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TRADE IMPACT OF REDUCING TIME AND COSTS AT BORDERS IN THE CENTRAL ASIA REGIONAL ECONOMIC COOPERATION REGION

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Abstract

Trade facilitation, by reducing trade costs and raising the efficiency of moving goods across borders, is integral to international trade. Using novel data on bilateral time and cost measures for trade facilitation in the Central Asia Regional Economic Cooperation (CAREC) Program, this study estimates the trade impact of reducing time and cost at border crossing points within CAREC. It finds that (i) time taken at an importer border is more influential in promoting trade than at the exporter border, and (ii) at an importer's border, time is a more objective measure than cost in determining trade flow changes. Gravity model estimations show that reducing time at the importer border by 10% increases intraregional trade among CAREC countries by 1.41%. However, simulation results show that trade facilitation only at borders may not be sufficiently effective to lead to broader economic impacts in the CAREC region; rather, holistic approaches at and behind borders are needed.

Keywords: trade costs, Central Asia Regional Economic Cooperation, trade facilitation indicator, gravity model

JEL Classification: C23, F14, N75, R41

Contents

1. INTRODUCTION

Trade facilitation has been integral to international trade because it reduces trade costs and raises the efficiency of moving goods across borders. Broadly speaking, trade facilitation simplifies, harmonizes, and standardizes trade procedures to expedite the flow of goods. Greater trade facilitation is associated with lower transaction time and costs at borders and ports, thereby promoting trade flow efficiency (Portugal-Perez and Wilson 2012; Ismail and Mahyideen 2015). It also fosters a better regulatory environment, which eventually encourages more trade, attracts foreign direct investment (Duval and Utoktham 2014), and hence creates more jobs leading to higher income per capita (Fox, Francois, and Londono-Kenet 2003).

In landlocked regions, such as Central Asia, lower trade gains are observed relative to their coastal counterparts due to the time and cost penalties from being geographically handicapped (Raballand 2003). Landlocked countries have limited participation in external trade and suffer from high trade transaction costs due to a lack of access to the seas and restricted border crossings. Such countries depend on transit-providing countries for goods shipments, which may be constrained by unfavorable political environments and are vulnerable to rent-seeking activities (Arvis, Raballand, and Marteau 2010). Weak institutions and poor infrastructure quality, likewise, may leave transportation costs higher than those of coastal neighbors (Arvis et al. 2011).

Trade costs in Central Asia are also higher than in other Asian regions. Tariff-equivalent trade costs from 2011 to 2016 in Georgia, Kazakhstan, the Kyrgyz Republic, and the Russian Federation were as much as 172.9 percentage points higher than in the East Asia-3 (Japan, the People's Republic of China [PRC], and the Republic of Korea) and 160 percentage points than ASEAN-4 countries (Indonesia, Malaysia, the Philippines, and Thailand) (based on UNESCAP 2018).[1] Although intraregional trade costs in Central Asian countries have declined significantly in the last few years, they are higher by 115.4 percentage points than domestic trade costs. Considering the declining trend of tariffs, the need to address nontariff costs is becoming increasingly important. To promote harmonization and standardization across nations, the role of trade facilitation should be emphasized in addressing a number of nontariff areas: publication and administration of policies related to trade issues, rules and procedures for import and export, product standards and conformance, trade-related infrastructure and services, and goods in transit (ADB and UNESCAP 2013).

Most of the existing literature on Central Asia's trade integration and facilitation highlights the importance of infrastructure. For instance, Grigoriou (2007) finds that imports and exports of Central Asian countries increase most when their infrastructure indicators improve. Moreover, developing the transit infrastructure among neighboring countries is essential in raising intraregional trade in the region. Shepherd and Wilson (2006) also support this conclusion and find in their study that upgrading infrastructure in Albania, Hungary, and Romania can enhance intraregional trade flows within Eastern Europe and Central Asia by as much as 50%.

[1] The differences in trade costs were computed using data from the UNESCAP (2018) report. The data are in terms of tariff-equivalent trade costs or *ad valorem* trade costs, which are expressed as percent relative costs of trading outside the borders (international trading) to trading within the borders (domestic trading).

A few studies have assessed the effects of trade facilitation measures on trade flows in Central Asia, and most find positive effects, with a wide range of impacts. For instance, measuring trade facilitation through the World Bank's Logistics Performance Index, Felipe and Kumar (2012) show that facilitation reforms result in significant gains in Central Asia's trade. Moreover, trade gains vary across countries, ranging from 28% (for Azerbaijan) to 63% (for Tajikistan). Intraregional trade is also found to increase by 100%, with the greatest gains from improvements in infrastructure.

Using trade facilitation indicators specific to Central Asian countries, one can analyze the impact of improved border crossing services on the regional economy and trade in Central Asia. The Corridor Performance Measurement and Monitoring trade facilitation indicators (CPMM TFIs) used in Central Asia Regional Economic Cooperation (CAREC) countries are one such set of indicators. For example, Tanabe, Shibasaki, and Kato (2016) use the data in the Multimodal International Cargo Simulation model for Central Asia and a Computable General Equilibrium model in estimating the effect of infrastructure development on international transportation costs and trade flows in a land transit network. Their study finds that in the short run, improving border crossing services can considerably decrease transportation costs, and hence increase the volume of trade flows.

This paper evaluates the impact of trade facilitation activities on bilateral trade flows in Central Asian countries using an augmented gravity model that employs CPMM TFI data available at the level of border crossing points. As the majority of Central Asia's intraregional trade occurs by road and railway, the cost and time taken at the border crossing points are expected to significantly contribute to higher trade costs, in addition to transit costs such as fuel for trucks and trains. To the best of our knowledge, this study on trade facilitation is the first to use the CPMM TFIs at the border crossing point level. Although Tanabe, Shibasaki, and Kato (2016) used CPMM TFI data, they only incorporated the aggregate *summary* data in setting up parameters for the calibration of their transport network Computable General Equilibrium model.

The results from the estimated gravity models support the usefulness of the CPMM TFIs in explaining trade flow changes within the CAREC region. The main findings are: (i) time in hours, not costs (in dollars), more objectively measures trade facilitation at the border; (ii) a reduction in average time taken at the importer border is more effective than a reduction in average time at the exporter border; and (iii) the estimated impact implies that reducing time at the border by 10% can lead to a 1.41% increase in intra-CAREC trade.

In this paper, Section 2 introduces the CAREC program and the CPMM TFIs and presents the recent trends of the CPMM TFIs. Section 3 explains the methodology implemented (the gravity model approach) and the estimation results. Section 4 discusses policy implications driven by the estimation results and policy issues.

2. BACKGROUND

2.1 Overview of the CAREC Program

The CAREC Program was formally established in 2001 to promote cooperation within the region that could accelerate economic growth and poverty reduction (CAREC 2019). The 11 member countries—Afghanistan, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, the PRC, Tajikistan, Turkmenistan, and Uzbekistan—work with development partners. The program's promotion and facilitation of regional cooperation focuses mostly on regional trade expansion, transport connectivity improvement, and economic corridor development. One unique aspect of the program is the participation of six multilateral institutions: the Asian Development Bank (ADB), the European Bank for Reconstruction and Development, the International Monetary Fund (IMF), the Islamic Development Bank, the United Nations Development Programme, and the World Bank (Linn 2012). ADB is the CAREC secretariat.

The CAREC countries are linked to each other through six transport corridors[2] intended to expand trade and improve competitiveness and thus augment regional cooperation. Agreements among countries were initiated to improve connectivity, such as the development of road and railway networks, and construct physical infrastructure. The activities of the CAREC Program are implemented through its institutional framework, which promotes active participation among the member countries and fosters partnership on policy and project initiatives. Its policymaking and strategy-setting body, the Ministerial Conference, guides overall direction. Operations are monitored by the Senior Officials' Meeting, which also ensures the Ministerial Conference's effective implementation of the policies and strategies (CAREC 2019).

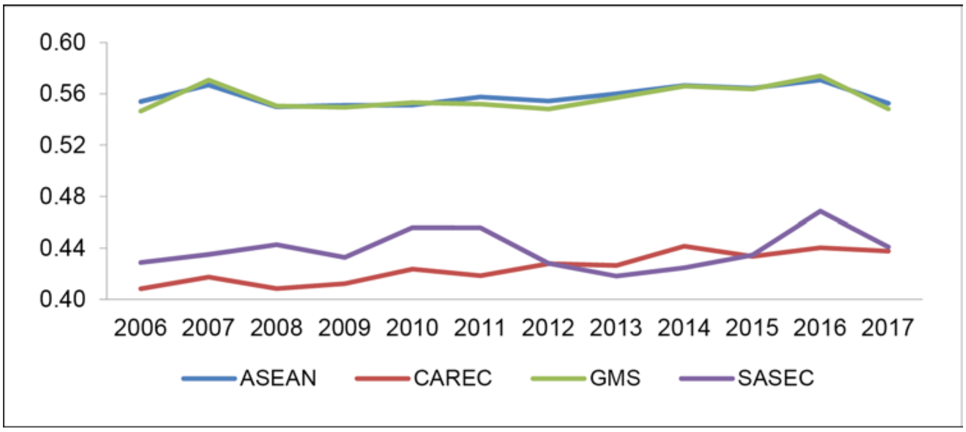
Much of CAREC's investment focuses on transportation—reflecting the importance of increasing connectivity—while trade facilitation has received substantial funding through technical assistance. To support CAREC's goal of regional cooperation through transport and trade facilitation, the Transport and Trade Facilitation Strategy 2020, formulated in 2013, focuses on two of four objectives: expansion of trade and improvement of competitiveness. It aims to achieve three sector outcomes: (i) establish competitive corridors across CAREC; (ii) facilitate efficient movement of goods and people through CAREC corridors and across borders; and (iii) develop sustainable, safe, user-friendly transport and trade networks (ADB 2014a).

Progress is noteworthy in advancing CAREC's efforts on regional integration. Using the Asia-Pacific Regional Cooperation and Integration Index (ARCII) developed by Huh and Park (2018), and Park and Claveria (2018), the CAREC region has made steady progress over the past decade, although it lags behind other subregional initiatives in Asia in terms of its level of integration with other Asian countries (Figure 1). The ARCII measures regional integration on a normalized scale of 0 to 1 in six dimensions: (i) trade and investment, (ii) money and finance, (iii) regional value chains, (iv) infrastructure and connectivity, (v) movement of people, and (vi) institutional and social integration. Compared to the Association of Southeast Asian Nations (ASEAN), the Greater Mekong Subregion (GMS), and the South Asia Subregional Economic Cooperation (SASEC) Program, CAREC is the least integrated region, driven mainly by low scores in movement of people, money and finance, and trade and investment (Figure 2). It performs relatively better than SASEC in infrastructure and connectivity, and institutional and social integration, while it is on a par with ASEAN in the areas of regional value chains.

Intraregional trade in CAREC has advanced slowly in the last few years and trade integration has remained subdued. The share of intraregional trade in total trade was 3.2% in 2017 compared to 3.1% in 2010 (Figure 3), implying that the CAREC countries benefit more from trade outside the region than from trade within. Excluding the PRC (the largest economy in East Asia), intraregional trade had slightly increased to 6.7% in 2017 from 6.2% in 2010. These numbers are relatively lower than in other regions in Asia and the Pacific. The intraregional trade share of Southeast Asia is estimated to be 23.1% and that of East Asia about 35.5% (ADB 2019). Notably, however, Afghanistan, Mongolia, and Turkmenistan traded with other CAREC countries, with shares of more than 50% in 2017.

[2] See https://www.carecprogram.org/uploads/2017-carec-corridor-map-FIN-1.pdf.

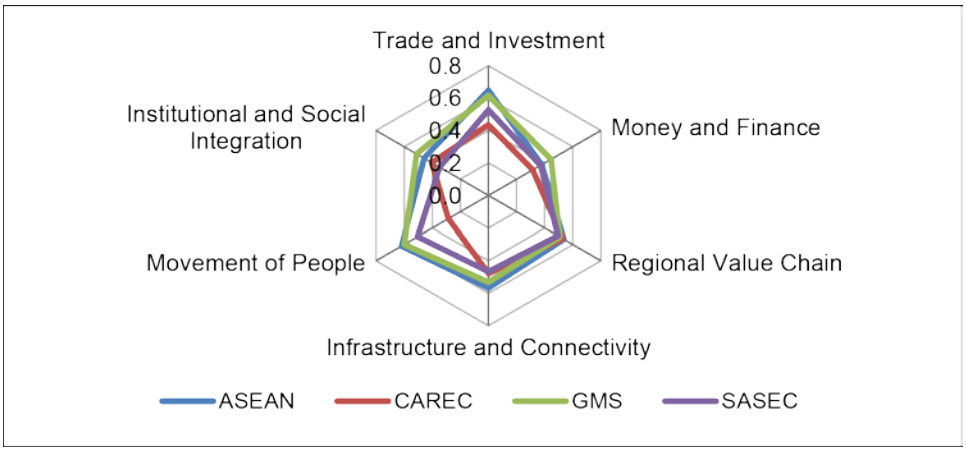
Figure 1: Asia-Pacific Regional Cooperation and Integration Index by Subregional Initiatives



ASEAN = Association of Southeast Asian Nations, CAREC = Central Asia Regional Economic Cooperation, GMS = Greater Mekong Subregion, SASEC = South Asia Subregional Economic Cooperation.

Source: ADB (2019).

Figure 2: Asia-Pacific Regional Cooperation and Integration Index by Subregional Initiatives and Dimensional Subindexes, 2017

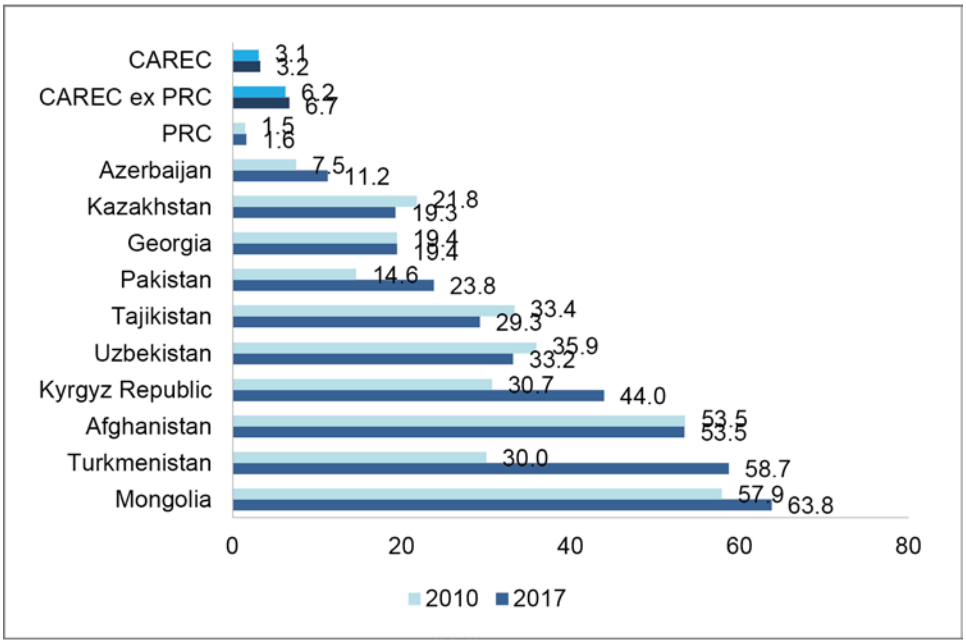


ASEAN = Association of Southeast Asian Nations, CAREC = Central Asia Regional Economic Cooperation, GMS = Greater Mekong Subregion, SASEC = South Asia Subregional Economic Cooperation.

Source: ADB (2019).

Four factors explain the low numbers: (i) CAREC countries have identical production structures, limiting the potential for intraregional trade, except in products such as hydrocarbons, cotton, and aluminum (Jha 2015); (ii) low export diversification and high concentration on the same set of commodities; (iii) the geographic concentration of exports is limited to those with close historical and cultural links; and (iv) geography causes high intraregional trade costs.

Figure 3: Intraregional Trade of CAREC Countries
(% share in total trade)



CAREC = Central Asia Regional Economic Cooperation, PRC = People's Republic of China.

Source: Authors' calculations using data from the International Monetary Fund's Direction of Trade Statistics.

2.2 Overview of CPMM Trade Facilitation Indicators

The CAREC CPMM trade facilitation indicators (TFIs) are time and cost measures that are used to monitor and assess the trade and transport facilitation performance of the six CAREC transport corridors. They are based on the time/cost-distance approach developed by UNESCAP. Five TFIs are measured in either hours/days or US dollars or kilometers (km) of trading in the corridors (Table 1). TFI1 measures how long freight moves in or out of a border crossing point on average, while TFI2 measures the corresponding accounting costs. The costs incurred of moving freight in a corridor section is provided by TFI3. Last, the average speed of travel (in km per hour) along a corridor section is measured by TFI4 and TFI5. All of the indicators help identify transport inefficiencies and bottlenecks in the movement of goods across border crossing points.

The CPMM TFIs are based on actual trade transactions and transit shipments—from origin to destination—using road and rail transport in the covered CAREC corridors. Various stakeholders are involved from the data collection stage to data reporting. For data collection, qualified truck drivers who transport shipments within and outside the CAREC region are required to fill in forms. A CPMM coordinator—the focal point of ADB and drivers—collects the forms every month from drivers. The data are standardized to address different attributes of the corridors (road development, length, cross-border protocols, etc.) and facilitate comparison. Analyses are published in quarterly and annual CPMM reports.

Table 1: CPMM Trade Facilitation Indicators

TFI1	**Time taken to clear a border crossing point (hours)**
	Average length of time (hour) it takes to move cargo (20 tons) across a border from the exit point of one country to the entry point of another; aims to capture both the complexity and the inefficiencies inherent in the border crossing process
TFI2	**Cost incurred at border crossing clearance ($)**
	Average total cost of moving cargo (20 tons) across a border from the exit point of one country to the entry point of another; both official and unofficial payments are included
TFI3	**Cost incurred to travel a corridor section ($ per 500 kilometers, per 20-ton cargo)**
	Average total costs incurred for a unit of cargo (a cargo truck or train with 20 tons of goods) traveling along a corridor section within a country or across borders; both official and unofficial payments are included
TFI4	**Speed to travel with delay along CAREC Corridors (kilometers per hour)—SWD (Speed with Delay)**
	Average speed (kph) at which a unit of cargo travels along a corridor section (a stretch of road 500 km long) within a country or across borders; the total time taken for the entire journey; distance and time measurements include border crossings; an indicator of the efficiency of border crossing points along the corridors
TFI5	**Speed to travel without delay along CAREC Corridors (kilometers per hour)—SWOD (Speed without Delay)**
	Traveling speed only; a measure of the condition of physical infrastructure (such as roads and railways)

CAREC = Central Asia Regional Economic Cooperation, TFI = trade facilitation indicator.

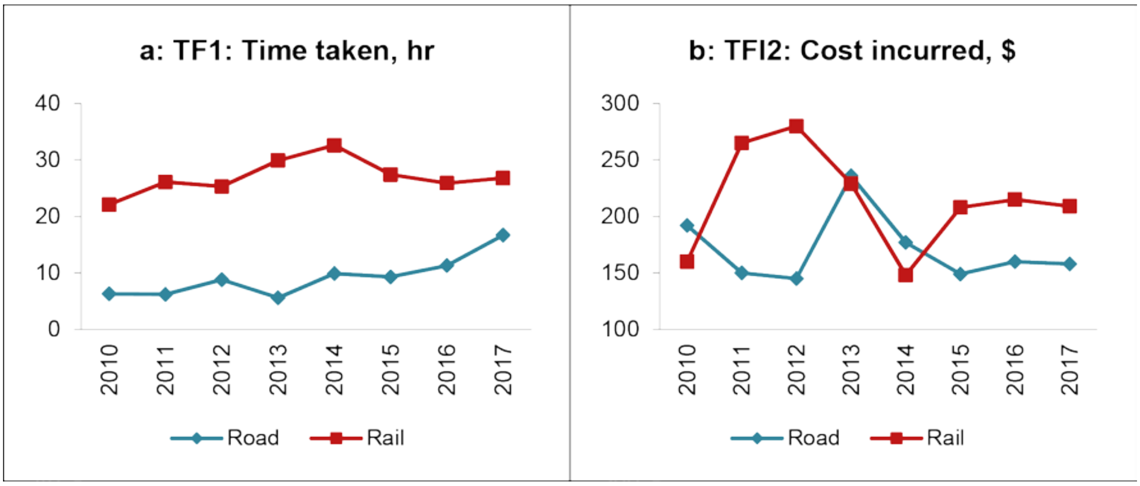
Source: ADB (2014b).

The CPMM TFIs are better trade facilitation measures than other available measures as they represent performance better in the landlocked developing economies. The usual trade facilitation performance indicators—such as the World Bank's Logistics Performance Index (LPI), the World Economic Forum's Enabling Trade Index, and the Organisation for Economic Co-operation and Development's Trade Facilitation Indicators—are complex measures, encompassing various dimensions, e.g., structural reforms, institutional characteristics, infrastructure development, and logistics quality. These indicators provide a holistic approach to assessing the trade facilitation performance of countries. However, they may have limitations in revealing important information. For instance, improvements in some key areas may not truly be reflected by the changes in the index scores. Arvis et al. (2012) point out that the low LPI scores of a landlocked country might only signify their problems in gaining access to other countries (e.g., transit difficulties) and may not sufficiently account for their domestic reforms in enhancing trade facilitation. As landlocked countries are involved in a complex cross-border transit network, advancing their reform efforts would be highly dependent on other transit countries' reforms. In addition, most of the complex trade facilitation indicators are only available at the country level, which might not be able to indicate the progress or challenges in trade facilitation at a bilateral or network level, especially for border crossing issues.

The CPMM TFIs are comprehensive measures of trade facilitation with details. The majority of CAREC's intraregional trade occurs within the transport corridors through land transportation. The CPMM TFIs are more representative of the CAREC region than any other indicators, as data by mode of transportation (road and rail) and by border crossing point are available for all of the six CAREC transport corridors. Moreover, the frequency of the data is at quarterly and annual levels. This is in contrast to the globally available trade facilitation indicators, which are usually released only on an annual or biennial basis, and thus limit timely analysis.

Figure 4 presents the recent trend of trade facilitation by mode of transportation in the CAREC countries. For road transportation, the time (TFI1) and costs (TFI2) taken at the border do not necessarily move together: time rose from 6.3 hours in 2010 to 16.7 hours in 2017, while cost declined from $192 in 2010 to $158 in 2017. On the other hand, the time taken to clear a border crossing point for trains rose from 22.1 hours in 2010 to 26.8 hours in 2017. Costs associated with rail transportation incurred at border crossings rose as well, from $160 to $209 in 2017. CAREC (2018) finds that irregular movements of the indicators are often caused by unexpected delays at some border crossing points in a particular period of time. For example, the increased average time taken at the borders in 2017 was mainly due to the delays caused by border closure and stricter control at the border crossing points of Peshawar (in Pakistan) and Chaman (in Afghanistan). Methodological changes such as the inclusion of new sample border crossing points may also affect temporary movement of the indicators. This makes a clear case for controlling time and locations in econometric analyses to assess precisely the trade impact of time/cost.

Figure 4: CPMM Trade Facilitation Indicators, 2010–2017



Source: Authors' calculations using CAREC Corridor Performance Measurement and Monitoring trade facilitation indicators data.

3. IMPACT OF BORDER CROSSING CLEARANCE ON INTRAREGIONAL TRADE IN CAREC

3.1 Data

To estimate the impact of trade facilitation on trade flows, quarterly bilateral data sets are used. Data on the value of goods export and import flows between reporting countries and their trading partners are available from the IMF's Direction of Trade Statistics database. The database covers all IMF member states and includes monthly, quarterly, and annual data. Data on trade facilitation, on the other hand, are usually generated at the country level. However, as one of the unique features of the CPMM data, measures of trade facilitation at the bilateral country level can be generated.

Although the CPMM TFIs are usually reported at the country level, country pair measures of TFIs can also be calculated to match the bilateral trade flow data. Among the TFIs, TFI1 (time) and TFI2 (cost) are the only indicators available with the data at the border crossing points. For road transportation across the six CAREC corridors, about 61 out of 76 border crossing point (BCP) samples have complete available data across all quarters from 2010 to 2017. The data for rail transportation, however, were not sufficient to conduct analysis since only 11 BCPs had available data. [3] Two types of data are used in the analysis: average time and cost measures at *inbound* and *outbound* BCPs of the CAREC countries. This directional information allows for the aggregation of time and cost taken to trade at outbound and inbound BCPs between two countries. It is straightforward to compute whether two countries are contiguous—i.e., countries sharing a common border. However, for noncontiguous countries—freight passes through multiple BCPs along one or more of six corridors—the bilateral time and cost of a country pair is an aggregation of all possible combinations of inbound and outbound time and cost.

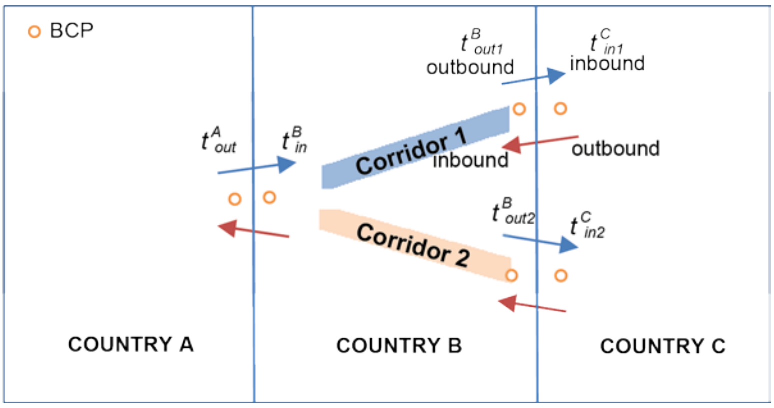
Specifically, time and cost at the BCPs at the bilateral country level were calculated using unweighted averages of inbound and outbound time and cost. It can be argued that accuracy will be improved if transit flows at each BCP are used as weights to come up with weighted averages. However, transit flow data at most BCPs are not currently available, and hence unweighted averages are used in this study. For contiguous country pairs but with multiple BCP pairs, the time and cost to facilitate bilateral import and export of goods will be the averages in all the BCP pairs. For noncontiguous country pairs, all possible inland routes along the six corridors are identified first, and for each route, the sum of the time and cost taken is computed. The unweighted averages of the total time and cost over all the identified corridor routes are then computed. Aside from the time and cost taken at the BCPs, the average number of BCPs is also included in the estimation, as it increases with the distance/route between noncontiguous countries.

Figure 5 illustrates the computation of the average time at the bilateral country level (the same applies to costs). When country A exports to its contiguous country B, t^A_{out} is the time taken at the outbound BCP while t^B_{in} is the time taken at the inbound BCP. On the other hand, trade flow from country B to country C, which are also contiguous to each other, can pass through either of the BCP pairs in corridor 1 or 2. The average time taken at the outbound BCPs is the average of t^B_{out1} and t^B_{out2}, while the average time taken at the inbound BCPs is the average of t^C_{in1} and t^C_{in2}. Therefore, the total (average) time taken for country B to export to country C is computed as the average of (t^B_{out1}+t^C_{in1}) and (t^B_{out2}+t^C_{in2}).

For the movement of goods from country A to C, there are two possible routes: corridor 1 or 2. The time taken at the outbound BCPs can be either (i) (t^A_{out}+t^B_{out1}) or (ii) (t^A_{out}+t^B_{out2}). The average of (i) and (ii) will be recorded as the average time taken at the outbound BCPs for the export from country A to C. The same approach is applied to the average time taken at the inbound BCPs. Last, the total (average) time taken is computed as the average of (i) (t^A_{out}+ t^B_{in}+t^B_{out1}+t^C_{in1}) and (ii) (t^A_{out}+ t^B_{in}+t^B_{out2}+t^C_{in2}).

[3] In mode of transport for trade, road transportation accounted for 70%, rail for 26%, and multimodal for 4% in 2016 (CAREC 2018).

Figure 5: Diagram for BCP Data Structures



BCP = border crossing point.

Source: Authors.

3.2 Gravity Model

Gravity models are standard theoretical and econometric models in international economics that identify factors affecting bilateral international trade flows. Most of the contemporary international trade studies use the model specification of Anderson and van Wincoop (2003), which accounts for multilateral trade resistance factors. This improves on traditional gravity models, which only consider bilateral distance and the size of respective source and destination economies as determinants of trade flows.

In general, trade costs are a major factor determining the intensity of trade or resistance to trade between countries. Exogenous costs are inherent factors and independent of policy choices. Examples include geographic distance between trading partners and their similar attributes, such as language, contiguity, and common history. Other factors that could affect bilateral trade flows are specific to the origin or destination and are usually policy related. Examples include logistics performance, trade facilitation, international connectivity, tariffs, and nontariff measures.

To examine the impact of trade facilitation on bilateral trade flows in the CAREC region, an augmented gravity model is estimated, following Anderson and van Wincoop's (2003) specification. The explanatory variables include the exogenous trade costs and trade facilitation measures. Moreover, to control for exporting and importing countries' time-varying characteristics, the interaction terms of country fixed effects and year dummies are added to the model, as in Olivero and Yotov (2012). The addition of these variables to the equation can effectively absorb all other time-varying multilateral trade resistance factors—both inward and outward—such as gross domestic product and population. "Corridor" dummies are also added to control for trade intensities within the six corridors.

The gravity model used for the estimation is defined as:

$$\log Y_{ijt} = \alpha + \beta X_{ij} + \gamma Z_{ijt} + \delta_{it} F_i \cdot t + \delta_{jt} F_j \cdot t + \sum_{k=1}^{6} \rho_{(k)} C_{ij(k)} + v_{ijt}$$

where Y_{ijt} is the value of country i's goods exports to country j at time t, expressed as a natural logarithmic form. The independent variables on the right-hand side of the equation are (i) X_{ij}, a vector of time-invariant exogenous trade cost variables; (ii) Z_{ijt}, a vector of trade facilitation measures; (iii) F_i and F_j, vectors of time-varying country fixed effects interacting with dummy variables for year *t*; and (iv) $C_{ij(k)}$, dummy variables for the country pair i and j, indicating whether they are part of the k^{th} corridor ($k = 1, 2, \ldots, 6$). Note that participation of a country pair in the six corridors is mutually exclusive—a country pair could belong to several corridors. The vectors of coefficients, β and γ, are estimated and provide the magnitudes of the partial effects of X_{ij} and Z_{ijt} on bilateral trade flows. The appendix lists the independent variables in the gravity model, their descriptions, and data sources.

Estimation of the gravity model equation is performed using the Heckman (1979) method. In contrast to the ordinary least squares (OLS) regression, the Heckman method addresses the sample selection bias and yields unbiased and consistent estimates. Bias in the sample selection occurs when some country pairs are included while others are dropped in the estimation. Using the OLS method, only country pairs with strictly positive values of exports will be part of the estimation, while those with zero trade flows will be forcedly dropped as the natural logarithm of zero is undefined. This results in a case of omitted variables—the regression equation lacks a variable that explains the possibility of trading between countries (i.e., including the case of no trade), and hence the error term and some independent variables (such as trade costs) will be correlated. This problem yields biased and inconsistent estimators.

The Heckman method addresses these problems in two steps. First, a selection equation is estimated using the probit regression method, which estimates an equation for a selection variable—in the gravity model case, the probability of countries trading with each other. Second, using the probit estimation results, the inverse Mills ratio is computed and added as an independent variable in the estimation of the econometric specification. The inclusion of this selection variable solves the omitted variable problem and hence estimates are unbiased and consistent. The results of the Heckman estimation are presented along with the results of the OLS pooled and panel regression estimations to check and compare the robustness of the results.

3.3 Estimation Results

The results of the regression estimations show that the bilateral trade flows among CAREC countries are more influenced by the average time taken at the inbound BCPs (i.e., importing countries) than that at the outbound BCPs (i.e., exporting countries) (Table 2). Only the coefficients of the time taken at the inbound BCPs are significant under pooled OLS and Heckman regressions (Cols 1 and 3, Table 2), while coefficients of the average time at the outbound BCPs are statistically significant only in the pooled OLS estimation (Col 4, Table 2). Moreover, the coefficient of the inverse Mills ratio is only significant under the time taken at the inbound BCPs, indicating that sample selection bias is present and Heckman is an appropriate estimation procedure. The average of the total time taken at the BCPs (i.e., both inbound and outbound) is also significant under pooled and Heckman regressions (Cols 7 and 9, Table 2), most likely reflecting the time taken at the inbound BCPs. The coefficients on average time at inbound BCPs in Col 3, Table 2 imply that a 10% reduction in the time taken at the importers' BCPs could increase bilateral trade flows by 1.41%.

Inbound BCPs relative to outbound BCPs can be a more important factor in determining bilateral trade flows. It is at the inbound BCPs where most of the delays occur and high costs are incurred (GIZ 2011). Furthermore, as imports tend to exceed exports (i.e., trade imbalance) in most landlocked developing countries, inbound trucks face higher volume, lower freight rates (due to competition), and lower discounts on road transport than exporters' trucks (UNOHRLLS 2007; Arvis, Raballand, and Marteau 2010). Hence, this encourages inbound trucks to overload to compensate, which leads to infrastructure deterioration, in turn posing road safety risks (UNOHRLLS 2007).

The results of the estimation on the impact of costs incurred at the inbound BCPs (Table 3) show that the coefficients are only significant under the pooled OLS regression, but with correct negative signs (Col 1, Table 3). On the other hand, the estimated coefficients of cost at the outbound BCPs all show negative signs, but they only show significance under the Heckman estimation (Col 6, Table 3).[4]

The overall results imply that among the trade facilitation indicators, the inbound BCP average time is a more significant factor than the average cost that affects the trade flows within CAREC countries. One potential explanation could be that trade facilitation measures, expressed in monetary and nominal terms, may not capture their "true" impact on bilateral trade as these measures are also influenced by inflation, foreign exchange rate fluctuations, and unofficial fees incurred irregularly to expedite the clearance from the border crossing processes.

Aside from the above-mentioned independent variables, the exogenous trade cost variables have, in general, the expected direction of relationships with bilateral exports in the estimation, as in the literature. The estimated negative coefficients of distance across all regression estimations are highly significant. This finding aligns with the significance of the number of BCPs passing along the corridors, which confirms that if moving cargoes go through multiple BCPs, trade between country pairs is less likely to flow smoothly, leading to lower trade volumes. The estimated magnitude of its impact, however, is closely associated with the impact of distance. Moreover, contiguous countries tend to show higher bilateral trade than noncontiguous ones. Unlike in most studies, the results here show that having a common official language is not a significant factor of bilateral trade. In the CAREC region, only Kazakhstan and the Kyrgyz Republic share a common official language, which is Russian (and both countries share a common border). Therefore, the dummy variable for the common official language could simply represent an indicator for their bilateral trade. The coefficient of this exogenous trade cost variable can be interpreted as the difference (on average) between the bilateral trade of these two countries and that of the other country pairs.

[4] However, the large variability in the coefficients on costs at outbound BCPs (–0.077 for pooled; –0.022 for panel; –0.244 for Heckman, Cols 4–6, Table 3) could indicate a robustness issue in the model, which may require further investigation in the future.

Table 2: Impact of Average Time at Border Crossing Points on Bilateral Trade in the CAREC Region

Dependent Variable: Ln(Exports)	(1) Pooled	(2) Panel	(3) Heckman	(4) Pooled	(5) Panel
Ln(Distance)	–0.558***	–0.842***	–0.884***	–0.676***	–0.852***
	(0.065)	(0.289)	(0.088)	(0.062)	(0.287)
Colonial relationship	0.228**	0.673	–0.071	0.385***	0.668
	(0.095)	(0.458)	(0.210)	(0.092)	(0.448)
Common language	0.661***	0.459	0.163	0.637***	0.495
	(0.116)	(0.532)	(0.195)	(0.116)	(0.527)
Contiguity	0.682***	0.734*	0.661***	0.637***	0.777**
	(0.081)	(0.383)	(0.084)	(0.081)	(0.381)
Number BCPs passed	–0.215***	–0.197**	–0.187***	–0.227***	–0.200**
	(0.022)	(0.095)	(0.021)	(0.022)	(0.092)
Ln(Avg time at inbound BCPs; hours)	–0.107**	–0.050	–0.141***		
	(0.048)	(0.038)	(0.051)		
Ln(Avg time at outbound BCPs; hours)				–0.078*	–0.021
				(0.042)	(0.025)
Ln(Avg total time at BCPs; hours)					
Constant	18.061***	20.833***	18.593***	19.438***	20.067***
	(1.524)	(3.403)	(1.426)	(1.445)	(3.306)
Inverse Mills ratio			–0.625***		
			(0.205)		
Corridor dummies	Yes	Yes	Yes	Yes	Yes
Exporter x Year FE	Yes	Yes	Yes	Yes	Yes
Importer x Year FE	Yes	Yes	Yes	Yes	Yes
Number of observations	3,045	3,045	41,318	3143	3143
Uncensored observations			2,553		

Dependent Variable: Ln(Exports)	(6) Heckman	(7) Pooled	(8) Panel	(9) Heckman
Ln(Distance)	–1.035***	–0.522***	–0.829***	–0.850***
	(0.084)	(0.064)	(0.288)	(0.087)
Colonial relationship	0.256*	0.197**	0.675	–0.177
	(0.189)	(0.094)	(0.457)	(0.210)
Common language	0.010	0.745***	0.488	0.232
	(0.191)	(0.116)	(0.529)	(0.194)
Contiguity	0.632	0.671***	0.742*	0.643***
	(0.084)	(0.081)	(0.384)	(0.084)
Number BCPs passed	–0.198***	–0.202***	–0.197**	–0.176***
	(0.021)	(0.022)	(0.094)	(0.021)
Ln(Avg time at inbound BCPs; hours)				
Ln(Avg time at outbound BCPs; hours)	–0.045			
	(0.054)			
Ln(Avg total time at BCPs; hours)		–0.136***	–0.050	–0.208***
		(0.051)	(0.033)	(0.058)
Constant	20.760***	18.821***	20.822***	20.007***
	(1.364)	(1.549)	(3.394)	(1.452)
Inverse Mills ratio	–0.032			–0.159
	(0.198)			(0.197)
Corridor dummies	Yes	Yes	Yes	Yes
Exporter x Year FE	Yes	Yes	Yes	Yes
Importer x Year FE	Yes	Yes	Yes	Yes
Number of observations	41,401	3,026	3,026	41,304
Uncensored observations	2,636			2,539

BCP = border crossing point, CAREC = Central Asia Regional Economic Cooperation, FE = fixed effects.

Notes: (i) only the PRC and Mongolia had a colonial relationship; (ii) only Kazakhstan and the Kyrgyz Republic use Russian as a common official language; (iii) Robust standard errors in parentheses; (iv) Heckman selection estimation was used to account for missing bilateral economy pair data.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' calculations using data from International Monetary Fund Direction of Trade Statistics, CAREC Corridor Performance Measurement and Monitoring trade facilitation indicators, and CEPII.

Table 3: Impact of Average Cost at Border Crossing Point on Bilateral Trade in the CAREC Region

Dependent Variable: Ln(Exports)	(1) Pooled	(2) Panel	(3) Heckman	(4) Pooled	(5) Panel
Ln(Distance)	–0.528***	–0.710**	–0.887***	–0.626***	–0.756**
	(0.066)	(0.310)	(0.091)	(0.072)	(0.300)
Colonial relationship	0.383***	0.427	0.308*	0.589***	0.574
	(0.091)	(0.503)	(0.226)	(0.107)	(0.449)
Common language	0.591***	0.594	0.017	0.706***	0.849
	(0.121)	(0.541)	(0.208)	(0.136)	(0.552)
Contiguity	0.787***	0.786**	0.774***	0.702***	0.804**
	(0.080)	(0.385)	(0.086)	(0.092)	(0.383)
Number BCPs passed	–0.240***	–0.214**	–0.223***	–0.209***	–0.178*
	(0.022)	(0.095)	(0.021)	(0.023)	(0.092)
Ln(Avg cost at Inbound BCPs; $)	–0.080*	–0.024	0.046		
	(0.048)	(0.029)	(0.063)		
Ln(Avg cost at Outbound BCPs; $)				–0.077	–0.022
				(0.052)	(0.029)
Ln(Avg total cost at BCPs; $)					
Inverse Mills ratio			0.073		
			(0.198)		
Constant	16.424***	20.178***	16.987***	19.070***	19.942***
	(1.474)	(3.530)	(1.484)	(1.539)	(3.306)
Corridor dummies	Yes	Yes	Yes	Yes	Yes
Exporter x Year FE	Yes	Yes	Yes	Yes	Yes
Importer x Year FE	Yes	Yes	Yes	Yes	Yes
Number of observations	2,931	2,931	41,205	2,826	2,826
Uncensored observations			2,440		

Dependent Variable: Ln(Exports)	(6) Heckman	(7) Pooled	(8) Panel	(9) Heckman
Ln(Distance)	–0.977***	–0.371***	–0.630*	–0.666***
	(0.091)	(0.074)	(0.325)	(0.095)
Colonial relationship	0.180	0.534***	0.303	0.073
	(0.190)	(0.107)	(0.499)	(0.223)
Common language	–0.008	0.742***	0.985*	0.179
	(0.209)	(0.138)	(0.563)	(0.220)
Contiguity	0.722***	0.950***	0.844**	0.933***
	(0.088)	(0.094)	(0.385)	(0.089)
Number BCPs passed	–0.190***	–0.203***	–0.184**	–0.196***
	(0.022)	(0.022)	(0.092)	(0.022)
Ln(Avg cost at Inbound BCPs; $)				
Ln(Avg cost at Outbound BCPs; $)	–0.244***			
	(0.072)			
Ln(Avg total cost at BCPs; $)		–0.092	–0.048	–0.154***
		(0.063)	(0.038)	(0.089)
Inverse Mills ratio	0.424**			0.576***
	(0.205)			(0.202)
Constant	21.142***	16.423***	20.361***	17.752***
	(1.445)	(1.562)	(3.417)	(1.596)
Corridor dummies	Yes	Yes	Yes	Yes
Exporter x Year FE	Yes	Yes	Yes	Yes
Importer x Year FE	Yes	Yes	Yes	Yes
Number of observations	41,124	2,618	2,618	40,936
Uncensored observations	2,359			2,171

BCP = border crossing point, CAREC = Central Asia Regional Economic Cooperation, FE = fixed effects.

Notes: (i) only the PRC and Mongolia had a colonial relationship; (ii) only Kazakhstan and the Kyrgyz Republic use Russian as a common official language; (iii) Robust standard errors in parentheses; (iv) Heckman selection estimation was used to account for missing bilateral economy pair data.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' calculations using data from International Monetary Fund Direction of Trade Statistics, CAREC Corridor Performance Measurement and Monitoring trade facilitation indicators, and CEPII.

3.4 Simulation

A simple simulation exercise is performed to calculate the estimated trade gains from CAREC-wide reduction in the average time taken at the border. Using the regression results of the Heckman model in Col 3, Table 2, the simulation results show that a reduction in the average time taken at the importers' BCPs of 10% would lead to an increase of $1.03 billion in CAREC's intraregional trade in goods (computed based on 2017 data) (Table 4). Relative to economic size, this increase in intraregional trade is equivalent to 0.58% of CAREC GDP in 2017 (4.6% excluding the PRC). Although the trade gains appear minimal, they are equivalent to an increase of as much as 0.01 of a percentage point of CAREC GDP (0.06 of a percentage point excluding the PRC).

Notably, across CAREC member countries, the trade gains vary considerably. The countries with higher shares of intraregional trade in GDP seem to have higher trade gains from a reduction in time taken at the BCPs than the countries with lower shares. For instance, Mongolia and Turkmenistan are the top exporters with the highest intraregional export share in GDP and they get the highest gains, with shares in GDP increasing by 0.65 and 0.24 percentage points, respectively.

Table 4: Trade Gains from Time Reduction at Border Crossing Points in the CAREC Region

	GDP (Current Prices, 2017)	Intraregional Goods Exports (Current Prices, 2017)		Trade Gains from 10% Time Reduction at Importers' BCPs	
CAREC Country	**$ billion**	**$ billion**	**% GDP**	**$ billion**	**% GDP**
Afghanistan	20.24	0.315	1.56	0.004	0.02
Azerbaijan	41.26	1.064	2.58	0.015	0.04
Kazakhstan	162.89	8.809	5.41	0.124	0.08
Kyrgyz Republic	7.70	0.547	7.10	0.008	0.10
Mongolia	11.43	5.272	46.11	0.074	0.65
Pakistan	304.95	2.949	0.97	0.042	0.01
Tajikistan	7.14	0.331	4.63	0.005	0.07
Turkmenistan	37.93	6.577	17.34	0.093	0.24
Uzbekistan	48.83	3.482	7.13	0.049	0.10
Georgia	15.08	0.626	4.15	0.009	0.06
PRC	12,062.28	43.302	0.36	0.611	0.01
Total	12,719.72	73.275	0.58	1.026	0.01
Total excl. PRC	657.44	29.972	4.56	0.420	0.06

BCP = border crossing point, CAREC = Central Asia Regional Economic Cooperation, PRC = People's Republic of China, GDP = gross domestic product.

Source: World Economic Outlook and Direction of Trade Statistics—both International Monetary Fund and authors' calculations.

4. CONCLUSIONS

Using the novel data of the CPMM trade facilitation indicators specific to the CAREC countries, this study investigates the extent to which reduced time and cost at the border crossing points facilitates trade among the CAREC countries. By transforming inbound and outbound time and cost data at the level of border crossing points into bilateral country level, matched with bilateral trade flows, the gravity model was implemented. The main findings and implications from the gravity model estimations are as follows:

- Compared to the time taken at the exporter border, the time taken at the importer border appears to be a more significant factor affecting bilateral trade, and hence it is the most relevant measure that can be used as a benchmark in facilitating bilateral trade in the CAREC region. Much of the time and cost taken at the CAREC border crossing points is spent on waiting/queuing, unloading/loading, various inspections, and customs clearance (CAREC 2018). Moreover, *inbound* border crossing points are inclined to involve higher time and cost levels than *outbound* border crossing points. This implies that a reduction in time taken during waiting/queuing, unloading/loading, various inspections, and customs clearance at the importer border crossing points could be a primary potential target to improve intraregional trade in the CAREC region.
- At the importer border, the time measure is more objective than the cost measure in explaining the changes in trade flows. The reason may be that the cost measure can be confounded by external factors such as inflation, foreign exchange rate, and unofficial payments. Thus, it may be helpful to disclose the extent to which these factors contribute to the movement of the cost measure to ensure that it properly represents the outcome of trade facilitation activities in the region.
- In particular, the estimated impact of a 10% reduction in time taken at the importer border increases CAREC's intraregional trade by 1.41%, equivalent to about $1.03 billion.

The findings support the usefulness of the CPMM TFIs in analyzing and assessing the trade facilitation performance of CAREC countries at border crossing points. The study also suggests which measures require careful examination. Indeed, as trade expansion is one of the CAREC Program's objectives, reducing the time taken at the importer border will help achieve this goal, as the empirical evidence suggests.

However, the simulation results reveal that improving trade facilitation through a reduction in time taken *at the border* may not be the only factor that can lead to broader economic impact in the CAREC region. Other relevant measures, which are not captured by CPMM TFIs, can also be considered relevant factors in determining bilateral trade flows. These factors could include *behind-the-border* issues, such as domestic and structural reforms in facilitating trade, sanitary and phytosanitary laboratory capability and capacity, and modernization of regulations to meet international standards. In addition, inadequate investment planning for trade facilitation due to low priority and a lack of institutional coordination is considered a major challenge in conducting trade facilitation.

Ensuring complementarity between soft and hard infrastructure is also essential in fostering efficient cross-border movement of goods from the source country (exporter), through transit countries, and to the destination country (importer). Apart from streamlined soft infrastructure, such as legal or institutional frameworks for trade logistics efficiency and quality of trade facilitation, efficient hard (physical) infrastructure networks are also crucial in delivering a positive impact on trade. Especially in Central Asian countries, which are mostly landlocked, better transit country infrastructure can play a key role in boosting trade flows in the region.

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APPENDIX: VARIABLES USED IN THE GRAVITY MODEL

Variable	Description	Expected Sign	Data Source
Dependent variable: Y_{ij}			
Bilateral goods exports	Nominal value (in $) of goods exports from source country i to destination country j, expressed in natural logarithmic. The export values are in terms of free-on-board, i.e., transaction costs for the shipping of the goods are borne by the exporter.		IMF DOTS
Explanatory variables:			
1. $\mathbf{X}_{ij}$—vector of exogenous trade costs			
a. Bilateral distance	Measure of distance between country i's capital city and country j's capital city in kilometers. This variable is expressed as natural logarithmic.	Negative	CEPII
b. Contiguity	A dummy variable that takes the value of 1 if country pair i and j share a common border. Contiguous countries are expected to engage more in trade, and hence have higher bilateral trade flows than noncontiguous countries.	Positive	CEPII
c. Common official language	A dummy variable that takes the value of 1 if country pair i and j share a common official language. Countries are more likely to trade if there are no language barriers, which implies easier transaction among traders.	Positive	CEPII
d. Colonial relationship	A dummy variable that takes the value of 1 if country pair i and j were ever in a colonial relationship (with one country as the colonizer and the other as the colony). Trade between two countries can also be reflected by their historical association.	Positive	CEPII
2. $\mathbf{Z}_{ij}$ —vector of trade facilitation measures			
a. Clearing time at border crossing points (BCPs)—inbound and outbound	Number of hours it takes to move cargoes across a border crossing point—exit from country i and enter country j. This is an aggregation of time spent on waiting/queuing, road tolls, unloading/loading, vehicle registration, weight inspection, traffic inspection, immigration, phytosanitary inspection, quarantine, customs clearance, and border security/control. Intuitively, cargoes can easily flow across borders if clearing time is minimal, and hence there are higher bilateral trade flows. This variable is expressed as natural logarithmic.	Negative	CAREC CPMM
b. Costs incurred at a BCP—inbound and outbound	Cost (in $) of moving cargoes across a border crossing point—exit from country i and enter country j. All costs are taken into account, such as fees for road tolls, vehicle registration, weight inspection, traffic inspection, immigration, phytosanitary inspection, and customs clearance. More trade goods would flow among countries if costs were low. This variable is expressed as natural logarithmic.	Negative	CAREC CPMM
c. Number of BCPs	Number of BCPs crossed in the bilateral trade. In noncontiguous country pairs, it would take more than two BCPs to pass and move cargoes. The number of BCPs crossed affects the flow of cargoes—and hence, bilateral trade—since each point crossed can slow the speed and increase the costs.	Negative	CAREC CPMM

continued on next page

Appendix *table continued*

Variable	Description	Expected Sign	Data Source
$C_{ij(k)}$—corridor dummies			
Corridor 1	A dummy variable that takes the value of 1 if country pair i and j belong to the Europe–East Asia corridor		CAREC CPMM
Corridor 2	A dummy variable that takes the value of 1 if country pair i and j belong to the Mediterranean–East Asia corridor		
Corridor 3	A dummy variable that takes the value of 1 if country pair i and j belong to the Russian Federation–Middle East Asia and South Asia corridor		
Corridor 4	A dummy variable that takes the value of 1 if country pair i and j belong to the Russian Federation–East Asia corridor		
Corridor 5	A dummy variable that takes the value of 1 if country pair i and j belong to the East Asia–Middle East Asia and South Asia corridor		
Corridor 6	A dummy variable that takes the value of 1 if country pair i and j belong to the Europe–Middle East Asia and South Asia corridor		

CAREC = Central Asia Regional Economic Cooperation, CEPII = Centre d'Études Prospectives et d'Informations Internationales (the French Research Center in International Economics), CPMM = Corridor Performance Measurement and Monitoring, IMF DOTS = International Monetary Fund's Direction of Trade Statistics.

Source: Authors' compilation.