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Article

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Assessing the effect of INSTC on India's trade with Eurasia: an application of gravity model

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ABSTRACT

India's trade with Eurasian countries has been improving steadily. India is aggressively addressing its troubles of accessibility and connectivity to the region, primarily through International North South Transport Corridor (INSTC). The present study has been undertaken to empirically examine the impact of INSTC on India's export to its member countries. Using gravity model of international trade in a panel data framework, the findings show that both distance and if a trade partner is landlocked, effect India's export negatively. Additionally, a positive effect of INSTC on India's export was also discovered, elucidating the need to quickly remove the bottlenecks holding back the success of the project. Knowledge transfer and investment in infrastructure is solicited to facilitate the smooth transfer of goods, which will entail economic benefits for all members and also provide a counter narrative to China's increasing influence in the region.

IMPACT STATEMENT

Economic corridors are generally regarded as a tool for the facilitation of international trade. Therefore, an assessment of a corridor from trade perspective is essential to take corrective measures, if necessary. Our research empirically examines the International North South Transport Corridor (INSTC) for examining its effectives in stimulating exports from India to other member states. The results suggest that both distance and a trade partner being landlocked adversely effects India's exports. The INSTC has been helpful in bridging these trade cost for India's export to the member states. This novel work gives credence to the potential of INSTC as a source mutual benefits for the member countries. The research assumes more significance in light of the concerns surrounding supply chain disruptions for INSTC members due to Russia-Ukraine war.

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1. Introduction

India aspires to become the world's third-largest economy by increasing its current $3.2 trillion GDP to $5 trillion in 2025. To achieve the required growth rate for realising the target, the government of India has set the ambitious goal of $1 trillion in exports by 2025, relying on the export-led growth strategy.[1] However, it will be a challenging assignment; it calls for economic reforms that will encourage the industrial sector by aiding corporations and assisting SMEs (small and medium-sized companies). In that direction, the "Make in India" project is one of many programs initiated by the government to transform the country into a manufacturing hub and assist in achieving the export target.

The success of export promotion programmes will depend on several factors, including identifying regions with high trade potential and developing relations with those nations. Undoubtedly, one such region is Eurasia, but direct access presents a challenge. The recent increase in trade flows with Russia

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due to the conflict in Ukraine is a testament to the region's potential for India. Therefore, to address the issue of accessibility to the region, the Indian government is making the construction of corridors one of its top foreign policy priorities (Tandon, 2016).

India is looking into new possibilities for economic collaboration and has been diversifying its trade and investment relations. Most of India's trade goes through the Suez Canal, but getting to Eurasia is expensive and challenging (including a potential region: Central Asia). Trade with Central Asia is also quite limited (Kuszewska and Khan, 2020). Therefore, as one of the founding members, India created the International North South Transport Corridor (INSTC), an economic corridor, to gain access to the region and beyond. INSTC is a multimodal transportation corridor including land, marine, and air components estimated to be around 7,200 kilometres long (Khan and Koch, 2021; Khan and Omidi, 2023). With the aid of reliable infrastructure, logistics, and distribution networks that connect production hubs, urban clusters, and international entry points, the INSTC envisions bringing the regions closer and making the transfer of goods more efficient.

Although INSTC has been operational for the last two decades, it remains to be seen whether INSTC has contributed to enhancing India's trade with the member countries. There needs to be more literature on the viability of INSTC as a tool for trade promotion to the Eurasian region. The limited literature we came across on INSTC explores the geopolitical angle of the project (See, for instance, Gogna, 2019; Kavalski, 2019; Meena, 2020; Mohapatra, 2022). The authors have yet to come across any research that empirically studies the impact of INSTC on India's export. The study Khan et al. (2023) looked at India's trade with Caspian nations within the framework of INSTC and sought to assess historical trends of Indo-Caspian trade potential using a gravity model; however, the study is only focused on Caspian nations. In view of the fact that India has been expanding its trade and investment links with the other INSTC countries and is looking into new possibilities for economic cooperation, the current study aims to highlight the importance of commercial interactions between INSTC member countries. Direct access to the Caspian region, however (most INSTC members), posed a barrier for India (Passi, 2017; Zafar, 2023). As a result, trade with nations in Central Asia is also quite limited. Moreover, the scant INSTC literature is studied from a geo-economics point of view. Further impartial investigation, according to the paper's authors, is required to ascertain how INSTC affects India's exports. We, therefore, investigate whether India's exports are hampered by distance and whether INSTC has been effective in bridging this gap.

We utilised the gravity model, one of the most extensively used models, to assess international trade and to estimate the trade potential between countries. Gravity model has been used in recent times to assess the economic significance of Belt and Road Initiative (BRI) for China's trade flows. In the Indian context, Lohani (2020) employing gravity model suggests that having a common border and official language is advantageous to trade and that any increase in distance results in a higher trade cost that negatively affects exports of goods. Additionally, trade agreements between countries have favourable effect on trade potential (Kohl, 2014).

This paper has six sections—the initial introduction, which focuses on the need and contribution of research. The background of INSTC is covered in the second part. The Gravity model, utilised in this study to determine the potential for trade, is expanded in the third section. Section four provides model specification and sources of data. The results of the panel regression are presented in section five. The paper concludes with a discussion on results in the last section.

2. Background of INSTC

India, Iran, and Russia together launched INSTC in September 2000. Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Ukraine, Oman, and Syria are the other ten nations that have since joined the INSTC. It would link the economies of Russia and Europe with those of the Indian Ocean and the Persian Gulf via Iran and the Caspian Sea. INSTC primarily consists of three routes, although sources in Iranian media indicate that there may be room for an additional 14 routes connecting ports in India, the United Arab Emirates, and Russia. The INSTC will utilise ships, trains and road transport to move goods. Goods will travel on ships from Jawaharlal Nehru and Kandla ports in Western

India to Iran's Bandar Abbas harbour, going by road and rail north through Baku (Azerbaijan) to Moscow and St. Petersburg as well as pass into Europe (Shepherd, 2017).

Once completely operational, the INSTC will diminish shipping costs and time for merchandise from India to Europe, Russia and Central Asia. As per test runs completed in 2014, the INSTC course was 30 per cent cheaper and 40 per cent shorter in terms of time (Purushothaman & Unnikrishnan, 2019). There are three primary routes part of INSTC (a) Western: This corridor connects Indian ports on the Western coast with Iran (Astara), Azerbaijan (Baku) and Russia. It runs through the Western coast of the Caspian Sea. (b) Central: It connects India to Bandar Abbas port in Iran and later passes from Nowshahr, Amirabad and Bandar-e-Anzali while running along the Caspian Sea. It reaches Astrakhan port in Russia. (c) Eastern: The eastern artery connects India and Russia through Central Asian countries like Kazakhstan, Uzbekistan and Turkmenistan via Iran.[2] In addition, an Indian agreement with Iran in May 2016 established Chabahar port in Iran, thus providing a vital potential conduit for India's exchange and commerce with West Central Asia (Grajewski, 2022). India has already committed over US$2.1 billion to the project, spending about US$500 million on the expansion of the Iranian port of Chabahar and another US$1.6 billion on the construction of a railway line between Zahedan, Southern, and eastern Iran and the Hajigak iron and steel mining project in central Afghanistan.[3]

2.1. How has INSTC gained significance in recent years?

First, it must be acknowledged that due to the war in Ukraine, Russia has reassessed its geoeconomic interests and intensified its engagement with INSTC affiliates to ensure the quick delivery of various infrastructure projects associated with INSTC. Russia has expressed interest in spending millions of dollars on constructing railway infrastructure in other nations, including China, Kazakhstan, and Mongolia, in response to recent geopolitical developments. Moscow has chosen to fund two significant INSTC-related projects in Iran and Azerbaijan. Given the current geopolitical environment, these initiatives mark significant shifts in Russia's regional infrastructure investments. The increased emphasis on INSTC was made possible by the Ukraine crisis and the intensification of Russia's policy towards the East.

Simply put, INSTC has benefited from the Ukraine situation; the project has gained prominence in the geopolitical strategies of the involved nations (particularly Russia). If the crisis persists, INSTC's influence

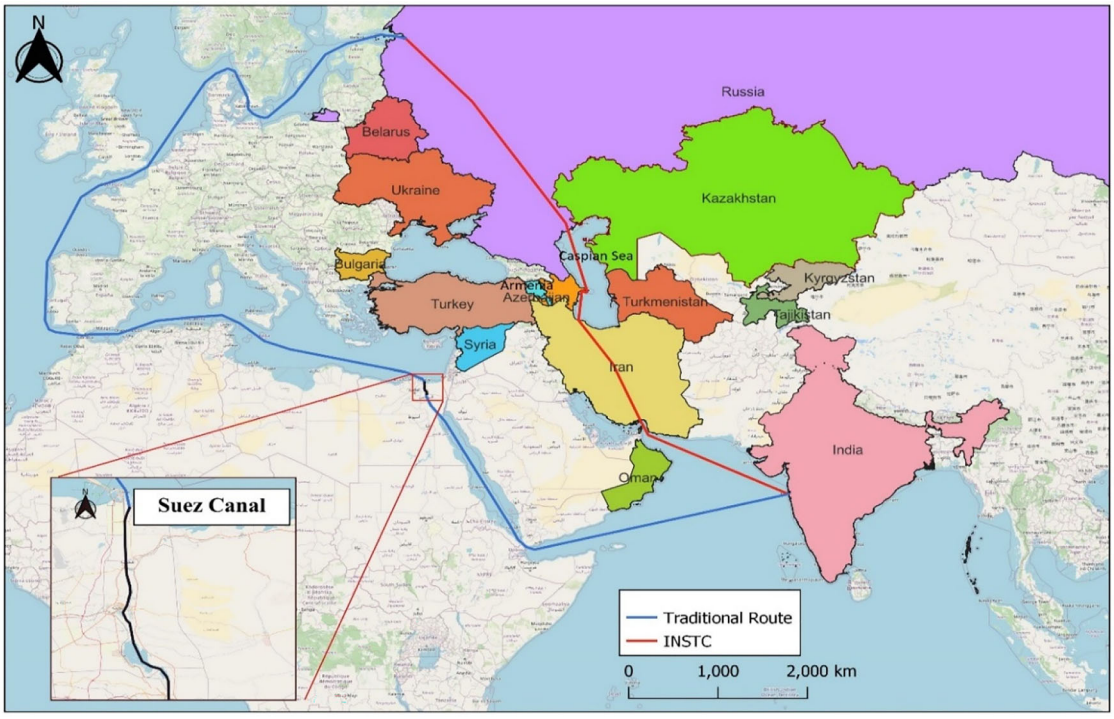

Figure 1. Traditional route (Via Suez Canal) Vs INSTC Route (Via Chabahar Port in Iran).
Source: Prepared by authors.

on Russian foreign policy—specifically on Moscow's interactions with nations in South and Southeast Asia—will grow. As a result, INSTC will be crucial to Russia's political economy, and it will play a more prominent geopolitical and geo-economic role as a route free of Western influence than ever before (Huwaidin, 2022).

Second, the recent Suez Canal blockage, which cost the global economy a hefty US$9 billion, has raised the profile of the International North South Transport Corridor (INSTC) as a cheaper and faster alternative multimodal transit corridor[4]. It can answer logistics headaches and mitigate against the worst impacts of future blockage scenarios (see Figure 1). Goods from India can be transported along this corridor with a relatively lesser cost and time and consequently more profitable when compared to the Suez Canal route (Divsallar, 2022).

Third, INSTC is a feasible and more equitable alternative to China's Belt and Road Initiative (BRI). The combined objectives of confronting and undermining China's BRI in resource-rich parts of the world, such as Central Asia and Africa, are part of New Delhi's grand geopolitical plan.[5] It is estimated that if India and the Eurasian Economic Union sign a free trade agreement (FTA) while the INSTC also becomes fully functional, India's two-way trade with Eurasia could reach $170 billion from the current figure of around $20 billion.[6] In April 2023, India and Russia began negotiating to sign a free trade agreement between India and the Eurasian Economic Union. India and the Eurasian Economic Union (EAEU), which consists of Russia, Belarus, Kazakhstan, Kyrgyzstan and Armenia, are negotiating a free trade agreement (FTA). If such bilateral agreements come into effect, they will offer a mechanism to counter China's plan of building a political and economic hegemony in the region through BRI.

Fourth, Increased trade volume among members: To date, the trade data among INSTC members are far from their true potential. Only 1% of the total exports in the CIS region come from India, whereas the overall trade connections with India are also visibly weak (Shepotylo, 2009). Energy products and military hardware heavily dominate India's trade with Russia. Given the size of the Indian and Russian economies and the comparative advantage, these countries enjoy in various products, there are multiple avenues to improve trade relations (Tochkov, 2018). The lack of knowledge about Indian markets among the Russian business class and the cost of trade are the main reasons for the minimal trade in other items. The INSTC will strengthen physical connectivity and knowledge and information-sharing processes and reconnect former conventional marketplaces that have been inaccessible since the division. These underdeveloped markets have enormous potential for trade and consumer growth.

3. Gravity model

Gravity derives its name from Newton's law of gravity, as its nonlinear function resembles the functional form of physics law. It has long been used to study bilateral trade patterns, analyse trade barriers and identify trade factors in empirical economics. Tinbergen (1962) was the first to translate the intuitive explanation of bilateral trade flows into applied international trade literature. His findings laid the foundations of the modern-day gravity model, which theorises that trade between nations is directly proportional to the size of their economies and inversely proportional to the cost of trading. In other words, gravity postulates that larger countries are expected to trade more, but countries that are more removed from each other are expected to trade less, probably because of higher trade costs. Since then, the model has been used in trade literature extensively.

Although the model was initially based on an intuitive idea, later scholars have explored the theoretical basis for employing the gravity model in trade literature (See, for instance, Anderson, 1979; Anderson & Van Wincoop, 2003). Addressing the challenges to theoretical underpinnings of gravity model, recent works provide a more comprehensive rationale for its usage (See for instance, Feenstra, 2015). It has been continuously improved over the years and expanded for studying emerging issues in international trade (See for instance (Bergstrand, 1989; Deardorff, 1998; Feenstra et al., 2001; Evenett et al., 2002).

The efficiency and effectiveness of gravity model is best highlighted by Beck (2020), who compared different determinants of trade for EU countries and states that 'gravity model takes lead in explaining trade flows'. Due the effectiveness of gravity model in trade studies, we have seen a considerable increase in the application of gravity model to gauge different aspects of international trade. For

instance, it has been used to study trade patterns of countries. Hassan Khayat (2019) and Lypko (2022) examined the trade pattern of GCC countries with developed nations and central and eastern Europe, respectively. Kabir and Salim (2016) used gravity model to study the effects of intellectual property rights (IPR) on china's electrical and electronic exports. Similarly, Nathoo et al. (2021) demonstrate a positive effect of aid for trade on both extensive and intensive margins of trade for countries in Sub Saharan Africa.

Another prominent area of application of the gravity model has been to estimate the trade potential of countries. For example, Batra (2006), using cross-sectional data from India, analysed trade patterns with the world and forecasted the future trade potential of India. Similarly, Sohn (2005) employed a gravity framework to examine factors affecting the bilateral trade flows of South Korea and opined that Japan and China need to trade with South Korea to their full potential. More recently, the gravity model has been adopted for studying the effects of free trade agreements and economic corridors. For example, Jagdambe and Kannan (2020) have studied the effects of ASEAN- India free trade agreements on agricultural trade and suggest the need to liberalise agricultural trade in free trade agreements. Similarly, Huang et al. (2020) forecast the trade potential of China with the five central Asian countries, highlighting the efficiency of the Belt and Road Initiative (BRI). Jing et al. (2020) also used the gravity model to forecast China's renewable energy trade potential with BRI countries. Although, there is extensive literature employing gravity model, Kabir et al. (2017) after conducting a thorough survey of existing studies, suggest a closer examination of the distance factor for determining trade flows in the presence of unilateral and multilateral arrangements between the countries. The present work will add to the strand of literature that has attempted to address concerns of Kabir et al. (2017).

4. Model specification

As mentioned in the preceding section, the gravity model was presented as an intuitive explanation of trade flows. In its most basic form, it can be written as:

$$X_{ij} = \dot{\alpha}_i + \dot{\beta}_1 GDP_i + \dot{\beta}_2 GDP_j + \dot{\beta}_3 TC_{ij} + \dot{\mu}_i \tag{1}$$

Where X_{ij} depicts exports from country i to country j, GDP_i and GDP_j is gross domestic product of originating and destination countries, TC_{ij} captures the trade cost between two countries, usually proxied by the geographical distance between the capital cities and $\dot{\mu}_{it}$ is a random error term. The $\dot{\alpha}_i$ term is the model intercept, and the β terms are coefficients, measuring the effects of explanatory variables.

Following macro-economic literature, we make the logarithmic transformation of the fundamental equation and replace trade cost with distance. The modified equation can be written as:

$$lnX_{ijt} = \dot{\alpha}_i + \dot{\beta}_1 lnGDP_{it} + \dot{\beta}_2 lnGDP_{jt} + \dot{\beta}_3 lnDis_{ij} + \dot{\mu}_{it} \tag{2}$$

Where ln represents the logarithmic application of the variables under consideration, X_{ijt} denotes the export of India to INSTC affiliates in period t, GDP_{it} and GDP_{jt} is GDP of India and INSTC countries, respectively, at time t, and Dis_{ij} is the geographical distance in kilometres between from India's capital city to respective trade partner under consideration.

As India's export is also affected by other factors, we conducted a survey to identify elements of India's trade and evaluated its relevance for the present study. Apart from GDP and distance, other variables, such as common borders and language, can be used in the standard gravity model (Frankel et al., 1997). Common language and border are employed in gravity models with an understanding that it alleviates trade costs between nations. However, it does not add value to the model for our purposes as India does not share a common border and language with any of the INSTC affiliates. Additionally, common religious culture has been suggested to influence countries' trade patterns, where some religious cultures are more conducive to trade and others not (Guo, 2007; Lewer & Van den Berg, 2007). Despite the relevance of religious culture for determining trade flows, we do not use it because of the absence of common religion between the countries under consideration.

Moreover, WTO membership and a country being landlocked have also been argued to improve the predictive capability of gravity models (Jing et al., 2020). We incorporate both variables in our model for carrying out the study. The Population of trade partners has also been considered in extended gravity

models to account for the exporting country's supply and consumption capacity and importing nations' consumption capacity (Jagdambe & Kannan, 2020). We test for the relevance of Population in our estimation of the gravity equation. Lastly, we incorporate INSTC in our study to identify its cumulative effects on India's export to INSTC members. The augmented gravity model in its linear form is presented as:

$$lnX_{ijt} = \dot{\alpha}_i + \dot{\beta}_1 lnGDP_{it} + \dot{\beta}_2 lnGDP_{jt} + \dot{\beta}_3 WTO_{ij} + \dot{\beta}_4 Landlocked_j + \dot{\beta}_5 lnPop_{it} + \dot{\beta}_6 lnPop_{jt} + \dot{\beta}_7 lnDis_{ij} + \dot{\beta}_8 INSTC_{ij} + \dot{\mu}_{it} \quad (3)$$

Where WTO_{ij} is a dummy variable taking a value of 1 if both India and the corresponding INSTC member are WTO members in a period and 0 otherwise. $Landlocked_j$ is a dummy variable that takes 1 if a country is landlocked and 0 otherwise. Pop_{it} and Pop_{jt} are the Populations of India and other INSTC members, respectively, for different years. $INSTC_{ij}$ is a dummy variable considered 1 if both India and the partner country are members of INSTC in a given year and 0 otherwise. If the results of the present study concur with the existing literature, $\dot{\beta}_1$, $\dot{\beta}_2$, $\dot{\beta}_3$, $\dot{\beta}_6$, and $\dot{\beta}_8$ are expected to have positive signs and $\dot{\beta}_4$ and $\dot{\beta}_7$ are expected to be negative, whereas $\dot{\beta}_5$ can have a positive as well as negative sign.

Recently, using the OLS technique for estimating gravity models has been criticised because of the problem of zero trade flows, as the assumption of $X_{ijt} > 0$ is violated in most cases. However, our dataset does not violate the positive trade flow assumption and, therefore, can be estimated using OLS. Furthermore, because of the presence of time-invariant variables like distance and landlocked in the model, we can only estimate the time-fixed effect. However, to extend robustness to our overall analysis, we estimate a fixed effect model, where the time invariant variables would be dropped due to collinearity. We also estimate the random effects model and then compare the results from the estimated model under different assumptions using the walds test of linear restrictions and the Breusch and Pagan Test. The results from the walds test and Breusch and Pagan test help us identify the correct model specification for our data. Lastly, in order to compare our results from random and fixed effect estimations, we perform Hausman test, which has the null hypothesis of random effects being a preferred model.

4.1. Data source and characteristics

In order to carry out the analysis, we use the extended gravity model in equation (3). We use a panel dataset of India's export to INSTC members from 2000 to 2019. The study period is chosen to remember the year in which the INSTC project started materialising and the visible structural break in the export figures post the global lockdown in 2020 due to the Covid19 outbreak. The country dimension of the panel dataset consists of 14 INSTC affiliates and 1 INSTC observer. The list of countries associated with INSTC is presented in Appendix 1. The source of the dependent variable, along with 8 explanatory variables, is given below.

The dependent variable X_{ijt} (India's export to INSTC members) is extracted from trade map and world bank database. Among the independent variables, the GDP and Population of countries have been derived from the world bank database of world development indicators. The status of WTO membership has been assessed from the official website of WTO. The data on the physical distance between India and other countries and INSTC landlocked countries have originated from the USITC (US International Trade Commission) database. INSTC membership information has been collected from the official website its official website. All variables have converted into logarithmic values for easy interpretation of results with the exception of dummy variables. Regression coefficients of logged variables can be interpreted as elasticity (Azmi & Akhtar, 2022). We use the stata15 software package to perform our quantitative analysis based on the recommendations of Azmi et al. (2023).

5. Results

We have estimated the gravity model with OLS and GLS. OLS estimation has been used to estimate POLS and time effect and fixed effects models, whereas GLS has been employed for estimating the random effect model. Additionally, we have estimated parameters employing Poisson pseudo-maximum likelihood (PPML) model to supplement our results with a sensitivity analysis, which in our case means

to examine whether results are sensitive to changes in the estimation technique. The results of the panel regression analysis are presented in Table 1. At the onset, we computed descriptive statistics of all variables employed in the study to get a sense of the data. The descriptive statistics reported in Appendix 2 are in line with our expectations and do not raise any cause of concern. Before proceeding for further analysis, we have tested cross sectional independence assumption using Pesaran (2021)'s CD test. The null hypothesis of the Pesaran's CD test is that the cross-sectional units are independent. From the results in Table 2, the CD test does not reject the null hypothesis of cross-sectional independence. Therefore, cross-sectional dependence is not a problem in the present context. We can proceed further.

Table 1 reveals that all the models show the GDP of reporting and importing countries to have a significantly positive effect on exports, except POLS estimates that found the GDP of India to be insignificant. Although all five models report the same level of significance for GDP, there are differences in the magnitude of their effects. With other things remaining the same with an increase in either the GDP of India or the importing countries, the exports from India to INSTC affiliates will increase. We also found India's Population to be insignificant for the fixed effect models and significant in the other three models. However, the Population of partner countries was reported to be significant only in the POLS. Distance has the expected negative sign and is highly significant under the time-fixed effect, random effects and PPML models. However, we observed that distance is insignificant when considering the POLS model. Lastly, the regression analysis suggests the landlocked and WTO membership status variable is significant at 1% for most models. The missing values in fixed effects models could not be estimated due to collinearity.

The log-linear regression findings can be interpreted as elasticities. Here, we emphasise that the coefficient estimates of the variables are almost similar when estimated with different methods. Hence, we will discuss the coefficient estimates of only one estimator. For instance, using random effect estimates, a 1% increase in India's GDP will result in a 0.449% increase in India's export to INSTC members. Since the landlocked WTO and INSTC were dummy variables, it should be interpreted by taking its exponential and then deducting one from it (Frankel et al., 1997). For instance, the coefficient of the landlocked variable is -0.438, which indicates that India exports 35% less [{exp (-0.438) – 1} *100] to a landlocked country relative to other countries. Similarly, the WTO membership coefficient can be interpreted as India exported 40 percent more [{exp (-0.342) – 1} *100] to a country when both countries are WTO members for a given year. Lastly, INSTC coefficients suggest a 27 percent increase [{exp (-0.243) – 1}

Table 1. Gravity model estimations.

Variable	POLS	Fixed Effects (Time)	Random Effects	Fixed Effects	PPML
Constant	−4.544*	−3.935*	−1.91	−5.557**	0.789
$lnGDP_{it}$	0.857	0.619***	0.449***	.929**	0.435**
$lnGDP_{jt}$	0.455***	0.737***	0.744***	0.421***	0.783***
WTO_{ij}	0.067	0.341***	0.342***	.045**	0.392***
$Landlocked_{j}$	−0.682***	−0.442***	−0.438***	–	−0.481***
$lnPop_{it}$	0.319**	0.278	0.179***	−1.138	0.168**
$lnPop_{jt}$	0.010*	0.168	0.098	0.235	0.159*
$lnDis_{ij}$	−0.857	−1.202***	−1.210***	–	−1.567***
$INSTC_{ij}$	0.454***	0.512	0.243**	0.346**	0.402***
$p >$ chi 2	0.00	0.00	0.00	0.00	0.00
R- sq	0.745	0.785	0.845	0.694	0.921
Walds Test (*p*-vale)	0.06				
Breusch and Pagan LM Test	930.71***				
Hausman RE/FE Chi Square Statistics: 5 P-Value: 0.54					

Source: Author's calculations.
***Significant at 1% level, **Significant at 5% level, *Significant at 10% level.

Table 2. Diagnostic tests.

Tests	Statistics	*p*-value
Pesaran's test of cross sectional independence	12.297	0.148
Modified Wald test for group wise heteroskedasticity	1.125	0.326
Wooldridge test for autocorrelation	0.593	0.867

*100]in exports by India to INSTC members in the years in which both the countries were its members as opposed to when they were not.

In order to identify which of the models best fits the data from our study, we first compare the results of the POLS and time effect model using the Walds test of linear restrictions, which tests whether adding time restrictions to the model improves it or not. In our case, it tests whether adding year dummies is more appropriate for specifying the augmented gravity model. It tests the null hypothesis of the joint significance of year dummies against the alternative that they are insignificant. As evident from Table 1, the Walds test returns a very low F statistic and is insignificant. The results can be interpreted as the walds test favours the POLS model over time effect model for our data.

Additionally, we performed Breusch and Pagan Lagrangian multiplier test to compare POLS and random effect results. The test has the null hypothesis of insignificant random effects, with the alternate hypothesis being that the random effects are significant. Table 1 reports the findings of the test. Relying on the high chi-square statistic of 930, we can reject the null hypothesis of insignificant random effects. In other words, the random effect model is better suited for our dataset.

Finally, the decision for best suited model between random and fixed effects was made based on Hausman test. The test examines, which compares a consistent estimator with an efficient estimator under the assumption being tested, with the null hypothesis being that the estimator is indeed efficient (and consistent). The results in Table1, show that the null hypothesis of Hausman test could not be rejected and therefore random effect model is the preferred model in our case.

The results of the present study are shown to be consistent as revealed by the diagnostic tests of autocorrelation and heteroscedasticity of error terms. The residuals are normally distributed with constant variance and there is no auto-correlation. The results of the diagnostic tests have been reported in Table 2.

6. Conclusion and discussion

In the present study, we check the relevance of the gravity model for India's export to INSTC member countries and determine whether INSTC has helped India's export. We estimated POLS, time-fixed effect and random effect models and used model specification tests to determine the model best suited for our study. We found most explanatory variables significant determinants of India's export to INSTC affiliates in all the models. Subsequently, the correct model specification was found to be random effects model, which suggests all variables considered for the study to be significant for India's export except for the Population of partner countries.

The findings for GDP and distance variables are similar to what Lohani (2020) reported for India's trade with BRICS nations, reinforcing that these factors are relevant to India's export. Therefore, policies aimed at enhancing India's economic growth will result in higher exports to INSTC members. Additionally, as distance is found to be inversely related to India's exports, the farther a country is from India, the less export it is likely to receive. As distance represents trade cost, the initiatives to remove market access hurdles and trade barriers will improve India's export to the countries under consideration. For instance, negotiating trade agreements with INSTC members, especially the CIS countries that have recently taken steps to integrate with the world economy, will help promote India's trade with these countries. Unlike Jagdambe and Kannan (2020), we discovered that the Population of only reporting countries matters for exports, whereas partner country populations are insignificant determinants of India's export. The significantly positive effect of India's Population on its export can be explained by the theory that a large Population stimulates the growth of the industrial sector and accrues benefits of economies of scale, which entails a comparative advantage to exports from India. For instance, India's export to INSTC members is heavily dominated by pharmaceuticals, and the pharmaceutical industry's efficiency can be attributed to the need for affordable medicine for India's growing Population.

We also found the effect of INSTC membership to be positive on India's export, which aligns with the results of Jagdambe and Kannan (2020), who show that trade agreements impact India's agriculture export positively. INSTC being a transport corridor, also serves the purpose of a trade agreement by reducing the distance and, thereby, the cost of trade between INSTC member states by proposing shorter routes of trade. Hence, resolving policy bottlenecks and giving further impetus to the

infrastructure development drives needed for the success of the transport corridor should be prioritised by the government.

It is also worth mentioning that in the backdrop of the Russia-Ukraine war, the significance of the INSTC can not be emphasised enough for its affiliates, as both Russia and Ukraine together account for the production of around 30% of the world's wheat and barley, a fifth of its maise and more than half of sunflower oil. In addition, the Russian Federation is the second-largest oil exporter in the world and the top exporter of natural gas. Belarus and the Russian Federation together export around 5% of the fertilisers used worldwide. However, the conflict in Ukraine is causing more frequent interruptions to supply chains and global logistics, which is adding to the already high levels of delay in the world's maritime transportation system. In several shipping categories, port congestion continues to play a significant role in driving up freight charges and strong market conditions (World Economic Situation & Prospects, 2019). Consequently, the findings of the current study assume more significance because it highlights the role of INSTC in easing the concerns of supply chain disruptions for its members and offers an opportunity for ironing out issues for future such scenarios.

Although the present study makes a significant contribution to the literature on INSTC, it has certain limitations. First, it considers only exports from India and not its overall trade. Second, it does not shed light on the changes in trade flows of partner countries due to INSTC. Third, INSTC has a broader objective of addressing connectivity issues from South Asia, Central Asia and Europe; therefore, considering just the INSTC affiliates for the empirical analysis narrows the scope of the research. Future researchers can address the limitations of the current study to elucidate the effect of INSTC on trade flows from regions.

Notes

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Data availability statement

Data used is available on public platforms without any fee.

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Appendix 1.

List of countries in INSTC

S. No	Name of Countries
1	Armenia
2	Azerbaijan
3	Belarus
4	Bulgaria (Observer)
5	India
6	Iran
7	Kazakhstan
8	Kyrgyzstan
9	Oman
10	Russia
11	Syria
12	Tajikistan
13	Turkmenistan
14	Turkey
15	Ukraine
16	Uzbekistan

Appendix 2.

Descriptive statistics

Variables	Mean	Std. Dev	Min	Max
lnX_{ijt}	7.11	0.81	4.88	8.74
$lnGDP_{it}$	12.1	0.25	11.67	12.45
$lnGDP_{jt}$	10.65	0.65	8.93	12.36
WTO_{ij}	0.45	0.44	0	1
$Landlocked_{j}$	0.46	0.44	0	1
$lnPop_{it}$	3.08	0.03	3.02	3.13
$lnPop_{jt}$	1.17	0.51	0.35	2.16
$lnDis_{ij}$	3.54	0.14	3.33	3.74
$INSTC_{ij}$	0.54	0.48	0	1

Source: Author's Calculations.