/efficiency in \( j \)th country at time \( t \). \( \text{Exp}_{pajt} \) = unit free value for export facility/capability for Pakistan in \( j \)th country at time \( t \).

The variables given below are considered when the quality of infrastructure for the countries is indexed. These variables are participating included in the transfers of merchandise among different territories.

| Variable                | Variable                  |
|-------------------------|---------------------------|
| 1) Railway size density (km per 1000 sq. km of surface area) | 6) Country’s proportion share in world fleet (percent) |
| 2) Road size density (km per 1000 sq. km of surface area) | 7) Container port circulation (TEUs per terminal) |
| 3) Air transportation freight (million tons per km) | 8) Fixed line and mobile phone subscribers (per 1,000 people) |
| 4) Air transportation, travelers approved (percentage of population) | 9) Electric power ingesting (kWh per capita) |
| 5) Aircraft leavings (percentage of population) |                      |

3.2.1. Estimating total bilateral trade costs

This study follows a Novy (2013) to describe the trade cost that is analytical solved theoretical based gravity model as follow:

\[
\tau_{pajt} = \left( \frac{X_{pajt}X_{jP}}{X_{pajt}X_{jP}} \right)^{\frac{1}{\sigma}} - 1 \]  

where,

\[
\tau_{pajt} = \text{Geometric average of bilateral total costs of trade between Pakistan and j country at time t}.
\]

\[
X_{pajt}X_{jP} = \text{International (bilateral) trade flow from Pakistan to j and j to Pakistan at time t}
\]

\[
X_{pajt}X_{jP} = \text{Intrnational (domestic) trade flow for Pakistan and j at time t}
\]

\[
\sigma = \text{Elasticity of substitution (That is set equal to 8, by following Novy (2013).)}
\]

It is important to take a geometric average of the barriers in both directions (that helps to distinguish the effect of policy barriers and shows the essential bi-directional tendency of obstacles to costs of trade). To obtain the tariff equivalent in the percentage of the goods it is important to deduct one to show the bilateral costs of trade. The rationale is clear behind \( \tau_{pajt} \). If bilateral trade flow \( X_{pajt}X_{jP} \) increases relative to domestic trade flow \( X_{pajt}X_{jP} \) the trade comes to be easier between two states related to domestic trade. This is due to decreasing value of \( \tau_{pajt} \) etc.

Thus, the calculation indirectly measures the trade costs derived from the exchange flow. Since these flows of trade vary over time, trade costs can be estimated not only for cross-sectional data but also for time series and panel data. This is an advantage over the method of Anderson and Van Wincoop (2004), which only uses cross-sectional data. It is also important to emphasize that bilateral trade costs are asymmetric/disproportionate (\( \tau_{pajt} \neq \tau_{jP} \)) rather than symmetric (\( \tau = \tilde{\tau} \)) measured by Anderson and Van Wincoop (2004) and that two-sided trade flows are unbalanced (\( X_{pajt} \neq X_{jP} \)).

3.2.2. Measuring transportation costs

For the estimation of transportation costs, we shadowed a model presented the Limao and Venables (2001), succeeding the differ-

\footnote{1 In terms of derivation, we suggest the Novy (2013) and Eaton and Kortum (2002).}
ences of CIF (cost insurance and freight) and FOB (free on board) standards.\(^2\)

Exporting country shows their total amount on the FOB, which estimates the cost of all expenses experienced in supplying the commodities in a foreign transporter to export port and to import cost, and importing country shows the amount of import from its trade-partner countries generally CIF. Signifying we describe the ad-valorem transaction costs as aspect as \(T_{\text{Pakjt}}\).

\[
t_{\text{Pakjt}} = \frac{c_{\text{fjk}}}{f_{\text{obPakjt}}} = \left(\frac{P_{\text{fobPakjt}} + T_{\text{Pakjt}}}{P_{\text{fobPakjt}}}\right) = f\left(\frac{x_{\text{Pakjt}}}{X_{\text{Pakjt}}} + X_{\text{Pakjt}}\right) (8)
\]

where, the ratio of \(c_{\text{fjk}}/f_{\text{obPakjt}}\) delivers the measurement costs of transactions for trade flows between both Pakistan and partner countries at time \(t\), \(P_{\text{fobPakjt}}\) shows the FOB price transported from Pakistan to \(j\), \(T_{\text{Pakjt}}\) represents the cost of shipping goods from Pakistan to nation \(j\), \(x_{\text{Pakjt}}\) is denoted as a vector of features connecting to journey between Pakistan and country \(j\), \(X_{\text{Pakjt}}\) represents physiognomies of Pakistan, \(X_{j}\) represents physiognomies of state \(j\) and \(\mu_{\text{Pakjt}}\) characterizes as all other unpredictable features. Suppose \(T_{\text{Pakjt}}\) can be approached by log-linear function for a certain size error, a normal experiential cost of transaction rates \(T_{\text{Pakjt}}\) looks like this:

\[
\ln T_{\text{Pakjt}} = \alpha + \beta x_{\text{Pakjt}} + \gamma \ln X_{\text{Pakjt}} + \delta \ln X_{j} + \omega_{t} (9)
\]

Succeeding Limao and Venables (2001), \(T_{\text{Pakjt}}\) (transaction costs) is measured by the ratio of \(((c_{\text{fjk}}/f_{\text{obPakjt}}))\) this represents the ratio of unit costs of the transaction from Pakistan to \(j\) partner country at time \(t\).

### 3.2.3. Estimating bilateral costs of trade associated with tariff barriers (TBs)

The bilateral trade costs related to TBs have been measured by the tariffs on each other’s imports imposed by the partner countries. This study analytically describes the bilateral costs related to TBs as follow:

\[
TTC_{\text{Pakjt}} = \sqrt{\left(\text{tariff}_{\text{Pakjt}} + 1\right)\left(\text{tariff}_{\text{Pakjt}} + 1\right)} (10)
\]

where,

\[
TTC_{\text{Pakjt}} = \text{Bilateral geometric mean of tariff trade costs between Pakistan and } j \text{ country at time } t.
\]

\[
\text{tariff}_{\text{Pakjt}} = \text{AHS dutiable tariff lines share } (\%) \text{ imposed by Pakistan on country } j \text{ at time } t.
\]

\[
\text{tariff}_{\text{Pakjt}} = \text{AHS dutiable tariff lines share } (\%) \text{ imposed by country } j \text{ on Pakistan at time } t.
\]

The effectively applied (AHS) dutiable tariff lines percentage share are used to measure the costs of trade associated with tariff barriers. The estimation of this rate considers the types in which tariffs are essentially collected and all other types in which zero tariffs imposed are not considered.

Simple average tariffs overstate the level of costs of the trade when a nation conducts most of its trade in a rare category with no tariffs, but many other import categories have higher tariffs where imports will never be valued. This problem can be somewhat ignored by using weighted average tariffs. A large/more protectionist nation described low tariff costs of trade because that country has relatively minimum trade due to its high tariffs in numerous categories (i.e., as to reduce imports by setting greater tariffs). In this case, it should also be noted that the simple average tariffs would incur higher costs of trade related to the tariff. So, the best way to calculate the accurate level of tariff trade costs is using them effectively applied dutiable tariff lines.

### 3.2.4. Bilateral trade costs associated with non-tariff barriers (NTBs)

In developing countries, distortionary and discriminatory ownership of NTBs requires a full understanding of these impacts, both in terms of export competitiveness and consumer access. With its growing complexity, the study of NTBs to trade costs has not been well-defined. Measuring them is a complex task that is confronted with specific quantifiable restrictions and limited access to data. To solve this issue, this research follows Anderson and Van Wincoop (2004) to analyze the bilateral trade costs related to NTBs, which includes all costs other than tariffs for the export of commodities as follows:

\[
\text{NTBC}_{\text{Pakjt}} = \left(\frac{1 + \frac{\text{tariff}_{\text{Pakjt}}}{\text{TTC}_{\text{Pakjt}}}}{\text{TTC}_{\text{Pakjt}}} - 1\right) \times 100 (11)
\]

where,

\[
\text{NTBC}_{\text{Pakjt}} = \text{Bilateral Trade costs associated with NTBs between Pakistan and country } j \text{ at time } t.
\]

\[
\tau_{\text{Pakjt}} = \text{Geometric average of bilateral total costs of trade between Pakistan and country } j \text{ at time } t.
\]

\[
\text{TTC}_{\text{Pakjt}} = \text{Bilateral geometric mean of tariff trade costs between Pakistan and country } j \text{ at time } t.
\]

### 3.2.5. Uncertainty of time (days) delay costs

The procedure of transferring the commodities from the exporter’s place to port includes substantial uncertain delivery costs of time. The greater contribution in total export costs is the share of time delays cost and it also fluctuates significantly between various geographical corridors. There are different sources of these costs shown by experience/be facing the exporters, like insufficient/poor information, corruption, and weak infrastructure. An evaluation of time delays cost for exporting goods shows a high level of these costs and hinders the capability of countries to contribute to the international export market. The payoff function for the exporter is the “iceberg” type. When they deliver the commodities on time, earn profits. There are costs for staying either too late or too early for exporters. Commodities that reach port too early are subject to be spoilage/ waste (for perishable goods), theft, or extra warehousing charges. Costs for reaching too late have been levied by the importer country in different forms like asking for discounts, rejecting the commodities, penalties of cash, and extra warehousing costs during waiting for the next ship.

The data on logistics systems, port district restrictions, real infrastructure, corruption, and complete information is not available to capture the role of uncertainty in time to export. This uncertainty of time (days) delay costs for exporters has been estimated by using Monte Carlo simulation to produce possible outcome values. It overlooks all consequences of financial costs for air travel or road and includes the costs associated with delay and early arrival per day. Simulation runs for different probabilities of occurrence \(p\) ranking from 0 to 1 \((p = 0)\) represents exports arriving too early costs, and \(p = 1\) shows exports arriving too late at their destination or yields the highest costs for arriving too late), we select the maximum and minimum ranges for probability based on the actual number of days that Pakistan takes to export to partner country and the average number of days required for export by using efficient procedures to export on time. So, minimum values of probabilities of occurrence represent exports arriving too early costs and maximum values represent exports arriving too late costs. To obtain accurate results, we run 20,000 simulations for every year and every partner country.

### 3.3. Sources of data

Bilateral export flows data were collected from UN COMTRADE. Data for GDP and elements for measuring infrastructure quality were obtained

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\(^2\) Several procedures have been taken to quantify transportation costs. The easiest way of its quantification in international trade is the difference between CIF and FOB trade prices. The difference/change of two values is a procedure to quantify the costs of moving an item from the exporter to the importer. See Baier and Bergstrand (2001) for more information.
from the World Development Indicators (WDI). Data on the monthly real exchange rate are collected from the organization for economic cooperation and development (OECD), Bank for International Settlements (BIS), International Monetary Fund (IMF), and Census and Economic Information Center (CEIC). Data for Pakistan’s imports, CIF and exports, FOB from partner countries were collected from the Direction of Trade Statistics (DOTS). The data for bilateral tariffs were obtained from World Integrated Trade Solution (WITS), World Trade Organization (WTO), United Nations Conference on Trade and Development (UNCTAD), and Trade Analysis Information System (TRAITS). Data for selecting the ranges in the simulation process for uncertainty in time delay cost are taken from International Monetary Fund (IMF) and World Bank Doing Business.

3.4. Empirical estimation and robust regression model

3.4.1. Linear dynamic panel gravity model

According to Roodman (2009), a short panel linear dynamic panel model of Eq. (5) can be modified as follow,

\[ ExpPakt = \alpha_{t} + \beta X_{i} + \epsilon_{t} \quad t = 1, 2, ..., T; \]

where \( \theta = 1 \times M \) and \( \beta = M \times 1 \), \( \alpha_{i} \sim \text{IID} (0, \sigma_{\alpha}^{2}) \) and \( \epsilon_{it} \sim \text{IID} (0, \sigma_{\epsilon}^{2}) \) independent among themselves and each other. Given the preceding conditions there exists a problem of serial correlation because of \( \text{ExpPak}_{t-1} \); that is the dependent variable’s first lag and heterogeneity amongst cross-sections in Eq. (12). Thus, the estimation through OLS leads to inconsistent estimates of \( \theta \) and \( \beta \), as the lagged dependent variable is related to \( \alpha_{i} \) and with stochastic error terms. Therefore, this study has been based on the fixed effect estimation technique considering \( \alpha_{i} \) as a fixed effect \( (|\theta| < 1) \). Furthermore, there is no problem with serial correlation as the panel is small.

The central issue in former studies has been the efficiency and accuracy of classical estimators in the fixed effect dynamic panel model. The problem of dynamic panel bias arises when the model includes lagged endogenous variables in presence of an individual and time effects, i.e., the correlation between \( \text{ExpPak}_{t-1} \) and \( \alpha_{i} \) makes the former variable endogenous, leading to inconsistent estimates (Egger, 2002). Therefore, this study suggests an instrumental variable (IV) technique to deal with the problem of endogeneity that arises due to lagged dependent variable. However, IV estimation techniques have its shortcomings. Its estimates are not accurate and efficient, especially when a model is overidentified; that is, the number of parameters is less than the number of moment conditions (Balaghi, 2005).

An appealing advantage of the GMM estimators is the internal instrument availability, i.e., the previous realizations (lagged values) of endogenous regressors are used as instruments, conditional on the accuracy of moment conditions. According to Baltagi (2005), GMM can be used as a treatment to overcome the shortcomings of the classical linear dynamic panel estimators. Roodman (2009) also contended that dynamic panel data estimators are best suited for a linear functional association when dynamic variables depend on their lagged values. They are explanatory variables that are not strictly exogenous and have a presence of endogeneity, short panels, fixed effects, serial correlation, and heteroskedasticity.

3.4.2. Generic linear GMM estimation

The model in Eq. (12) is overidentified if the number of regressors is less than the number of instruments \((L > M)\). To satisfy the moment conditions the vector of the empirical moment is defined as,

\[ \frac{1}{N} \sum_{t=1}^{T} Y_{it} \]

where the residual vector is represented by \( \epsilon \) and positive definite weighting matrix \((W)\) is symmetric and is \( L \times L \) matrix which can be used to define moment function in quadratic form; as,

\[ J(\tilde{\gamma}) = \frac{1}{N} \sum_{i=1}^{N} Y_{i} \frac{1}{N} \sum_{i=1}^{N} Y_{i} = \frac{1}{N} W Y W\epsilon \quad \text{(13)} \]

To minimize the \( J(\tilde{\gamma}) \), it is feasible to exclude \( b_{0} \) since omission of \( b_{0} \) does not alter the estimate of \( \tilde{\gamma} \) that minimizes \( J(\tilde{\gamma}) \) which can be written as

\[ J(\tilde{\gamma}) = \epsilon^T W Y W \epsilon \]

where \( J(\tilde{\gamma}) \) is defined by GMM criterion and the GMM estimator can be written as

\[ \tilde{\gamma}_{GMM} = \arg \min J(\tilde{\gamma}) = \left( \frac{1}{N} W Y W \epsilon \right)^{-1} \frac{1}{N} Y \epsilon \]

where \( Y \) indicates the instrumental variables and \( X \) shows the independent variables.

Balaghi (2005) argued that the efficiency of GMM estimators depends on the choice of an optimal weighting matrix which requires major consideration. The equation below indicates the covariance matrix of the moment conditions \( P \), which is used to define the weighting matrix based on the inverse of their covariance matrix; as,

\[ P = \frac{1}{N} E(Y \epsilon \epsilon^T Y) = \frac{1}{N} E(Y H Y) \]

An optimum weighting matrix that produces efficient GMM estimates is based on the inverse of a variance-covariance matrix (Hansen, 1982). The optimal choice is \( W_{GMM} = P^{-1} = (Y H Y)^{-1} \), and the corresponding GMM estimator is given as follow,

\[ \tilde{\gamma}_{GMM} = \left[ X Y (Y H Y)^{-1} X \right]^{-1} X Y (Y H Y)^{-1} Y \epsilon \]

Therefore, the feasible efficient GMM (FEGMM) estimator turn out to be

\[ \tilde{\gamma}_{FEGMM} = \left[ X Y (Y H Y)^{-1} X \right]^{-1} X Y (Y H Y)^{-1} Y \epsilon \]

where \( H \) produces consistent estimates of \( H \).

3.4.3. Two-step GMM system model estimation

Before the system estimation, the model applied to estimate the linear dynamic panel gravity model was the first difference model, has been confirmed by Blundell and Bond, 1998. However, such transformation of the model as done in Eq. (12) results in loss of information (Blundell and Bond, 1998). It is, therefore, feasible to utilize system estimation to avoid information loss from the transformation. Additionally, it helps in incorporating more restrictive assumptions. Such assumptions create extra orthogonal conditions that enable the availability of more valid IVs and attain efficiency advantages.

The system GMM model that utilizes the \( \Delta \text{ExpPak}_{t-1} \) for level equation as an instrument, in addition to \( \text{ExpPak}_{t-1} \) as an instrument for the first difference model, has been confirmed by Blundell and Bond, 1998. The assumption \( E(\Delta \epsilon_{t} | \alpha) = 0 \) for \( i = 1, 2, ..., N \) and \( t = 3, ..., T \) necessitate that individual effect and variations in residual are not associated with each other. It implies that the model has \( T - 2 \) extra linear orthogonality conditions that is \( E(\epsilon_{t} | \alpha, \Delta \text{ExpPak}_{t-1}) = 0 \). This additional condition
enables us to use $\Delta \text{Exp}_{t-1}$ as an instrument for the level equation. Nevertheless, a system model using a two-step system GMM estimator combining the level and first difference model is recommended by Blundell and Bond (1998).

\[
\frac{\Delta \text{Exp}}{\text{Exp}} = \theta \left( \frac{\Delta \text{Exp}_{t-1}}{\text{Exp}_{t-1}} \right) + \beta \left( \frac{\Delta X}{X} \right) + \frac{\Delta \varepsilon}{\alpha + \varepsilon}
\]  
(16)

The system model given in Eq. (16) can be estimated with GMM based on two types of the instrument; that is, $Y_i$ as an instrument for level model and $Y = Y^2$ as an instrument for the first difference model; such that,

\[
Y_i^1(Y_i^{1x}, Y_i^{1y}) Y_i^{exp} = \begin{pmatrix}
\text{EXP}_{0} & 0 & 0 & 0 & 0 & 0 \\
0 & \text{EXP}_{0} & \text{EXP}_{1} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \text{EXP}_{0} \\
0 & 0 & 0 & 0 & 0 & \text{EXP}_{t-2}
\end{pmatrix}
\]

\[
Y_i^2 = \begin{pmatrix}
X_{02} & 0 & 0 & 0 & 0 & 0 \\
0 & X_{03} & \ldots & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \text{EXP}_{t-2}
\end{pmatrix}
\]

\[
Y_i^3 = \begin{pmatrix}
\Delta \text{EXP}_{2} & 0 & 0 & 0 & 0 \\
0 & \Delta \text{EXP}_{3} & \text{EXP}_{1} & 0 & 0 \\
\vdots & \ddots & \ddots & \ddots & \ddots \\
0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0
\end{pmatrix}
\]

\[
Y_i^4 = \begin{pmatrix}
Y_i^2 & 0 \\
0 & Y_i^1
\end{pmatrix}
\]

where the first row relates to $t = 3$ up to $t = T$ and $Y^P$ shows the IVs for GMM estimator based on the system model. The additional moment constraint is

\[
E(Y_i \hat{\varepsilon}_i) = 0 \text{ with } \hat{\varepsilon}_i = \begin{pmatrix} \varepsilon_{0} \\ \varepsilon_{t} \end{pmatrix}
\]

The system model comprises two equations. The first equation is focused on the first difference and is based on $T - 2$ stacked equations. The second equation is based on $T - 2$ stacked level equations for $t = 3, \ldots, T$. Hence, the system GMM parameter can be calculated as follow:

\[
\tilde{\gamma}_{\text{GMM system}} = \left( \frac{\theta}{\beta} \right) = \left( [\Delta \text{EXP}_{-1}, \Delta X] Y^P W Y^P^\prime [\Delta \text{EXP}_{-1}, \Delta X] \right)^{-1}
\]

\[
[\Delta \text{EXP}_{-1}, \Delta X] Y^P W Y^P^\prime \Delta \varepsilon
\]  
(17)

Blundell and Bond (1998) defined the preliminary conditions of assumptions that should be satisfied for the validity of the system estimator. They also developed moment conditions for the level and first difference equations as instruments for the validity of additional moment conditions even when instruments are weak.

The most recent lag of the first difference is used in system GMM as IVs in the level equation. However, studies are also utilizing level lag as instruments for first difference equations. In this regard, Blundell and Bond (1998) argued that the utilize of additional first difference lagged values result in redundancy of the moment conditions. The literature emphasizes the importance of the selection of the definite weighting matrix for single-step GMM and as the first step in two-step GMM. Windmeijer (2005) noticed that the performance of two-step GMM is superior to the single-step GMM as the two-step GMM has lower standard errors (SEs) and has low bias. Thus, quite accurate SEs are produced by the two-step GMM model.

Roodman (2009) asserts that Stata commands are replicated for the specified model as far as the empirical application is concerned. Roodman (2009) developed xtabond2 codes for GMM estimation in Stata and discussed the proper methodology that needs to be followed for the estimation of GMM in Stata. The short panel is more appropriate in cases when the number of time-series observations is sufficiently large. It makes the dynamic model panel bias insignificant; and hence, traditional, or standard fixed effect is applicable. On the other hand, assumptions such as no cross-correlation among individuals and in the error terms for the robustness of the SEs and autocorrelation test, hold if time dummies are included in the estimation. Finally, the researcher is required to report to all specifications among the alternatives available choices, such as one-step or two-step GMM, system or difference GMM, orthogonal deviations or first difference, and Windmeijer-corrected or non-robust.

3.5. Specification tests

3.5.1. Test for the validity of instrument

(Sargan, 1958) and Hansen (1982) proposed the test for the non-existence of relationships concerning idiosyncratic error terms and IV. Furthermore, the strength of association among residual and IVs depends on the choice of IVs. Additionally, even a negligible correlation also makes estimates inconsistent (Blundell and Bond, 1998). Likewise, weak IVs have very significant detrimental effects, as recognized by Baltagi (2005). Therefore, for consistent estimates the model should have IVs, should be valid and relevant, and the issue of over-identification restrictions (OIR) needs to be solved. Sargan (Hansen) OIR test is as follow,

\[
m = \Delta \hat{U} Y \left[ \sum_{i=1}^{N} Y_i (\Delta \hat{U})(\Delta \hat{U})^{-1} \right] Y (\Delta \hat{U}) \sim x^2_{L-M}
\]

where the number of columns of $Y$, is given by $L$, and the idiosyncratic error term of two-step estimation is shown by $\Delta \hat{U}$.

$\Delta \varepsilon$ adheres to MA (1) process under no serial correlation assumption, and level lagged dependent variable series from $t – 2$ to $t – T$ are assumed to be valid IVs for the estimation of the model. If there is a problem of serial correlation; that is, $\varepsilon_{i,t-1}$ is serially correlated then IVs are not valid. Thus, we can test the $H_0$ of serially uncorrelated errors by assessing the deviation amongst Sargan and Hansen statistics related to two IVs; that is, $Y_i$ based on IV described by the $\text{EXP}_{t-2}$, $\text{EXP}_{t-3}$, $\text{EXP}_{t-4}$ and $\text{EXP}_{t-7}$ and $Y_i$ based on IV that does not depend on the assumption of $\varepsilon_{i,t}$ are serially uncorrelated. To improve the power of the test, we need to be more precise for alternative hypotheses and then test $H_0$ against $H_1$ and denote the difference by $DQ_{i,t}$; that is Sargan and Hansen statistics. $DQ_{i,t}$ has $\chi^2_{L-M}$ distribution under $H_0$, where $P_0$ and $P_1$ indicate the number of IVs in $Y_0$ and $Y_1$, respectively.

3.5.2. Test for absence of serial correlation in the error term

The use of the first difference of endogenous variables and lagged values as IVs is overshadowed by the presence of serial correlation in the error term. Therefore, it is critical to test for $H_0$ to be serially uncorrelation against the alternative hypothesis. A test based on the result of the first difference model is proposed by Arellano and Bond (1991). Assume a vector of the error term in first difference model shown by $\Delta \hat{\varepsilon}$. $\Delta \hat{\varepsilon}$ be its second lag, and $\Delta \hat{\varepsilon}^\prime$ be the decline in $\Delta \hat{\varepsilon}$ which allows multiplication of $\Delta \hat{\varepsilon}^\prime$ and $\Delta \hat{\varepsilon}$. The importance of order two serial correlation is provided by this measure once the first difference model is written. Model does not have a serial correlation of order if error terms have no serial correlation, assuming $\Delta \hat{\varepsilon} = \hat{\varepsilon}_{t} - \hat{\varepsilon}_{t-1}$ follows an MA (1) process. On
4.2. Trends in total trade costs and export growth

The total costs of trade values significantly fluctuate along with the value of elasticity of substitution. These calculated costs of trade values consequently can be used to evaluate fluctuations over time in trade costs. The average (from 2003 to 2018) bilateral total trade costs and trade costs associated with policy barrier measures have been provided in Table 2.

Table 2 represents a declining trend in the total trade costs globally. The results illustrate that a continued historic declining trend in total trade costs is certainly one of the fundamental reasons behind the increase in trade flows around the world, with approximately every country trading today for more than a decade. The UNCTAD (2015) discoveries showed that the rate of export growth for worldwide trade rises (add up to around US$ 19.5 trillion in 2018, while in contrast, it was approximately US$ 6.45 trillion in 2000). On the other hand, the results represent that in the comparison of worldwide the rate of decreasing trend in total costs of trade is low for Pakistan.

Table 2 shows that comparatively worldwide the declining trends of total costs of trade were almost 63% less for Pakistan. As a result, Pakistani exports are also growing very slowly in the world market because of the higher costs of trade. Larger costs of trade lower down the speed of export growth. In the world market, Pakistan’s export growth rate (as a % of GDP) declined around 15.17% in 2003 to approximately 8.97% for 2018 respectively. It indicates that the exports of Pakistan become expensive in terms of moving from one destination to another destination due to additional costs of trade.

4. Findings and analysis

4.1. Descriptive statistics

The explanatory analysis represents the quantitative description of the main features of the data used in the study. Table 1 provides summary statistics of Pakistan’s bilateral export flows regarding the trade costs’ components included in the study. Table 1 shows that for the economy of Pakistan overall bilateral export flows remain 5.08 percent on average with the maximum level of 9.15 percent and the minimum level continued at 1.07 percent. The estimated value of standard deviation at level 1.38 represents a small fluctuation in the data from their mean value.

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The result represents that the falling trend of trade costs is also lower relative to developed partner countries of Pakistan, like for the United Kingdom, the United States, and Germany it was 59%, 61%, and 58% correspondingly lesser. Along the same line, Pakistan’s bilateral exports (% of total exports) flows in 2003 went to the United States, the United Kingdom, and Germany were about 23.06%, 7.06%, and 5.10% respectively. In 2018, it becomes lesser for the United States to approximately 16.09%, a slight rise for the United Kingdom by about 7.32% and a little increase for Germany around 5.55% respectively for the same partner countries. The trends of bilateral export flows represent that Pakistan can enhance its exports share with these partners by reducing efficient way more total costs of trade. Anderson and Van Wincop (2004) finding the existence of higher trade costs even among larger trade partner countries also support these results.

Moreover, in parallel to developing partner economies like China and India, the decreasing trend of costs was about 43% and 36% correspondingly smaller. In response to these trends, bilateral exports (% of total exports) flow of Pakistan with them in 2003 was 0.70% and 2.18% correspondingly. In 2018, a slight increase of bilateral export shares with them approximately 1.62% and 7.69% individually. Pakistan has more potential by increasing its bilateral export share with these neighboring trading partners via more efficiently minimizing higher costs of trade. According to results, the higher total trade costs as one of the major reasons behind the drastic decline or a little increasing trend of the bilateral export growth rate of Pakistan with its major trading partners. The relative position of the country is deteriorating as the costs of trade for the rest of the globe are falling more rapidly than in Pakistan (Table 2).

Figure 1 also illustrates the empirical facts that the higher costs of trade in the case of Pakistan lower the share of exports to partner countries. As a first glance at the data, Figure 1 shows that due to different levels of their costs of trade the greater share of export almost 70%–80% is going to limited trading partner states (China, UK, USA, U.A.E, Bangladesh, Afghanistan, Spain, Germany, France, and Italy).

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3 Based on the literature review the elasticity of substitution set equal to 8. See Jacks et al. (2008) for more details.

4 Data is available: https://databank.worldbank.org/source/world-deve-lopment-indicators.
Consequently, the disparity in the costs of trade for different states causes the disparity of export shares to them. This indicates that traded commodities are no longer exported to these partners with whom costs of trade are high, this is true for many partner states. For that reason, the maximum portion of exports to trading partner territories is under the forty-five-degree line (Figure 1).

This suggests that larger trade costs are slowing the rate of export growth and isolating Pakistan from the world export market. Even though trade costs have decreased over the last decades, their significance has enriched with the flow of scrappy supply and more competition among developing countries. The rate of a slowly decreasing trend in costs of trade for developing countries is due to larger constraints of trade, strict approval procedures, political uncertainty, worldwide volatilities in trade barriers, and visa problems (Kee et al., 2008). Another several reasons in the less declining trend of trade costs like limited/not much liberalization of trade, the uncertainty of exchange rate, less technology, limited trade assistance, insufficient energy delivery/resources, no corporate tax policy, and poor quality of infrastructure.

4.3. Trends in trade costs associated with tariff barriers (TBs) and export growth

Policy barriers often raise the cost of tradable goods by imposing taxes, customs duties, applied tariffs, insurance, and other border taxes, and fees, as they move through the measures associated with modern supply chains. Even after liberalization, tariffs still become a burden for many of the developing country’s trade policies and impose costs, such as Pakistan is still a high tariff upholding economy.

Pakistan is unable to boost its export sector with the rest of the world by rising cascading-based tariff slabs, retaining higher tariffs and taxes on imported inputs, raw materials, equipment, intermediate and capital goods, in addition to customs duties and regularity duties. Along the same line as Corden (1966), increasing costs of inputs and production for exporters by a greater rate of import tariffs have adversely affected the export growth of Pakistan. The domestic industry is faced with import tariff costs ranging from 3% to 20% for imports of machinery and industrial raw materials (GoP, 2018).

In quantification of tariff barriers related to costs for Pakistani exporters levied by partner countries and domestic tariff policies, Table 3 shows the declining trend but with a minor rate. The trade costs associated with TBs have decreased over the past decades because of tariff liberalization, free trade agreements, and trade policies. But their influence through cost accumulation is expected to become stronger and increasing, mainly for the exported products, and make systematic losses.

Results illustrate that the level of declining tariff-related trade costs for developed partner countries is less than the average tariff trade costs declining rate of Pakistan. Like the United States, the United Kingdom, and Germany decreasing rate of tariff-related costs was nearly 6.07%, 6.43%, and 3.21% respectively less than the average rate (Table 3). However, Pakistan’s biggest export markets exemplified by its three major developed trading partners are not regional neighbors. One of the main reasons for this is the status of GSP + which allows Pakistan to enter the European market duty-free and preferred rates of 70%. A falling rate while with a smaller ratio of trade costs related to TBs presents an idea about increasing export share in the global export market boosting more liberalizing and bilateral free trade agreements with them.

Table 3 indicates that the rate of trade costs related to TBs are decreasing with a small ratio in the assessment of developing trading partners like China, India, Afghanistan, Sri Lanka, and Bangladesh. The decline rate of the costs related to TBs for these countries was around 61.80%, 79.04%, 67.37%, 74.19%, and 73.51% respectively less than the average decreasing rate of TBs related costs. One of the main reasons for this decreasing trend of TBs related trade costs is becoming a member of the Economic Cooperation Organization (ECO) and South Asian Association for Regional Cooperation (SAARC). Consecutive series of mutual trade concessions have also facilitated significantly to reduces the costs of trade particularly related to TBs. Multilateral talks under the auspices of WTO and GATT have reduced tariffs for Pakistan over the past two decades. Pakistan with developing trading partners has signed many Free Trade Agreements (FTAs), South Asian Free Trade Areas (SAFTAs) and Preferential Trade Agreements (PTAs) to eliminate tariffs, quotas, and other trade barriers.

However, exports should not flow freely between partner states, not even between those with friendly relations in Pakistan. Nonetheless, the potential incomes of more dismantling tariff barriers for partner nations in Pakistan are significant. Table 3 indicates that there could be larger export flows, particularly in neighboring partner countries, if tariffs for Pakistani exporters (on exported commodities) are lower. Additionally, to put the state on the path to the long-term growth of export, import tariffs on medium-sized intermediate commodities and machinery should be abolished in the short to medium term. Instead of depending on the rate of tariff increases and additional tariffs on imports, a better domestic policy option is to increase the Collection Efficiency Factor (CEF) through transformations for automatic risk-based accounting. It is defined by the
likelihood of rating and the penalty of underpayment, and the delay in implementation suggests that the current policymaker defines the efficiency of the tariff system for the future (Aizenman and Jinjarak, 2008).

4.4. Trends in trade costs related to non-tariff barriers (NTBs) and export growth

The contribution of NTBs to total trade costs has become more evident and more important. With the lowering of TBs over the past decades, awareness is growing that NTBs are imposing new restrictions on trade, especially with the rising importance of global trade. According to World Integrated Trade Solution (WITS), more trade costs other than tariff barriers faced by exporters are induced by NTBs, namely lengthy border clearance procedure, export registration requirements, permit requirements to export, labeling requirements, export technical measures, licensing for non-economic reasons, dealings of partner country’s customs, certification, imposition, and application of standards requirement from partner countries.

Trade costs related to NTBs are found to be more than double in comparison to tariff’s trade costs (Table 4). The increasing trade costs related to NTBs between 2003 and 2018 for Pakistan are rising. Table 4 shows this increasing trend along with its major trading partners. According to a report by the Federation of Pakistan Chambers of Commerce and Industry (FPCCI), a Pakistani exporter wishing to export a normal container filled with goods would have to spend $257 on paper obedience and $406.4 on border obedience, in total $663.4 of other than tariff barriers costs. However, its neighbor and partner countries like India, exporters spend much lower at $474 for shipping similar containers. An exporter from Bangladesh spends almost $633 less than its Pakistani counterparts, while an exporter from Sri Lanka spends the lowest of the four countries at $414. This indicates that the costs of trade related to NTBs restrict the exports growth of Pakistan in the world export markets.

### Table 3. Bilateral trade costs related to TBs of Pakistan with major partner countries.

| Year | Average trade costs of TBs | USA | UK | Germany | China | Afghanistan | India | Sri Lanka | Bangladesh |
|------|---------------------------|-----|----|---------|-------|-------------|-------|-----------|------------|
| 2003 | 13.88 | 11.15 | 9.51 | 8.98 | 14.77 | 10.73 | 20.76 | 14.33 | 20.96 |
| 2004 | 12.96 | 10.60 | 9.45 | 8.88 | 13.78 | 10.70 | 20.19 | 14.27 | 19.64 |
| 2005 | 12.82 | 10.13 | 9.35 | 8.78 | 12.61 | 10.68 | 15.41 | 14.01 | 18.68 |
| 2006 | 12.81 | 10.01 | 9.29 | 8.68 | 11.53 | 10.25 | 15.40 | 12.31 | 18.04 |
| 2007 | 12.71 | 10.01 | 9.26 | 8.67 | 10.66 | 10.29 | 14.83 | 10.80 | 17.97 |
| 2008 | 12.12 | 9.96 | 9.20 | 8.51 | 10.33 | 9.88 | 14.40 | 10.54 | 17.85 |
| 2009 | 12.01 | 9.81 | 9.20 | 8.45 | 10.31 | 9.88 | 13.12 | 10.23 | 17.82 |
| 2010 | 11.99 | 9.81 | 9.18 | 8.30 | 10.15 | 9.52 | 11.14 | 9.53 | 17.61 |
| 2011 | 11.80 | 9.77 | 8.80 | 8.29 | 9.82 | 9.29 | 11.13 | 7.84 | 17.29 |
| 2012 | 11.79 | 9.73 | 8.24 | 8.18 | 8.08 | 9.25 | 10.69 | 5.85 | 17.41 |
| 2013 | 11.67 | 9.64 | 8.04 | 7.78 | 7.84 | 9.25 | 8.61 | 5.45 | 16.35 |
| 2014 | 11.47 | 9.63 | 7.70 | 6.80 | 7.69 | 9.24 | 7.95 | 5.06 | 14.32 |
| 2015 | 11.47 | 9.10 | 7.10 | 6.56 | 7.57 | 9.18 | 7.73 | 5.00 | 11.67 |
| 2016 | 11.10 | 9.00 | 7.00 | 6.28 | 7.55 | 9.07 | 7.62 | 4.34 | 11.22 |
| 2017 | 11.09 | 8.66 | 6.98 | 6.28 | 7.54 | 8.71 | 7.59 | 3.60 | 11.22 |
| 2018 | 11.08 | 8.52 | 6.89 | 6.27 | 7.44 | 8.58 | 7.40 | 3.48 | 10.39 |

Source: Authors’ calculation.

### Table 4. Bilateral Trade Costs related to NTBs of Pakistan with Major Trading Partner Countries and World.

| Year | Average trade costs of NTBs | USA | UK | Germany | China | Afghanistan | India | Sri Lanka | Bangladesh |
|------|-----------------------------|-----|----|---------|-------|-------------|-------|-----------|------------|
| 2003 | 221.87 | 99.26 | 103.11 | 108.95 | 100.33 | 68.81 | 109.60 | 105.88 | 104.81 |
| 2004 | 222.49 | 103.64 | 106.49 | 110.64 | 105.85 | 72.29 | 112.34 | 97.83 | 104.96 |
| 2005 | 225.05 | 107.29 | 106.74 | 116.31 | 106.06 | 72.30 | 113.06 | 97.84 | 104.17 |
| 2006 | 227.38 | 107.87 | 107.07 | 116.47 | 106.22 | 74.39 | 114.84 | 99.39 | 105.02 |
| 2007 | 235.34 | 108.10 | 109.26 | 116.76 | 107.66 | 74.39 | 117.87 | 104.46 | 105.51 |
| 2008 | 236.04 | 109.09 | 109.83 | 118.77 | 109.13 | 75.92 | 122.05 | 109.39 | 106.17 |
| 2009 | 236.10 | 109.11 | 111.29 | 118.87 | 109.40 | 77.05 | 124.69 | 114.06 | 106.60 |
| 2010 | 240.40 | 109.80 | 112.42 | 119.40 | 109.51 | 77.07 | 127.35 | 114.44 | 107.59 |
| 2011 | 241.95 | 111.34 | 112.96 | 120.94 | 110.47 | 77.49 | 128.56 | 115.88 | 107.73 |
| 2012 | 243.08 | 112.57 | 113.38 | 122.32 | 111.40 | 77.62 | 133.24 | 126.22 | 109.56 |
| 2013 | 245.08 | 117.57 | 114.33 | 122.85 | 111.27 | 78.78 | 136.12 | 126.34 | 113.11 |
| 2014 | 247.30 | 120.22 | 114.41 | 122.90 | 112.14 | 79.88 | 136.52 | 128.77 | 124.50 |
| 2015 | 248.97 | 121.98 | 114.90 | 123.06 | 112.17 | 80.21 | 138.19 | 133.29 | 133.92 |
| 2016 | 250.38 | 122.41 | 116.12 | 124.53 | 113.48 | 85.38 | 138.03 | 134.24 | 134.87 |
| 2017 | 252.87 | 122.81 | 116.84 | 125.08 | 113.76 | 86.45 | 139.40 | 137.84 | 136.19 |
| 2018 | 255.79 | 124.49 | 119.00 | 125.67 | 119.73 | 89.29 | 140.53 | 139.75 | 136.52 |

Source: Authors estimation.

Note: The costs of trade are estimated in the form of ad valorem equivalent.
Another key outcome of this study is that the growth rate of costs of trade related to NTBs in emerging markets is higher than in developed partner countries, apart from the USA. According to Table 4 average increase in a trend of costs of trade related to NTBs as compared to developed partners like the United States, the United Kingdom, and Germany indicated almost 25.62%, 53.15%, and 50.71% respectively was greater.

In developing countries such as China, India, Afghanistan, Sri Lanka, and Bangladesh, the increasing trend in the average costs of trade associated with NTBs has been around 42.81%, 8.81%, 38.62%, 0.15%, and 6.52%, respectively large (Table 4). Results represent that except for China and Afghanistan this rising trend was near to the average increasing trend of trade costs associated with NTBs for emerging partner countries of Pakistan.

Deprived connectivity, fewer trade facilities, lesser favorable concession agreements, and a strict safety standard make the costs of trade related to NTBs a major challenge for Pakistan and make its exported commodities more expensive, especially in neighboring countries. Higher trading costs associated with NTBs, not the only costs that reduce the exports of Pakistan in the global market, but also show that the major achievements of bilateral free trade agreements, FTAs, and the liberalization of Pakistan's economy have not fully resulted in trade gains. This rising trend of trading costs related to NTBs more increases the total trade costs and probably reduces Pakistan's prospects/probabilities for new investment and trade. Pakistan often has difficulty accessing international export markets due to the higher costs of trade, mostly correlated to NTBs.

Therefore, the propensity to increase the bilateral exports of Pakistan would be higher with a reduction of costs associated with NTBs. The Policy plans of going well outside the boundaries of traditional trade policies must be addressed. It is a required policy framework that includes lowering the costs of trade led by NTBs. Regarding this, it is worth noting the remarks made by the UNCTAD Secretary-General Mukhisa Kituyi (2019): ‘trade costs other than tariff barriers were substantially decreased by merely shifting to paperless trading and cross-border electronic information exchange.

4.5. Econometric/empirical analysis for dynamic panel gravity model

The robust regression outcomes for the linear dynamic panel gravity model to evaluate the effects of trading costs’ components for two-sided flows of export is calculated by using a two-step system GMM estimation approach (see Table 5). All variables in natural logarithms measure their elasticity by estimated coefficients.

The inclusion in a model of a lagged endogenous variable leads to dynamic panel bias as the association with lagged regress and variable makes former endogenous, so the results are inconsistent (Roodman, 2009). To solve the endogeneity of the lagged regress and variable (as covariates along with the error term and explanatory variable), Windmeijer (2005) proposed a two-step system, the GMM model. They are general estimators that are calculated for the conditions of small-time (T) and large individuals (N), where independent variables are not strictly exogenous (it means they correlate with the past and current value of error term), fixed effects, heteroscedasticity, and presence of autocorrelation within individuals.

The result shows that bilateral exports from Pakistan are positively and significantly influenced by the economic sizes of both exporting and partner countries. The coefficients of economic sizes were observed to be steadily significant at the level of 1 percent. The positive sign represents the same line of theoretical prediction of gravitational trade flows, which anticipates that trade level will improve with a rise in the economic sizes in exporting and importing countries. The estimated coefficient of GDP suggests that the 1 percent rise in the economic size of the partner state will result in a rise of about 0.47 percent in the export flows of Pakistan. The findings are in the same line with Hassan, 2019 outcomes. Using the gravity model this study found that trade flows between developed states and the GCC states are positively related to their economic size.

The highpoint of the empirical findings is the robust effect of the components of costs of trade on exports. The greater costs of transport, tariff, time instability (delay), and efficiency of infrastructure exchange between each pair of countries, and lesser the exports of Pakistan. Results show that all these variables characterizing costs of trade are statistically significant and have an expected negative sign, consequently indicating the appropriate correlation between bilateral exports of Pakistan and trade cost components.

The estimated coefficient of TBs-related trade costs significantly decreases the bilateral exports by about 0.24 percent, respectively. Tariff's trade costs always act as an obstacle to export thus hampering exports of Pakistan. Its tariff rates and other taxes on exporters needed to be cut substantially. Thus, Pakistan and its trading partners must assume their responsibilities in reducing their tariffs to boost up exports. Bonariva et al. (2009) and Lashkaripour (2021) found that the costs of tariff barriers in the processing of trade are more vulnerable and restrict the developing countries to trade in global markets.

Other components of trade costs such as the costs of poor quality of infrastructure have a huge effect on international export flows. This relationship is subject to the physical location costs, the quality, and the availability of infrastructure costs. The result shows that the higher costs on account of weak infrastructure quality in both partner countries and Pakistan's is consistently significant at the level of 1 percent and harm the bilateral exports. It is to say that a 1 percent rise in trade costs due to poor quality of infrastructure in partner countries indicates a 0.72 percent decline in the exports of Pakistan, while a 1 percent rise in the trade costs due to poor quality infrastructure causes a 0.89 percent decline in Pakistan’s exports.

Thus, poor quality of infrastructure inflicts a heavy toll on export competitiveness resulting in loss of exports opportunities. The empirical research indicates that an improvement in infrastructure efficiency increases bilateral trade flows. Hasan and Raza (2015) found that almost 60 percent of the road network in Pakistan is in poor condition due to inadequate maintenance and vehicle overloading. The share of national highways and motorways in Pakistan's total road network is only 4.2 percent, but they cater to 90 percent of Pakistan's total traffic (GoP, 2006). Tassew et al. (2021) and Bougheas et al. (1999) also discovered a substantial impact of location deformation and infrastructure for bilateral trade. Poor quality of roads not only raises the cost of production but also retards the much-needed connectivity in the movement of goods. Needless to say, better infrastructure quality generates additional prosperity/income by lowering the trade costs especially because of its non-competitiveness and non-biased features.
The estimates of uncertainty costs associated with time (day) delays in exports represent a strongly significant negative effect on the bilateral exports of Pakistan. The estimated coefficient shows that a rise in costs associated with uncertainty (delay time) led costs reduces bilateral exports by 0.57 percent. It is worth noting that due to poor border management procedures, trucks lose more time when crossing borders than during transit. This introduces many different costs for exporters such as costs of rescheduling, delays due to roadblocks and large numbers of checkpoints, and periodic hijacking often contributes to extremely erratic truck arrival times at the sea or airports (Christ and Ferrantino, 2011). Hummels and Schaur (2013) also found that the delay of one day reduces the 2 percent exports of goods and longer delays reduce the exportability of the countries to export to the international market.

Moreover, with an inadequate port warehouse capacity, trucks might be contributed themselves as ad hoc warehouses before the arrival of the ship, revealing commodities to the risk of loss of quality and even theft, and drivers might be required to pay extra for sustenance and lodging in the port city whereas waiting for the ship. For Pakistani exporters, the effect of time uncertainty is relatively high than its competitors due to poor infrastructure, roads, hurdles of customs, clearances, tax, and administrative processes. Djankov et al. (2010) estimated that time delays discourage exports more than one percent of developing countries.

The most persuasive outcome is the greater effect of transaction costs on bilateral exports, i.e., the greater the costs of the transaction between partner states, the lesser the exports (by 0.77 percent). To put it another way that transaction costs between trading partners would undoubtedly decrease Pakistan's exports by a very large proportion. This higher cost of transportation is a major obstacle for exporters by making the export process slow and costly. Reducing transaction costs enhances Pakistan's ability to broaden its export markets. The inefficiencies of Pakistan's transport sectors reduced total factor productivity and the volume of international trade (Ahmed et al., 2013). That is why Pakistan's transportation systems needed to increase their capacity, productivity, and lower the cost of the mobility of goods to improve bilateral trade.

Additionally, the export amount in the previous year was found to have a substantial influence on the following year's/year exports. The lagged EXP shows a positive relationship that means the growth of the economy by explaining the relevant roles of different trade cost factors. Furthermore, the export amount in the previous year had a positive impact on recent/present year exports. The assumption is that enhancing export volume in the previous year would increase Pakistan's exports. This research further examines the effects of different trade cost factors on bilateral exports. The observed assessment was presented using trade data for 141 trading partners for the period 2003–2018. The model of system GMM linear dynamic panel gravity was quantified and assessed by using a two-step general method approach to moment estimation.

Empirical findings show that in comparison to other states of the world, Pakistan has experienced the smallest/lowest decline in total trade costs. This lowest decline is due to trade restrictions, political uncertainty, poor infrastructure, roads, hurdles of customs, clearances, administrative, restricted processes for licensing, and the obstacles of visas. These higher costs act as an obstacle for export flows. Since the greatest of the inputs to produce exported commodities are only imported via designated ports and roads, etc., this suggests that there is still considerable scope for further reductions in trading costs.

This paper quantifies the trends of total costs of trade and discovers whether emerging economies like Pakistan had higher or lower trade costs in comparison to the world and other partner countries. And to analyze trends in the trade costs associated with policy obstacles over the years. This research further examines the effects of different trade cost components on bilateral export flows. The observed assessment was presented using trade data for 141 trading partners for the period 2003–2018. The model of system GMM linear dynamic panel gravity was quantified and assessed by using a two-step general method approach to moment estimation.

The over-identification restrictions (OIRs) or the common reliability for instrumental factors must be tested. The study shadowed the traditional GMM test or the Sargan and Hansen test statistics of limitations on over-identification. The outcome of the study is that the model holds valid over-identification conditions (OIRs), or instrumental variables are legitimate. Because the null hypothesis asserts that OIRs are legitimate, this is not rejected.

5. Conclusion and policy implications

This paper quantifies the trends of total costs of trade and discovers whether emerging economies like Pakistan had higher or lower trade costs in comparison to the world and other partner countries. And to analyze trends in the trade costs associated with policy obstacles over the years. This research further examines the effects of different trade cost components on bilateral export flows. The observed assessment was presented using trade data for 141 trading partners for the period 2003–2018. The model of system GMM linear dynamic panel gravity was quantified and assessed by using a two-step general method approach to moment estimation.

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There is a solid empirical suggestion that costs of trade associated with NTBs follow a continuously increasing pattern and is a major reason why trade costs persist obstinately higher, especially for developing countries. Consequently, economies may decline opportunities to participate in the world trade market when exporters consider that the costs of meeting extra market demands are too higher. In the past two decades, there has been a decline in tariffs due to trade liberalization and other free trade agreements. Despite this fact, tariffs still impose costs and need to be reduced further and consider important for international trade.

The findings of this research have major policy implications for the economy of Pakistan, the one that is keen to increase exports and reduce the volume of imports by reducing its total trade costs, by decreasing the costs associated with different components. Findings suggest that poor quality of infrastructure; transport, exchange rate instability, and uncertainty of time (day) delays costs hold a greater share in total trade.
costs and are the main determinants of higher costs of trade for Pakistan in the present context. To lower the costs associated with these components is not only essential to the increasing growth rate of bilateral exports but also a decisive factor in incorporating the participation of emerging economies in the world market.

Therefore, the priority should be to (a) reinforce the chain of necessary trading infrastructure facilities, starting from the point of production to the point of shipment, and related trade facilitation measures; (b) control transaction and uncertainty of time delay costs by consolidating the shipments, reducing in the rates of air and ocean freight, adopting the new and advance technological way for improving in the quality of ship speed and freezing the perishable commodities, etc.; and (c) Pakistan needs to negotiate and further enhance cooperation with trading partners to lower costs of trade.

In that way, regulators develop another significant tool for worldwide cooperation to reduce trading costs. These principles are a long-term goal for Pakistan's economy. The regularity authority can enhance the trading capability of the economy by reducing costs/challenges to meet export market requirements and strengthening the infrastructure.

Declarations

Author contribution statement

Shabana Noureen: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Zafar Mahmood: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

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Data included in article/supplementary material/referenced in article.

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The authors declare no conflict of interest.

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