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Impact of trade facilitation indicators on trade flows in transport corridors of CAREC region and policy implications

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ADBI Working Paper Series

**IMPACT OF TRADE FACILITATION
INDICATORS ON TRADE FLOWS IN
TRANSPORT CORRIDORS OF CAREC
REGION AND POLICY IMPLICATIONS**

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Abstract

The development of transport corridors and better trade facilitation enhance cross-border trade flows and stimulate economic integration via stronger regional cooperation. Against this backdrop, this paper intends to analyze the effect of trade facilitation indicators (TFIs) on trade flows in the Central Asia Regional Economic Cooperation (CAREC) transport corridors and offer policy implications for strengthening trade facilitation. Using the Corridor Performance Measurement and Monitoring TFIs database, an augmented gravity model has been estimated to examine the effect of TFIs on bilateral trade flows in the CAREC countries along CAREC transport corridors. The study reveals that the TFIs in CAREC corridors have generated a considerable positive impact on bilateral trade flows of the CAREC economies though fluctuated over time. Trade times and longer time delays can increase trade costs and lower trade. Transaction delays and insufficient information, longer physical inspections, inadequate coordination, and lengthy customs procedures can negatively impact inbound trade flows. Longer customs clearance hampers the quality and prices of agricultural exports. The heterogeneity in the TFIs along CAREC corridors is considerable and likely to have a significant positive impact on bilateral trade flows in the CAREC economies. With stronger TFIs, regional integration and cooperation among CAREC corridor economies along the routes is being bolstered. With better TFIs in CAREC corridor economies, inward trade flows are likely to decline comparatively higher than the surge in outward trade flows. The bilateral trade inflows are likely to boost trade volume and can be used for the development of infrastructure and natural resources. Therefore, there is a need to support the CAREC corridor economies to vigorously contribute to the development of transport corridors and improve the TFIs for robust trade performance. Stronger regional economic cooperation should promote the development of novel technologies, skills, and knowledge in order to improve the TFIs further for better trade performance.

Keywords: trade facilitation indicators, trade flows, transport corridors, CAREC region, policy implications

JEL Classification: F13, F14, M48, P25, R41

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1. INTRODUCTION

Transport corridors provide a network to link economic hubs domestically and across borders (Kalyuzhnova and Holzhacker 2021). A transport corridor accentuates the infrastructure, trade, and investment integration of regional economies for inclusive growth and improved welfare (Vickerman 2002). Upgrading transport corridors attracts investment in potential sectors initially, followed by other latent sectors. The development of transport corridors and better trade facilitation increase cross-border trade flows (Samad, Masood, and Ahmed 2023) and stimulate economic integration through stronger regional cooperation (Laird and Venables 2017). Trade facilitation refers to effective and transparent information, regulations, and border clearance procedures for cross-border mobility of products (Anderson 1979). In a formal sense, trade facilitation refers to increasing the passage, discharge, and authorization and shipment of products (WTO 2001). In a narrow sense, trade facilitation implies smoother mobility of products across borders with a reduction in transaction costs linked to customs procedures (WTO 2014), while in a broad sense, trade facilitation includes efficient and transparent regulations, official procedures, and customs clearance at borders (Moïsé and Sorescu 2013). TFIs such as transportation and institutional infrastructure (Francois and Manchin 2013) and official practices, customs clearance, and cooperation (Hummels and Schaur 2013; Zaki 2015) significantly impact trade flows. Trade costs create more significant obligatory obstacles to cross-border trade than tariffs (Anderson and Van Wincoop 2003). Delays in time at border crossing points (BCPs) increase trade costs and trading time surges with the increase in official procedures, which lowers the export value specifically of perishable goods and high-tech products (Djankov, Freund, and Pham 2010; Volpe, Carballo, and Graziano 2015).

Extant studies used narrow aspects of trade facilitation to analyze its impact on trade flows. Trade facilitation eases the trade process, increases cross-border trade, and boosts trade volume by reducing transaction costs linked to official procedures at borders. Trade facilitation fosters economic growth (Anjande et al. 2020) and regional integration (Safaeimanesh and Jenkins 2021) through technology transfer (Sakyi et al. 2017). Longer times spent in customs clearance can increase illegal rent-seeking and trade-linked bribery, and discourage exports. Upgrading all features of trade facilitation improves trade performance and supports export diversification, while long time to imports and lengthy paper procedures for exports adversely impact trade outcomes. Delays in the transportation of perishable and electronics parts negatively impact their exports, while better trade facilitation leads to smoother mobility of parts and components. Modern border procedures and trade facilitation reforms lower trade costs significantly and increase trade flows (Safaeimanesh and Jenkins 2021). Transportation barrier-induced trade delays are significantly greater in landlocked Central Asian countries (Baniya and Kiyoshi 2022), while efficient trade facilitation promotes trade flows (Christ and Ferrantino 2011). Against this backdrop, this paper intends to analyze the impact of TFIs on trade flows in the Central Asia Regional Economic Cooperation (CAREC) transport corridors and offer policy implications for strengthening trade facilitation.

This paper contributes to the extant literature in the following ways. First, the paper provides a theoretical framework consisting of principles and components of trade facilitation, trade facilitation measures, goals and categories of trade facilitation measures, and types and benefits of TFIs, and compares TFIs advanced by the World Bank, World Economic Forum, Organisation for Economic Co-operation and Development (OECD), and Asian Development Bank (ADB). Second, it provides

descriptive analysis of TFIs and export volume in the CAREC transport corridor economies. Third, the study provides empirical evidence on the effect of TFIs on bilateral trade flows along the transport corridors of CAREC economies using an augmented gravity model utilizing the novel database on the Corridor Performance Measurement and Monitoring (CPMM) TFIs. Fourth, the study offers significant insights regarding the comparative implications of inbound and outbound BCPs in determining bilateral trade flows among the CAREC countries. Fifth, the paper advocates the need for better trade facilitation in the CAREC member countries and provides country-specific policy recommendations. Lastly, the paper outlines the limitations of the study and future research direction.

2. REVIEW OF LITERATURE

Trade facilitation reforms benefit open economies more than less open economies (Jacks, Meissner, and Novy 2008). Trade costs are substantially higher in developing countries than developed countries (Arvis et al. 2016). Trade facilitation reduces transportation costs and benefits more developing countries (WTO and OECD 2017), influencing trade performance and economic growth in African economies (Sakyi et al. 2017) and Asian countries (Ali and Shakoor 2020). The effectiveness of ports, border clearance, regulations, and e-trade positively impacts trade flows in the Asia and the Pacific region (Wilson, Mann, and Otsuki 2003). Inefficient trade procedures negatively impact intra-African trade (Kouty 2021).

The CAREC region's trade depends on transport corridors via bordering nations to use seaport services (Raballand, Kunth, and Auty 2005). The fact of being landlocked significantly lowers trade value in CAREC countries (Mazhikeyev, Edwards, and Rizov 2015). In landlocked CAREC economies, trade gains are smaller than in coastal countries (Raballand 2003) due to greater transportation costs (Arvis, Raballand, and Marteau 2010), inadequate infrastructure, and weak institutions (Arvis et al. 2011). Trade-linked tariff costs are significantly higher in CAREC economies than in other Asian countries (UNESCAP 2018). Intraregional trade costs have declined considerably in CAREC economies in recent years but have remained higher than national trade costs, which makes it necessary to lower nontariff costs (ADB and UNESCAP 2013).

Inadequate trade facilitation measures due to bureaucratic impediments at corridor borders lead to more substantial trade costs than the remoteness of the CAREC region (Pomfret 2017). The repetition of documentation clearance and inefficient handling at borders delay consignments (Arvis, Raballand, and Marteau 2010), which adversely affects the agricultural exports in the CAREC region and forces the CAREC countries to trade their farm goods within the region, which causes underutilization of agricultural trade capacity (Kim and Mariano 2020). Improvements in trade facilitation (Grigoriou 2007) and transit infrastructure (Shepherd and Wilson 2006) can significantly lower transit times and boost intraregional trade in the CAREC region (Kim, Mariano, and Abesamis 2022).

Felipe and Kumar (2012) used the Logistics Performance Index (LPI) and found that trade facilitation and upgrading corridors' infrastructure led to substantial trade gains in the CAREC region with considerable country-level variations. Tanabe, Shibasaki, and Kato (2016) used the Corridor Performance Measurement and Monitoring (CPMM) TFIs and revealed that improvements in trade transit facilities can significantly lower costs and boost trade flows in the CAREC region. Based on perception-based trading across border indicators, Sharafeyeva (2020) found an optimistic linkage between

export volume and time. Total exports are more susceptible to time than cost in the CAREC region (Kim and Mariano 2020), while Sharafeyeva (2023) revealed that exports are more significantly affected by elevated export costs than more export time.

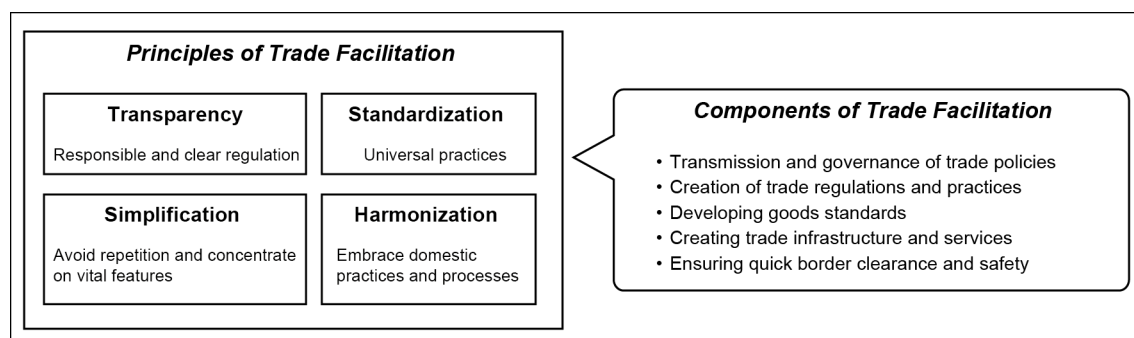
In recent years, trade patterns have altered considerably in the CAREC region by linking the People's Republic of China (PRC) and Eurasian countries via Kazakhstan (Pomfret 2021) due to substantial investment in the Belt and Road Initiative (Pomfret 2017). This can substantially increase the total real income in the CAREC region by significantly lowering border crossing times and trade costs (De Soyres et al. 2018) compared to novel investment in transportation infrastructure. Therefore, the significance of TFIs in increasing trade flows cannot be overemphasized in the CAREC region (Kim, Mariano, and Abesamis 2022). Despite the surge in trade facilitation studies, scant quantitative research has analyzed the impacts of TFIs on trade flows along transport corridors using the CPMM TFIs in the CAREC region, which this paper intends to study.

3. THEORETICAL FRAMEWORK

A landlocked country faces a unique threat to trade facilitation due to its specific barriers as well as the trade facilitation policies of the neighboring countries. Trade costs are high in landlocked countries, which suggest that the benefits of trade facilitation reforms can be substantial in such countries. Landlocked countries face inadequate transit infrastructure, which hinders trade flows (Raballand 2003; Christ and Ferrantino 2011) due to deficiency in official procedures and time delays at border crossings (Freund and Rocha 2011).

Figure 1 shows the principles and components of trade facilitation. Transparency encourages ingenuosness and responsibility through the dissemination of clear instructions to seek advice before implementation, while simplification removes superfluous constituents and repetitions of essential trade procedures. Harmonization supports domestic trade practices, procedures, and paperwork among stakeholders and standardization targets to embrace global best practices (UNECE 2012). Trade facilitation concentrates on disseminating and governing trade policies, instituting trade regulations and processes, generating goods standards, developing trade infrastructure to lower trade costs, and ensuring speedy border clearance and safety (ADB and UNESCAP 2013).

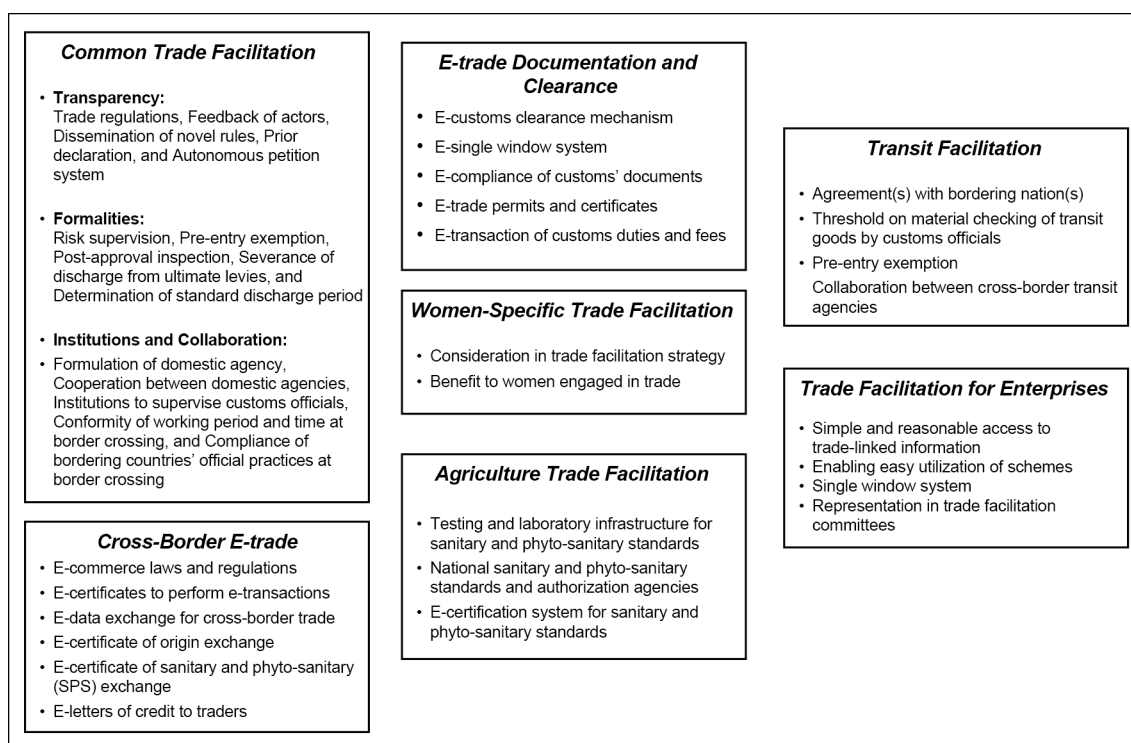
Figure 1: Principles and Components of Trade Facilitation



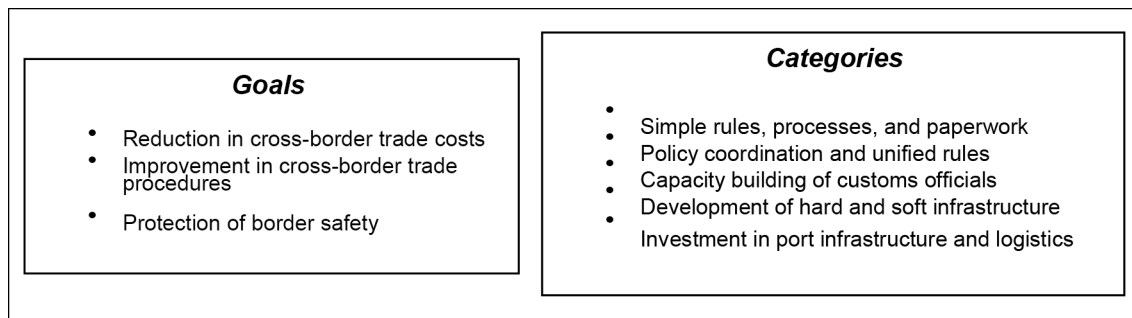
Source: Author's creation based on UNECE 2012; ADB and UNESCAP 2013.

Trade facilitation measures aim to increase cross-border trade by tackling the obstacles to improving regulations, procedures, formalities, and customs clearance (Moisé and Sorescu 2013). Figure 2 displays trade facilitation measures. Landlocked developing economies experience greater execution of trade facilitation measures than least-developed economies due to high transparency and better regulations, institutions, and cooperation. Trade facilitation measures can help achieve sustainable and inclusive growth (UNESCAP 2019). Figure 3 shows the goals and categories of trade facilitation measures. Trade facilitation measures such as domestic trade guidelines and principles, trading chain logistics arrangements, port infrastructure and services, and trade practices directly influence customs operations by lowering cross-border trade costs, enhancing cross-border trade procedures, and protecting border safety. The categories of trade facilitation measures include simple and more efficient trade regulations, processes, and paperwork; instituting a single window system; policy and consultation to support national and cross-border cooperation; scientific backing and expert knowledge to improve the functioning of border clearance bodies; the development of dedicated software, hardware, and information, communication, and technology apparatus; and the establishment of material infrastructure like ports.

Figure 2: Measures of Trade Facilitation

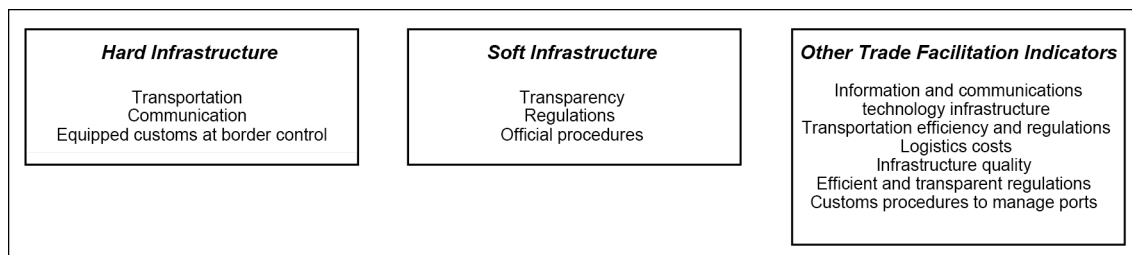


Source: Author's creation based on UNESCAP 2019.

Figure 3: Goals and Categories of Trade Facilitation Measures

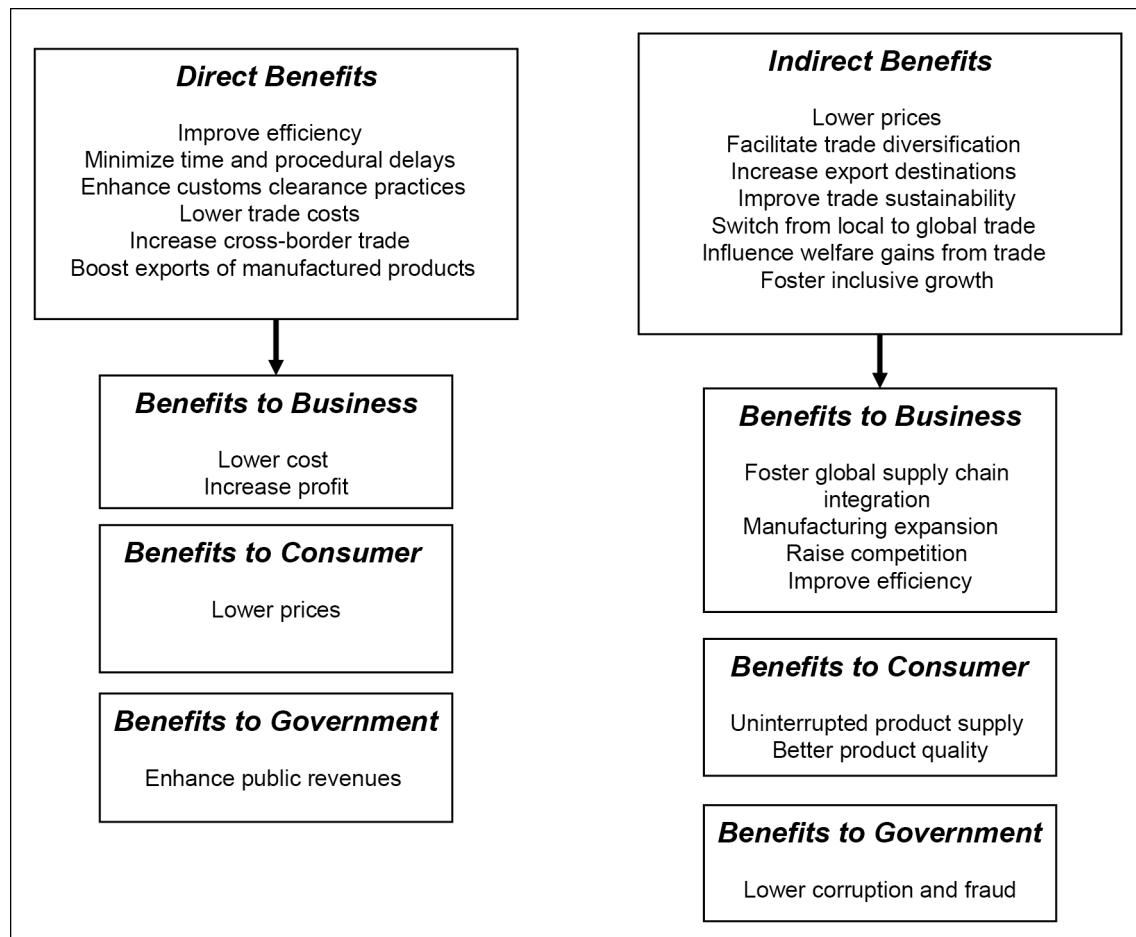
Source: Author's creation based on World Bank 2017.

Figure 4 depicts the types of TFIs, covering both hard and soft infrastructures (Zaki 2014). The hard dimension of trade facilitation includes transportation and communication infrastructure as well as equipped customs at border control for product mobility, while the soft trade facilitation dimension covers intangibles such as transparency, regulations, and official procedures to improve efficiency and minimize time and procedural delays at borders. The execution of soft trade facilitation enhances customs clearance practices, which lowers trade costs, increases cross-border trade, boosts exports of manufactured products, and facilitates trade diversification. Soft TFIs entail a move from local trade to global trade and influence the welfare gains from trade in developing countries.

Figure 4: Trade Facilitation Indicators

Source: Author's creation.

Benefits of TFIs are depicted in Figure 5. Delays in customs clearance lead to higher trade costs and adversely impact trade flows. Modern border procedures can lower trade costs significantly. Trade facilitation reforms such as the single window system lower trade costs, increase trade flows, and benefit developing countries more. The analysis of TFIs is comparatively novel compared to the estimation of trade costs. Different trade facilitation measures have been applied to capture the effect of TFIs on trade flows. Infrastructure indicators and institutional quality indexes have been used to analyze the impact of TFIs on trade flows (Francois and Manchin 2013; Portugal-Perez and Wilson 2012). However, these studies were not based on real, regular, and orderly collection of data and thus did not attract policymakers (Moïsé and Le Bris 2013). Recently, the World Bank (2016, 2017), WEF (2016), and OECD (2013) developed worldwide comparable indicators based on the LPI, the Enabling Trading Index (ETI), and TFIs, respectively, and the ADB (2014) developed the CPMM TFIs.

Figure 5: Benefits of Trade Facilitation

Source: Author's creation.

Figure 6 provides a comparison of these TFIs. The LPI, ETI, and TFIs are complex measures and may not strictly signal progress in certain major components in the index; they may also not fully depict both domestic and transit countries' trade facilitation reforms. These trade facilitation measures lack an adequate database covering a longer period, which poses significant obstacles in understanding the impact of trade facilitation on trade flows. The CPMM TFIs are superior, comprehensive, and representative TFMs in the context of the landlocked CAREC countries. The CPMM TFIs amply exhibit trade facilitation performance in the CAREC transport corridors, where most of the trade is intraregional. The quarterly and annual data on CPMM TFIs are available by both road and rail as well as by BCP for all six CAREC transport corridors for better analysis of trade facilitation and trade flows in the CAREC corridor economies.

In brief, the theoretical framework makes it evident that trade facilitation reduces trade costs, which sequentially improves trade flows. Trade facilitation reforms can significantly reduce time at BCPs. Better trade facilitation practices lead to greater trade flows and diversification in products and destinations. However, the extant studies on the impact of TFIs on trade flows in the CAREC transport corridors are limited.

Figure 6: Comparing Trade Facilitation Indicators

<i>World Bank's Logistic Performance Index</i>	<i>World Bank's Doing Business</i>	<i>WEF's Enabling Trading Index</i>	<i>OECD's Trade Facilitation Indicators</i>	<i>ADB's CPMM Trade Facilitation Indicators</i>
Customs	Border compliance (cost and hours)	Efficient customs	Authority and fairness	Border compliance (cost and hours)
Ease of consignment	Documentary requirement (cost and hours)	Transparent customs organization	Information access	Traveling along a corridor section (costs)
Timeliness			Fees and levies	Travel speed with delay (km/h)
Infrastructure			Petition process	Travel speed without delay (km/h)
Quality of logistics			Advanced rulings	
			Formalities and guarantees	
			Cooperation	
			Agreements	

Source: Author's creation based on World Bank 2016, 2017; WEF 2016; OECD 2013; ADB 2014.

4. OBJECTIVES AND METHODOLOGY

This study intends to analyze the impact of TFIs on trade flows in the CAREC transport corridor economies using the database on the CPMM TFIs and draws policy implications for improving the TFIs. The CAREC Program developed the CPMM database to measure the efficiency of six transport corridors, which connect 11 CAREC regional economies, namely Afghanistan, Azerbaijan, Georgia, Kazakhstan, Mongolia, Pakistan, the Kyrgyz Republic, the PRC, Tajikistan, Turkmenistan, and Uzbekistan, to the Eurasian countries and worldwide markets using the time/cost–distance structure methodology evolved by United Nations Economic and Social Commission for Asia and the Pacific. Data were collected from transport operators/logistics firms and collaborators regarding the time/cost of real consignments followed by analysis of data to draw inferences by applying statistical tools and publicizing the results. The CAREC CPMM methodology aims to ascertain sources of delays and cost surges at BCPs and transitional halts, assist the corridor organizations in tackling recognized impasses, and measure the achievement of regional collaboration activities executed by CAREC member countries along the corridor routes.

The CAREC CPMM system was introduced in 2009 and provides the data on four TFIs covering the time taken to clear a BCP, the cost incurred at customs clearance, the cost incurred in traveling a corridor section, and the speed of travel using both road and rail transport for CAREC transport corridors from 2010 to 2020 on both a quarterly and annual basis. However, data regarding rail transport are confined to 11 BCPs only, which restricts the analysis of both rail and road transport (ADB 2018). In 2020, the data were gathered from a sample of 2,999 consignments across nine countries. In Azerbaijan and the Kyrgyz Republic, data were confined exclusively to road transport, while in other CAREC countries data on both road and rail transports were captured. However, road transport remained dominant in goods mobility, including agriculture and horticulture products, through the CAREC corridors (ADB 2021). The CPMM database for the period 2010–2020 has been used to analyze the operational efficiency of the TFIs and increase access along the routes. These indicators have been employed to assess and validate the impacts of TFIs on trade flows in CAREC corridor economies.

An augmented gravity model has been used to assess the impact of TFIs on bilateral trade flows in the CAREC countries along the CAREC transport corridors based on Anderson and van Wincoop (2003) and Kim and Mariano (2020). The explanatory variables comprise the exogenous average time to cross a corridor, average costs to cross a corridor, and other facilitation measures such as distance. “Corridor” dummies are inserted to allow for trade intensities in six corridors. The gravity model is performed by using OLS pooled regression to estimate the results. This is because the data points from bilateral trade for a year are limited, so we have just used the OLS pooled regression model to capture the impact of trade facilitation across the corridor on bilateral trade flows.

Bilateral trade flows among the CAREC economies through a corridor are affected by average trade cost and average time incurred to cross the border or corridor (inbound and outbound). The gravity model used for the analysis is given below:

$$\log Y_{ijt} = \alpha + \beta \log X_{ij} + \gamma \log Z_{ijt} + \sum_{k=1}^6 C(k) + v_{ijt}, \quad (1)$$

where Y_{ijt} = the value of country i 's goods exports to country j by crossing the corridor at time t .

Independent variables are depicted as follows:

X_{ij} = a vector of time variant exogenous trade cost incurred at BPCs;

Z_{ijt} = a vector of trade facilitator measures;

$C(k)$ = dummy variables for the k^{th} corridor ($k=1,2\dots6$) for country i and j used for the export; and

u = error term.

The values are expressed in natural logarithmic form.

$$\log Y_{ijt} = \alpha + \beta \log X_{ij} + \gamma \log Z_{ijt} + \sum_{k=1}^6 \rho(k) C(k) + v_{ijt}, \quad (2)$$

where Y_{ijt} = the value of country i 's goods exports to country j by crossing the corridor at time t .

Independent variables are described as follows:

X_{ij} = a vector of time variant exogenous average time taken to clear BCPs;

Z_{ijt} = a vector of trade facilitator measures;

$C(k)$ = dummy variables for the k^{th} corridor ($k=1,2\dots6$) for the i and j used for the export; and

u = error term.

A detailed description of the variables is given in Table 1. In the above equation, the vectors of coefficients β and γ are the magnitude of partial effects of X_{ij} and Z_{ijt} on bilateral trade flows. The commodities exported by road transport are shown in Table 2.

Table 1: Variables and Data Sources

Dependent Variable	Description	Source
Bilateral goods exports	Nominal value (in US\$ in millions) of goods exports from source country <i>i</i> to destination country <i>j</i> , expressed in natural logarithmic form by road transport. The export values are in terms of free onboard, i.e., transaction costs for the shipping of the goods are borne by the exporter.	UN Comtrade Database
Explanatory Variables		
Bilateral distance	Measure of distance between country <i>i</i> 's capital city and country <i>j</i> 's capital city in kilometers. This variable is expressed in natural logarithmic form.	CEPII Database by Head and Mayer (2014)
Contiguity	A dummy variable that takes the value of 1 if country pair <i>i</i> and <i>j</i> share a common border. Contiguous countries are expected to engage more in trade, and hence have higher bilateral trade flows than noncontiguous countries.	CEPII Database by Head and Mayer (2014)
Common official language	A dummy variable that takes the value of 1 if country pair <i>i</i> and <i>j</i> share a common official language. Countries are more likely to trade if there are no language barrier, which implies easier transaction among traders.	CEPII Database by Head and Mayer (2014)
Colonial relationship	A dummy variable that takes the value of 1 if country pair <i>i</i> and <i>j</i> 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.	CEPII Database by Head and Mayer (2014)
Clearing time at BCPs: Inbound and outbound	Number of hours it takes to move cargo across a BCP exit from country <i>i</i> and enter country <i>j</i> .	CAREC CPMM
Costs incurred at a BCP: Inbound and outbound	Cost (in US\$) of moving cargoes across a BCP—exit from country <i>i</i> and enter country <i>j</i> . All costs are taken into account, such as fees for road tolls, vehicle registration, weight inspection, traffic inspection, immigration, phyto-sanitary inspection, and customs clearance.	CAREC CPMM
Number of BCPs	Number of BCPs crossed in bilateral trade. In noncontiguous country pairs, it would take more than two BCPs to pass and move cargo.	CAREC CPMM
Gross domestic product (GDP)	GDP of countries engaged in bilateral trade.	World Bank

Source: Author's compilation.

Table 2: Commodities Exported by Road Transport

CAREC Country	Exports by Road Transport
Afghanistan	Fresh fruits and vegetables
Azerbaijan	Electrical equipment and machinery, and pharmaceuticals
PRC	Consumer and industrial goods, construction equipment and building materials, refined petroleum, consumer items, food commodities, and plastic pipes
Georgia	Pharmaceuticals
Kazakhstan	Agricultural products
Kyrgyz Republic	Fresh and dried fruits, and textiles
Mongolia	Crude oil and coal
Pakistan	Fruits and vegetables, electrical equipment and machinery, and ceramic products
Tajikistan	Fruits and vegetables, and consumer items
Turkmenistan	Data not available
Uzbekistan	Fruits and vegetables

Source: Author's compilation.

Data and Variables

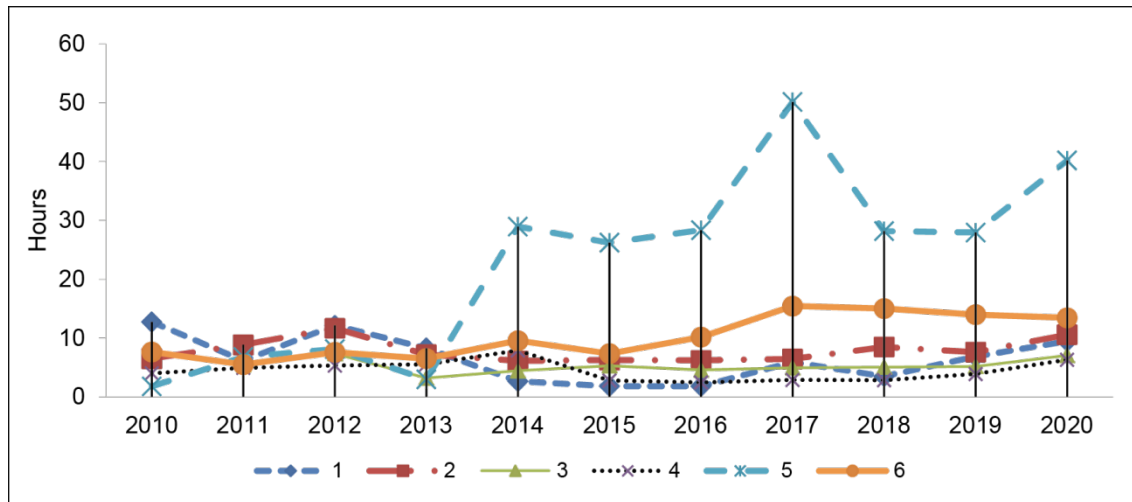
The value of goods exports between the CAREC countries is derived from the UN Comtrade database. The trade facilitation data at country level are available in the CPMM database, which is further generated at the bilateral country level. The trade facilitator measure includes cost (inbound, outbound, and total cost in US\$) incurred at border crossing clearance, and time taken (inbound, outbound, and total time in hours) to clear a BCP. The literature argues that many other inherent factors also influence bilateral trade, which is included in the regression analysis, such as gross domestic product (GDP), contiguity, common history (colonial relationship), language, number of BCPs, and geographical distance between the trading partners (for details, see Table 1). The frequency of CPMM TFIs data is only yearly and in some cases quarterly, thus limiting our analysis to only pooled regression. This analysis is performed for road transport only, as the data are available for most of the BCPs, but rail transport data are insufficient to perform a detailed assessment, which is available for only a few BCPs (ADB 2018).

5. RESULTS AND DISCUSSION

Descriptive Statistics

The average time at the BCP for road transport was highest in corridor 5, followed by corridors 6, 2, 1, 4, and 3. However, there was a significant difference between the average time at BCPs in corridor 5 and those in other corridors. Specifically, the average time at BCPs in corridor 5 has increased significantly since 2014, primarily due to much longer border clearance times resulting from the inclusion of new BCPs with additional inspections and documentations. Additionally, there were sanitation controls and the shutdown of some road BCPs in the most recent year due to COVID-19 (see Figure 7). The delays also encompassed waiting in queues, loading/unloading, emergency repairs, and escort/convoy, as well as weight/standard inspection activities (ADB 2018). On the other hand, the other corridors showed a declining trend in the average time spent at BCPs from 2010 to 2017. However, this trend has reversed in recent years for similar reasons to those mentioned above. The shorter customs inspection time largely contributed to the reduction and declining average time at BCPs, particularly in corridors 1, 3, 4, and 6. The average BCP time for these corridors has stabilized or improved since the benchmark in 2014, mainly driven by the sizable reduction in customs inspection time, except for the COVID-19 year. In particular, the average time at inbound BCPs was relatively higher than at outbound BCPs across all six corridors in the CAREC countries. In general, improvements in customs inspections, an activity that often causes the most severe delays during inbound BCPs, can lead to substantial enhancements in overall trade facilitation at BCPs. This analysis indicates that the relatively higher average inbound BCP time is not a result of capacity or equipment issues but rather regulatory constraints (see Table 3 and Annual CAREC CPMM Reports, 2015 to 2020).

Figure 7: Average Time Taken to Clear Border Crossing Points (hrs) in Six CAREC Corridors



Source: Author's creation based on the CAREC CPMM database.

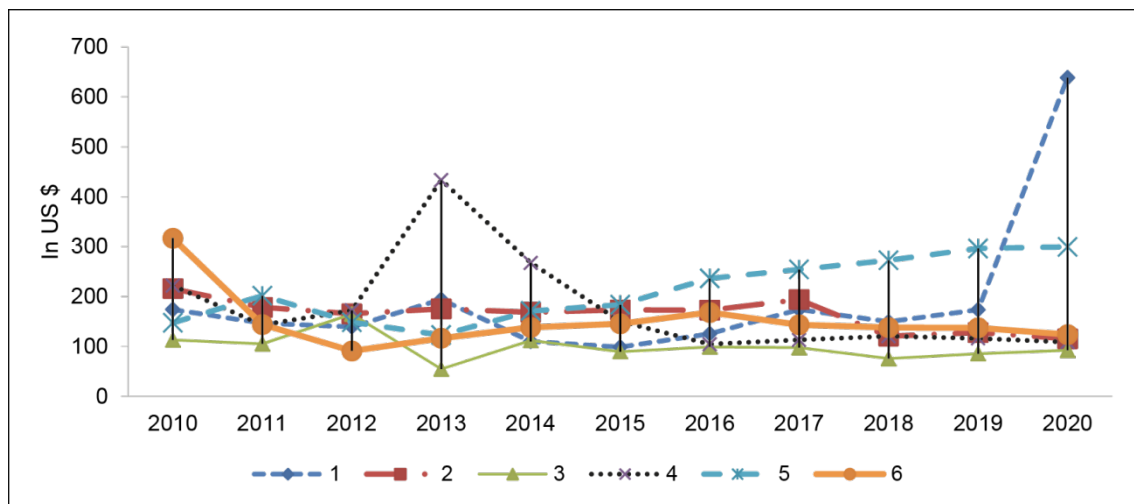
Table 3: Time Taken to Clear Border Crossing Points (hrs)

Corridor	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	12.7	6.2	12.1	8.3	2.7	1.8	1.8	5.9	3.5	6.9	9.5
2	6.5	8.8	11.7	7.2	6.1	6.3	6.2	6.4	8.5	7.6	10.6
3	7.7	5.5	7.3	3.2	4.4	5.3	4.6	4.9	5.1	5.2	7.1
4	4.0	4.9	5.3	5.5	7.9	2.8	2.4	2.9	2.8	3.9	6.3
5	1.8	6.8	8.1	3.0	28.9	26.2	28.4	50.2	28.2	28.0	40.2
6	7.6	5.5	7.6	6.5	9.6	7.4	10.2	15.4	15.0	14.0	13.5
<i>Inbound</i>											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	14.0	7.0	11.0	9.0	2.0	2.0	2.0	7.0	3.0	7.0	9.0
2	7.0	10.0	15.0	10.0	9.0	8.0	7.0	8.0	10.0	9.0	13.0
3	9.0	6.0	9.0	4.0	7.0	8.0	5.0	6.0	5.0	6.0	8.0
4	4.0	5.0	5.0	6.0	8.0	3.0	2.0	3.0	3.0	4.0	7.0
5	2.0	7.0	9.0	4.0	35.0	32.0	31.0	54.0	31.0	30.0	43.0
6	8.0	6.0	9.0	8.0	12.0	9.0	11.0	17.0	16.0	15.0	15.0
<i>Outbound</i>											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	11.0	6.0	14.0	8.0	3.0	2.0	2.0	5.0	3.0	7.0	10.0
2	6.0	8.0	9.0	5.0	3.0	5.0	5.0	5.0	7.0	6.0	8.0
3	7.0	5.0	5.0	2.0	2.0	3.0	4.0	4.0	5.0	5.0	6.0
4	4.0	5.0	6.0	6.0	8.0	3.0	3.0	3.0	3.0	4.0	6.0
5	1.0	6.0	7.0	2.0	22.0	20.0	26.0	47.0	25.0	26.0	37.0
6	7.0	5.0	6.0	5.0	7.0	5.0	9.0	14.0	14.0	13.0	12.0

Source: Author's compilation based on the CAREC CPMM database.

Similarly, the average cost incurred at BCPs was highest for corridor 5, followed by corridors 6 and 1, while the average cost at BCPs for other corridors was relatively lower, hovering around US\$100 (see Figure 8). Over time, the average cost at BCPs for corridor 6 consistently declined, and this trend was particularly pronounced for corridor 4 after 2014, while the average cost at BCPs increased for corridor 5. On the other hand, the average cost at BCPs for the remaining corridors fluctuated, experiencing an increase in the initial period from 2010 to 2013–2014, followed by a decline until 2018, and a subsequent increase in 2019 and 2020. The rise in the average cost at BCPs for corridor 5 also resulted from costs associated with longer border crossing times, as discussed in the above paragraph. Additionally, the customs-related border crossing fee showed slight fluctuations at most inbound BCPs and was reflected in the price movement of the average cost at BCPs. Specifically, the average cost at inbound BCPs was relatively higher than at outbound BCPs. The high border crossing fee also led to rent-seeking behavior, where procedures were intentionally made cumbersome, compelling private operators to make unofficial payments at police checkpoints and inspections to avoid the high transaction costs. The recent increase was attributed to prolonged delays for inbound traffic complying with health and sanitation controls due to COVID-19 (see Table 4 and CAREC Annual Reports, 2015 to 2020).

Figure 8: Average Cost Incurred at Border Crossing Points (US\$)



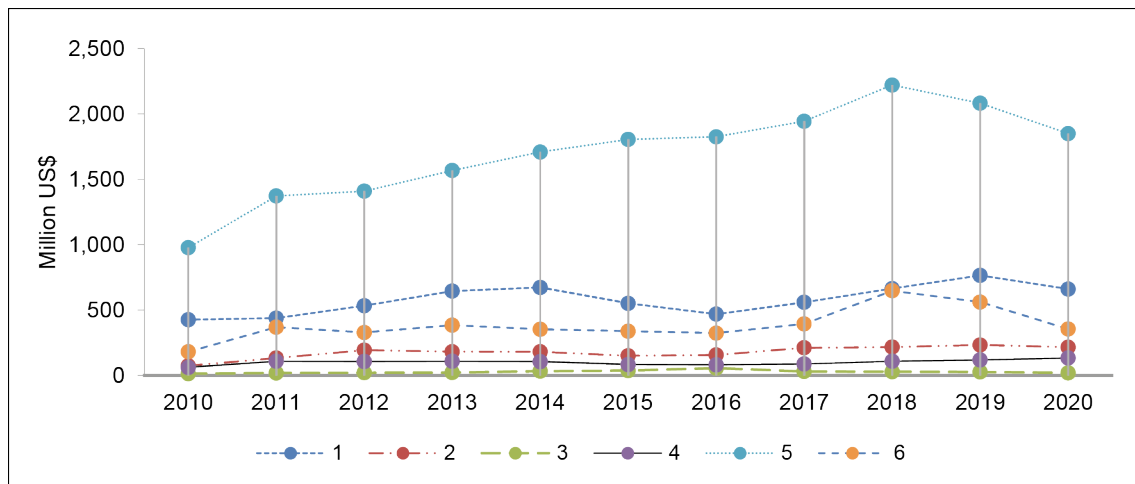
Source: Author's creation based on the CAREC CPMM database.

Table 4: Cost Incurred at Border Crossing Points (US\$)

Corridor	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	744	928	1,234	1,450	1,123	1,069	981	753	1,129	1,092	1,788
2	595	714	540	610	513	522	521	521	595	662	563
3	524	1,196	1,076	2,245	2,348	1,559	951	573	546	606	728
4	1,552	1,683	1,322	1,437	1,126	992	1,302	1,167	1,805	1,491	1,510
5	352	1,602	1,547	2,393	2,050	2,008	1,835	1,513	708	706	650
6	939	967	729	1,150	769	1,276	931	866	836	823	717
<i>Inbound</i>											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	158	145	142	226	117	109	159	225	147	194	581
2	242	224	239	268	236	202	242	280	141	166	149
3	131	135	240	83	157	119	139	140	87	108	119
4	342	223	268	709	399	162	110	148	140	147	96
5	170	207	162	139	188	201	276	307	249	303	279
6	356	182	125	159	179	183	215	184	155	167	153
<i>Outbound</i>											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	191	149	137	163	103	88	92	123	152	153	696
2	190	133	92	82	101	144	103	108	100	90	82
3	95	75	90	26	67	60	59	54	64	63	65
4	102	63	76	158	136	139	99	79	101	85	121
5	125	197	135	106	154	167	196	202	296	290	320
6	278	106	57	74	97	108	121	103	121	108	95

Source: Author's compilation based on the CAREC CPMM database.

Moreover, the average annual export volume between 2010 and 2020 through road transport among CAREC countries exhibited variations, with corridor 5 (US\$1706 million) recording the highest, followed by corridors 1, 6, 2, and 4, and the lowest at corridor 3 (US\$29 million). Over time, the export volume for only corridor 5 consistently increased, while the export volume for other corridors recorded fluctuations. Initially, there was an upward trend in export volume for most of these corridors in 2010–2015, followed by a decline in 2015–2017, and a subsequent increase in 2018–2019, with a further decline in 2020 (see Figure 9). In general, the CAREC countries demonstrated positive developments in terms of exports through these corridors. Corridor 2 witnessed the highest annual growth in exports at a 14% annual average growth rate, closely followed by corridor 6 with a 13% annual average growth rate, corridor 4 with a 10% annual average growth rate, and corridor 3 with a 9% annual average growth rate, while the lowest growth was observed in corridor 1 at 7% and corridor 1 with a 6% annual average growth rate (see Table 5). This indicates a dynamic and evolving pattern in the trade landscape in road transport across the CAREC countries, with varying degrees of growth and performance among the different corridors.

Figure 9: Export (million US\$) by Road Transport

Source: Author's creation based on the CAREC CPMM database.

Table 5: Export Value (million US\$) by Road Transport

	Corridor					
	1	2	3	4	5	6
2010	428	75	14	62	978	182
2011	439	134	19	110	1,373	370
2012	534	194	21	107	1,411	330
2013	646	183	22	110	1,568	385
2014	673	182	34	106	1,710	354
2015	553	151	38	85	1,806	339
2016	470	158	57	82	1,826	325
2017	560	212	31	89	1,945	395
2018	665	217	30	110	2,222	648
2019	766	234	28	119	2,083	562
2020	661	217	21	134	1,851	356
Average	581	178	29	101	1,706	386

Source: Author's compilation from CAREC CPMM database.

Regression Analysis (Augmented Gravity Model)

The pooled regression result indicates that both the average time and total time taken at inbound and outbound BCPs are negatively related to export by road transport and statistically significant (see Table 6), after controlling the other explanatory variables such as gross domestic product, contiguity, colonial relations, and common language. However, the average time at inbound BCPs influenced bilateral trade flows among CAREC countries more than at the outbound BCPs. The coefficient of average time at inbound BCPs depicts that a 10% decline in the time taken at inbound BCPs could increase bilateral trade flows by 1.06%, which is significantly higher than at outbound BCPs (i.e., a 0.87% increase in trade flows).

Table 6: Impact of Average Time at BCPs on Bilateral Trade (Pooled Regression)

Dependent Variable Ln(Export)	(1)	(2)	(3)
Contiguity	0.191 (0.023)	0.225 (0.019)	0.216 (0.021)
Number of BCPs passed	−0.027*** (0.012)	−0.027*** (0.012)	−0.029*** (0.011)
Colonial relationship	2.738*** (0.147)	2.787*** (0.134)	2.758*** (0.141)
Common language	0.209 (0.399)	0.210 (0.395)	0.207 (0.402)
Ln(GDP)	0.207*** (0.054)	0.207*** (0.054)	0.210*** (0.054)
Ln(Average time at inbound BCPs, in hours)	−0.106* (0.048)		
Ln(Average time at outbound BCPs, in hours)		−0.087** (0.054)	
Ln(Average total time at BCPs, in hours)			−0.099* (0.057)
Constant	5.051*** (0.506)	5.051*** (0.507)	5.034*** (0.508)
Corridor dummies	Yes	Yes	Yes
No. of observations	1,058	1,055	1,060
R-squared	0.969	0.970	0.970
Adjusted R-squared	0.966	0.966	0.966

Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Notes: (i) Mongolia and the PRC embrace a colonial history, and (ii) the Kyrgyz Republic and Kazakhstan have Russian as a common official language.

Source: Author's computation.

Similarly, the regression results reveal that the impact of trade costs incurred has the expected statistically significant negative relationship with bilateral export by road transport (see Table 7) after controlling the other explanatory variables such as gross domestic product, contiguity, colonial relations, and common language. The regression results demonstrate that cost incurred at inbound BCPs has a statistically significant coefficient. However, the coefficients associated with trade costs at outbound BCPs display a negative but not statistically significant sign. In particular, the coefficient of inbound BCPs' average cost is higher-than-average time, suggesting that the former is a more important factor than the latter in impacting the trade flows with the CAREC economies. Furthermore, the other independent variables, such as distance and number of BCPs, exhibit the anticipated negative coefficients in relation to bilateral exports. Remarkably, the number of BCPs presents a statistically significant and negative correlation with bilateral trade. This implies that a higher presence of BCPs along the corridors is less likely to contribute to a smooth flow of cargo movement, resulting in increased time and costs, and subsequently leading to a lower trade volume. Interestingly, the countries sharing a common historical background within the CAREC region display higher bilateral trade flows than others. Nevertheless, the presence of a common official language and contiguity among countries does not emerge as a significant factor influencing the bilateral trade dynamics. In addition, the countries with a higher GDP also recorded higher bilateral trades among the CAREC countries.

Table 7: Impact of Average Cost at BCPs on Bilateral Trade (Pooled Regression)

Dependent Variable Ln(Export)	(1)	(2)	(3)
Contiguity	1.011 (0.112)	1.021 (0.121)	1.041 (0.115)
Number of BCPs passed	−0.033** (0.012)	−0.209*** (0.010)	−0.033** (0.020)
Colonial relationship	0.608*** (0.167)	0.605*** (0.169)	0.645*** (0.166)
Common language	0.403 (0.401)	0.501 (0.600)	0.371 (0.431)
Ln(GDP)	0.227*** (0.054)	0.225*** (0.053)	0.227*** (0.054)
Ln(Average cost at inbound BCPs, in US\$)	−0.142** (0.086)		
Ln(Average cost at outbound BCPs, in US\$)		−0.051 (0.086)	
Ln(Average total cost at BCPs, in US\$)			−0.024 (0.091)
Constant	4.183*** 0.627	6.093*** 0.729	4.236*** 0.634
Corridor dummies	Yes	Yes	Yes
No. of observations	1,055	1,058	1,060
R-squared	0.969	0.969	0.969
Adjusted R-squared	0.965	0.965	0.965

Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Notes: (i) Mongolia and the PRC embrace a colonial history, and (ii) the Kyrgyz Republic and Kazakhstan have Russian as a common official language.

Source: Author's computation.

The above-discussed regression results offer valuable insights about the relative significance of inbound and outbound BCPs in shaping bilateral trade flows among the CAREC economies. The impact of inbound BCPs appears to have a greater influence than their outbound counterparts, particularly the influence of the average cost and time taken at inbound BCPs when considering importing nations. This aspect has an important role in driving bilateral trade flows among the CAREC countries, as opposed to the average cost and time taken at outbound BCPs, which pertains to exporting nations. This asymmetry in significance is primarily underpinned by the inherent characteristics of inbound BCPs. At these entry points, delays result in escalated trade costs. It is important to point out that inbound cargo typically contends with unique dynamics, including larger shipment volumes, smaller cargo charges attributed to competitive pressures, and reduced fees on road transportation in comparison to outbound cargo. As a result of these factors, there exists a propensity for inbound cargo to adopt an approach of overloading to compensate for substantial costs.

The cargo operators attempt overloading to maximize operational efficiency and returns and minimize vehicle operation and maintenance costs (Teravaninthorn and Raballand 2009). Overloading is evaded by making unofficial payments at police checkpoints and inspections to avoid the high transaction costs (Pinard 2010). Moreover, the penalties to regulate vehicle overloading seem inadequate to restrain the violators. This practice of overloading, though driven by economic incentives, introduces a series of challenges. The pressure exerted on infrastructure due to excess

cargo weight can give rise to deterioration in road conditions, thereby exacerbating road safety risks. This concern is echoed in a study by UNOHRLLS (2007), suggesting that the interplay between overloading practices driven by economic motives and potential infrastructure degradation poses a notable challenge to road safety. The operation and maintenance costs of transport corridors are likely to surge along the routes and jeopardize sustainability and efficiency. The option of cost recovery from the transport operators is expected to drive up their operational costs. The transport corridor authorities can offload the overloaded trucks. However, offloading cargoes is almost unfeasible and may increase the procedural menace and delays. There seems to be institutional laxity and inadequate regulatory capacity to strictly adhere to overloading rules and efficient monitoring of weighing stations (World Bank 2007). Therefore, domestic regulations on axle loads in the CAREC member countries should be vigorously enforced to get rid of the menace of overloading of trucks along the CAREC transport corridor routes. Overloading can be checked by embracing novel digital technologies to enforce an automated weight management system. The toll charges should be levied equitably in accordance with authentic transport corridor use (Banerjee and Prozzi 2015). Overloaded trucks should be levied fees in terms of their real damage to corridor infrastructure using the widely applied toll-by-weight scheme (Hang, Xie, and He 2013).

In summary, the regression results emphasize the pivotal role of inbound BCPs and their associated time delays and cost in shaping trade flows among the CAREC countries. The intricate interplay between trade cost dynamics, cargo characteristics, and infrastructure integrity underscores the complexity of managing these factors to optimize trade among CAREC economies, while safeguarding road safety and sustainable transportation systems.

6. CONCLUSION AND POLICY IMPLICATIONS

TfIs in the CAREC corridors have generated a considerable positive impact on the bilateral trade flows of the CAREC economies though fluctuated over time. Trade times and longer time delays can increase trade costs and lower trade. Transaction delays and insufficient information, longer physical inspections, inadequate coordination, and lengthy customs procedures can negatively impact inbound trade flows. Longer customs clearances hamper the quality and prices of agricultural exports. The heterogeneity in the TfIs along the CAREC corridors is considerable and likely to have a significant positive influence on bilateral trade flows in the CAREC economies. With robust TfIs, regional integration and cooperation between CAREC corridor economies along the routes is being bolstered. With better TfIs in the CAREC corridor economies, inward trade flows are likely to decline comparatively more than surges in outward trade flows. The bilateral trade inflows are likely to boost trade volume and can be used for the development of infrastructure and natural resources.

Developing stronger TfIs along the CAREC corridors can result in a significant positive impact on the bilateral trade performance in the CAREC economies. Therefore, the CAREC corridor economies should be vigorously supported to bolster transport corridor development and improve TfIs for robust trade performance. This can help the CAREC corridor economies to spot relative benefits in resources and markets along the routes and improve poor infrastructure through substantial investment in transport corridor projects. Stronger regional economic cooperation should promote the development of novel technologies, skills, and knowledge to improve the TfIs further for better trade outcomes. Moreover, developing economies in the CAREC corridors experience more differential influence of the TfIs on trade flows than comparatively

more developing economies along the routes, which signifies that the CAREC corridors can ease disparity in the international division of labor between developing and more developed economies. Therefore, regional economic cooperation among the CAREC corridor economies should also center on the heterogeneity of the TFIs in developing and more developed economies along the routes.

Trade facilitation reforms are necessary to bolster the border clearance mechanisms and drastically reduce trade costs, which entail reducing customs documentation, time, and real customs clearance costs. More transparency in official communications and regulations can lower delays in trade flows. The institutional and organizational development of border agencies should be implemented to minimize trade times and facilitate smoother cross-border trade. The rationalized customs procedures and physical verification of trade documents facilitate fast mobility of products at borders. The pre-arrival verification of customs documents can smooth goods mobility at border points. Information and data sharing among border agencies can facilitate stronger cooperation of customs administration. Trade facilitation reforms should focus on recruiting and retaining trained manpower and boost teamwork among border bureaucracy to bolster border agencies. The customs bureaucracy should be incentivized to build transparency and accountability to achieve intentions of trade facilitation reforms and to reduce leakages.

Robust customs infrastructure and logistics, including digitalization of customs procedures, can significantly reduce the costs of trade and increase cross-border trade. The use of ICT apparatus for official customs procedures can lower trade delays and improve the transparency of customs operations. Building the capacity of the border administration is essential to implement digitalization of customs practices. A single window system can reduce time delays and trade costs, and boost trade flows considerably. The Authorized Economic Operator (AEO) scheme can reduce border clearance times, increase exports, and facilitate export diversification.

Trade facilitation reforms are essential for the enforcement of cost-effective customs procedures and cooperation of border agencies to minimize rents. Expenses to leverage automated customs clearance, data, exchange, single windows, digital equipment, and capacity building should be curtailed to lower trade costs using efficient and transparent strategies. The sustainability of trade facilitation reforms requires capacity building to impel changes and identify and tackle novel problems that may emerge in the future. This entails the capacity building of higher-ranked officials in border agencies to escort and carry trade facilitation reforms. Trade facilitation reforms to bolster border agencies should be evaluated to ascertain impact and offer corrective measures. Trade facilitation measures can entail novel legislation to revise available laws. This requires time and specialized officials to evaluate available regulations, guarantee reliability and consistency with existing national strategy policies, and analyze likely unplanned effects on different clients.

Country-specific Recommendations

In the following paragraphs, country-specific policy recommendations are provided:

Afghanistan: Clear cargo rules and transit charges should be implemented to address vague transit and official practices along corridor 2. The AEO scheme should be implemented to reduce the border clearance time of unlawful cargoes from Afghanistan to neighboring countries. Green lanes should be instituted to facilitate the firms' cargoes operated through the AEO for smoother border crossing.

Georgia: A system of common customs management at BCPs along corridor 3 should be developed to minimize delays of cargoes to bordering nations. Novel and rapid direct road transport routes equipped with robust hard and soft infrastructures should be constructed to connect Georgia with Tajikistan through Turkmenistan rather than Kazakhstan to realize cost-effectiveness and minimize delays at BCPs. New agreements on reduced cargo transit fees should be inked between Georgia and Tajikistan to equalize the transit charges with the Kyrgyz Republic and Uzbekistan at similar BCPs.

Kazakhstan: In Kazakhstan, the competence of border clearance officials should be enhanced to lower the transit interruption and waiting time at BCPs along corridor 1, due to physical authentication of cargoes, which entails instituting truck scanners for efficient inspection. The road transport fees on the heightened-traffic Urumqi–Almaty route should be diminished and equalized with the lower charges on the PRC-XUAR route in corridor 4. Institutional changes are required to implement containerization in a multimodal transportation system for achieving higher functional effectiveness. Novel laws and institutions should be developed to execute the practical application of the e-Carriage of Goods by Road system. The capacity building of the technical and logistics workforce should be implemented in bolstering both the hard and soft infrastructures.

Kyrgyz Republic: The Kyrgyz Republic should substantially increase novel investment in cold-chain infrastructure along corridor 3 to foster perpetual exports of agricultural and horticultural products. The government should make substantial efforts to profoundly merge trade and transport aspects into the Eurasian Economic Union focusing on digital papers and ICT practices to abolish excessive paperwork.

Mongolia: The official border clearance practices should be fostered for speedier transit of perishable goods along the Mongolia-PRC transit points in corridor 4. In the case of high-value and heavy machinery and equipment, the transfer of road freight to rail cargo including customs procedures causes delays and increases the cost at border crossings. Therefore, substantial investment should be made in rail transport development for cost-efficient transit of heavy goods from Mongolia to the PRC.

Pakistan: A single window system should be implemented in Pakistan for smoother transit of cargoes from Afghanistan along corridor 5 to reduce stoppages at seaports. Pakistan should implement the reciprocal AEO scheme with economies along corridor 5 to increase the effectiveness of transit trade. The International Road Transport (TIR) parks should be developed to tackle larger traffic flows at BCPs and minimize the time for cargo to cross borders. Rail transport should be strengthened to reduce transport cost and enhance the quality and value of agricultural exports.

Tajikistan: Tajikistan should replace the customs guide for TIR cargoes by instituting a global positioning system to significantly reduce trade transit costs along corridor 6. Illegal cargoes from Afghanistan should be supervised using novel digital techniques like digital stamping and smart scanners to reduce the transit time at BCPs. Tajikistan should also implement the AEO scheme as well as green lanes for smoother transit of trucks loaded with agricultural and horticultural goods.

Turkmenistan: Turkmenistan should foster the technical and managerial skills of logistics operators in supply-chain and cold-chain management to achieve trade cost efficiency along corridor 6. Turkmenistan should upgrade the hard infrastructure and modernize the soft infrastructure at BCPs to reduce delays. The AEO scheme should also be practiced on a reciprocal basis among bordering countries.

Uzbekistan: Uzbekistan should install digital scanners for faster cargo verification, raise the number of access lanes to BCPs, and create more green lanes to reduce delays at BCPs along corridor 3. Uzbekistan should renovate the hard infrastructure and integrate digital technologies to upgrade soft infrastructure at custom clearance points to reduce the time at border crossings along corridor 6.

7. LIMITATIONS AND FUTURE RESEARCH DIRECTION

Data inadequacy is one of the major limitations confronted by this study. Generally, the CPMM TFIs data are available for the CAREC countries. The TFIs for country pairs can be captured to complement the bilateral trade flows along the CAREC corridor countries. Regular data are available only for time and cost indicators of trade facilitation at BCPs over the period. The frequency of CPMM TFIs data is available on a yearly basis, and in some cases it is available on a quarterly basis, which restricts the analysis to pooled regression only. The data on rail transport are available for a few BCPs only, which is insufficient to perform a detailed assessment. Even data on road transport are available for 61 BCPs against the sample of 76 BCPs for most of the years since 2010 and road transport is used for 70% of trade along the CAREC corridor countries (ADB 2018). Therefore, analysis of TFIs has been done for road transport only. The comparative data on imports are scarce; therefore, this study has focused on exports only. Keeping these limitations in mind, future research studies can aim to analyze the effects of TFIs on bilateral trade flows along both road and rail transportation routes as well as analyzing the impact of TFIs on both imports and exports along the CAREC transport corridor economies.

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