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TURKISH ECONOMY IN THE BELT ROAD INITIATIVE: A GRAVITY MODEL FOR INTERNATIONAL TRADE

Dr. Öğr. Üyesi Alper YILMAZ*

ABSTRACT

In this paper, we attempt to analyze the determinants of international trade flows between Turkey and countries in the Belt Road Inıtıative (BRI) project and their implications for the Turkish economy through the estimation of panel data using a gravity model. In particular, we employ the Poisson Pseudo Maximum Likelihood (PPML) estimation procedure for the nine BRI nations during the period of 2000-2021. This estimator is more robust than other methods such as pooled, fixed, random models and it is free from the problems of autocorrelation, asymptotic bias, multicollinearity, and heteroscedasticty in the residuals for estimation and inference. First, panel unit root tests show that conducted variables are stationary at conventional level. Second, the gravity estimations revealed that remoteness, scale, land endowment variables and dummies (Preferential Trade Agreement and Border) in the gravity model have a positive impact, while GDP Distance and Capital Endowment have an inverse effect on trade flows. Only the language dummy is statistically insignificant. For policy purposes, we concluded that it would be better to promote trade flows with the BRI countries.

Keywords: *China, Asia, New Silk Road, 'One Belt, One Road' Cooperation.*

JEL classification*: F50, F59, F63, F15, F13.*

BİR KUŞAK BİR YOL PROJESİNDE TÜRKİYE EKONOMİSİ: ULUSLARARASI TİCARET İÇİN ÇEKİM MODELİ

ÖZET

Bu çalışmada, Türkiye ile Bir Kuşak Bir Yol projesindeki ülkeler arasında gerçekleşen dış ticaretin belirleyicileri ve Türkiye ekonomisi açısından etkileri panel çekim modeli çerçevesinde incelenmiştir. Projedeki 9 ülkeye ait 2000-2021 verileri için oluşturulan çekim modeli, Poisson Pseudo Maximum Likelihood (PPML) yöntemi ile tahmin edilmiştir. Bu metod diğer yöntemlere göre (EKK, Sabit ve Rassal Etkiler) daha sağlıklıdır ve otokorelasyon, çoklu doğrusallık ve değişen varyans sorunlarından etkilenmemektedir. Analiz kapsamında ilk olarak birim kök testleri uygulanmış ve modelde kullanılan değişkenlerin durağan olduğu sonucuna ulaşılmıştır. Ikinci adımda model tahmin

* Adnan Menderes Üniversitesi, İşletme Fakültesi, Uluslararası Ticaret ve İşletmecilik Bölümü, Aydın/ Türkiye, E-mail: alper.yilmaz@adu.edu.tr.

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edilmiş ve mesafe, ölçek, kaynak donatımı ve kukla değişkenlerin (Tercihli Ticaret Anlaşması ve Sınır Komşuluğu gibi) ticaret akımı üzerinde pozitif etkide bulunduğu tespit edilirken, GSYİH ve Sermaye Donatımı değişkenlerinin ters etkide bulunduğu görülmüştür. Sadece ortak dil değişkeni istatistiksel olarak anlamsız çıkmıştır. Politika önerileri açısından, proje kapsamındaki ülkelerle dış ticaretin arttırılmasının faydalı olacağı düşünülmektedir.

***Anahtar Kelimeler**: Çin, Asya, Yeni İpek Yolu, Bir Kuşak Bir Yol Projesi.*

***JEL Sınıflandırması**: F50, F59, F63, F15, F13.*

1. INTRODUCTION

The Asia-Pacific region emerged as a global factory during the second half of the last century. Structural changes in this region started with mass consumption and marketing in Western economies during the 1960s, and reached a climax in the 2000s with a period of sustained household consumption and the Chinese accession to World Trade Organization (WTO) membership in 2001 (WTO, 2011:13). After the 2008 financial turmoil, Asia-Pacific countries have quickly recovered with a healthy dose of momentum and they have strengthened their role in the global economic system through outward-oriented (openness to trade, expanding export markets) policies. The accelerating trend of opening domestic markets to international trade, while gaining political power has prompted them to expand effective economic integration through regional and global cooperation. One of the most important attempts on this basis is the Belt & Road Initiative (BRI) program, which was introduced in September 2013 by China with the intention of strengthening economic ties across Asia as well as with Europe, Africa and even Latin America (Xu and Lu, 2020: 137).

Belt & Road Initiative (BRI) initiative of China is a longterm program that integrates Asia, Europe, Middle East and Africa through the construction of land and sea-based (maritime) infrastructure projects (Callahan, 2016: 1). The project's trade route crossing these continents can be viewed as an improved design of the ancient *Silk Road* from a modern perspective (Küçükcan, 2017: 83). It is an open and inclusive platform for all countries. In this program, international and regional organizations, in addition to individual countries can engage on the basis of mutual contribution and shared benefits (Karpathiotak, Tian, Zhou and Huang, 2021:43). The primary goals of the project are to promote regional connectivity and trade cooperation among participants (China and 64 Asian, European, and African countries), overcome trade barriers, develop bilateral relations, create a transit network, improve transportation infrastructure (it is crucial for the development of the initiative) that is centered on railways roads, shipping, aviation and pipelines, generate new jobs and lower the costs of trade. The construction of transportation networks linking East-Asian, European, and African hubs and ports is important for fast and undisturbed trade. It is also promoting the development of infrastructure along its twin land and sea-based routes (Dossani, Bouey and Zhu, 2020:7-9). The BRI initiative pursues a non-competitive and non-exclusive business nature. It also aims for green development and a sustainable

growth that is low-carbon and circular by committed to strengthening cooperation on environmental protection (green energy finance and investments in the BRI project were $6.3 billion in 2021) and defuse environmental risks (Krukowska, 2016: 16161-16165; Putten, Seaman, Huotari, Ekman and Iglesias, 2016: 3-10).

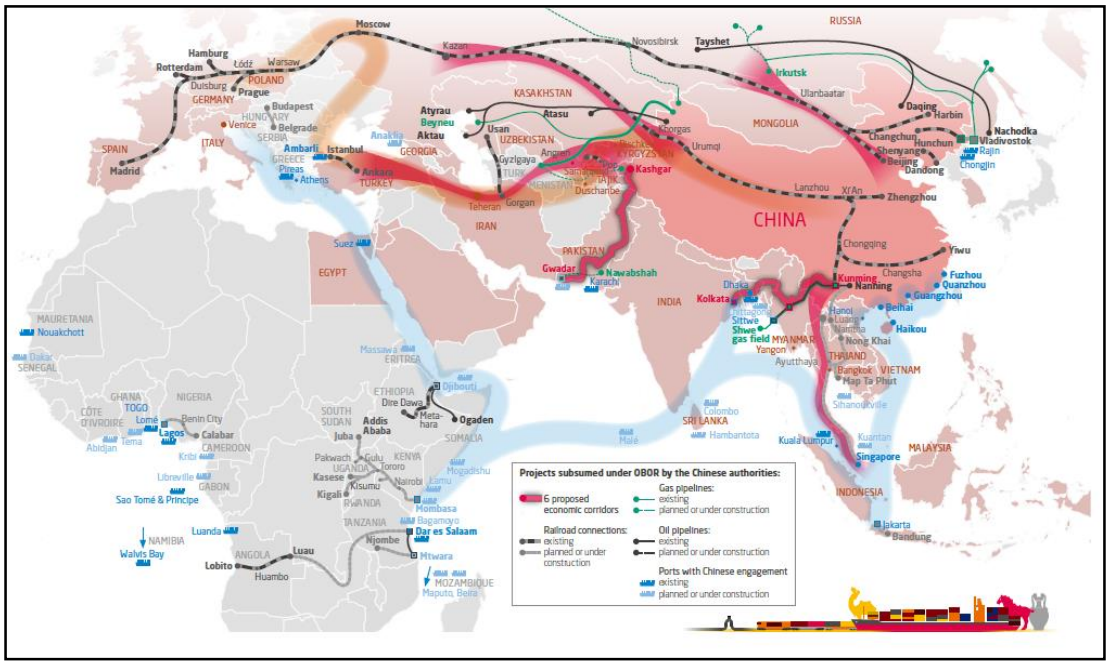
On the other hand, there are some critics of the project. The BRI includes irresistible soft loans, hard loans, aid, bank lending, and foreign direct investment; however, there are always consequences for least developed countries, sometimes unexpected (e.g. declaring a moratorium, decreasing bargaining power, increasing external dependence, trade deficit), and the competitive, exclusionary, and debt-laden aspects of loans remain unclear. Securing market access for Chinese exports and increasing China's diplomatic and commercial influence are also dangerous for LDCs. (Putten and Meijnders, 2015: 28-29). Some points of view argue that by developing trade links with China through the BRI, a partner country becomes dependent on China for its foreign trade. Second, China looks for become a global power with cross-border trade through this initiative (Zreik, 2022: 9). In this respect, some analysts perceive the project as a foreign policy tool of China against the West in a geopolitical confrontation (Qoraboyev, 2018: 2). Third, uneconomic projects with poor-quality implementation, high initial costs, and low operating returns could become unviable. Also, borrowers may accept the Chinese government handing out projects on a privileged basis to favored Chinese banks and firms without competitive bidding. It will be the first step in China's descent into debt tarpaulin (Dossani et al., 2020: 18). However, more countries and international organizations have signed cooperation agreements to join the BRI. By the end of March 2019, 173 cooperation agreements had been signed with 125 countries and 29 international organizations (Athari and Ajazi, 2020: 44–45).

Turkey is an important participant in the project, both in terms of economic size and geostrategic position. The Middle East and East Asia have become important trade partners for Turkey in recent decades, and trade ties are still growing. Commercial and political relations with the region are expected to improve with the BRI project. Because of the proposed advantages, Turkey found it suitable to participate in. The main objectives of Turkey in the project are to boost economic growth; create investment opportunities and new jobs; confirm ties with five Turkic Republics (namely Azerbaijan, Kazakhstan, Uzbekistan, Turkmenistan, and Kyrgyzstan), expand export markets and achieve large economic scales. For this purpose, in November 2015, China and Turkey signed a "Memorandum of Understanding" on the project, and Turkey welcomed the first freight train in 2019 that departed from Xian in China, which passed over the Baku-Tbilisi-Kars railway (BTK) and below the Bosporus via Istanbul's Marmaray tunnel (which makes transportation time 18 days between China and Western Europe) for the first time (Çakılcı, 2021: 95).

The initiative calls for a six network of economic corridors. These are the China–Mongolia–Russia Economic Corridor (CMREC), The New Eurasian Land Bridge (NELB), The China–Central Asia–West Asia Economic Corridor (CCWAEC), The China–Indochina Peninsula Economic Corridor

(CIPEC), The China–Pakistan Economic Corridor (CPEC), and The Bangladesh–China–India–Myanmar Economic Corridor (BCIMEC) (Karpathiotak et al., 2021: 43). In the program, Turkey provides a rational continental passage. The BRI program puts forward the Middle Corridor (MC), which includes the Trans-Caspian Route (TCR). Other alternatives that would be connected to MC are the Trans-Siberian Railway (TSR) over Russia via the Northern Corridor and the Trans-China Railway (TCR) through Kazakhstan by the Southern Corridor. But political and military tensions between Russia and Georgia, harsh winter conditions, and U.S. sanctions on Iran make them unattractive. A third and favorable alternative is passing over the Caspian Sea. The TCR can be integrated into Kazakhstan's railway network and extends to Azerbaijan via the Trans-Caspian roll-on/roll-off (RORO) link and finally reach BTK. This is faster and less costly than other alternatives (Acar, Bentyn and Kocaoglu, 2015: 105-106).

Figure 1. The One Belt One Road Project



Source: Putten et al., 2016: 10.

As seen from Figure 1, the project consists of building the Silk Road Economic Belt that links Asia and Europe through Turkey (the yellow line). At this point, the BRI project is the first Eurasian continental bridge with railway and land routes connecting Turkey and the rest of the world. So Turkey's geographical position is vital for the project. Since then, Turkey has always expressed its interest in becoming an economic bridge between East and West by creating energy and sea corridors. On that note, the Marmaray tunnel is a crucial part of this route (Athari and Ejazi, 2020: 51).

In Figure 1, the second route is the Maritime Silk Road, which connects China with the South Pacific Ocean through the South China Sea (the blue line). The third part is the Asian Infrastructure Investment Bank (AIIB) funding states (countries in brown). Lastly, the BRI program defines six

economic corridors (red line). Technically, the project has many multiple-dimensional transport network interconnections across the Eurasian continent, consisting of railways, highways, airports, maritime transport, oil and gas pipelines, transmission lines, and communication networks. As of 2017, 33 cities in China and 33 cities in 12 European countries are mutually connected within the BRI's framework (Jielin and Lu, 2019: 79) For example, in 2016, the first commercial train start from Yiwu City in east China's Zhejiang Province to Iran, passing through Kazakhstan and Turkmenistan to cover a distance of more than 10,000 km. On May 4, 2018, the Chinese train set off from Tangshan to Antwerp, a 16-day journey that covered a distance of 16,000 km (Zreik, 2022: 8). With these statistics, the project accounts for 62.3% of the world's population (they will have economic benefit) and three-quarters of the world's energy resources (Bruni, 2019: 5). Within the scope of the BRI, contractual (most of them are energy and transportation) cooperation in 2022 was about $59.5 billion. According to official information, 144 countries (42 in Sub-Saharan Africa, 34 in Europe & Central Asia, 25 in East Asia & Pacific, 6 in South Asia, 19 in Latin America, and 18 in the Middle East & North Africa) who had signed memorandums of understanding (Wang, 2022: 26). As a result, while this project offers many advantages to its participants, it also forces them to compete with China, which is the most powerful exporter in global trade.

2. THEORETICAL FRAMEWORK

The effects of economic integration (reducing trade barriers and establishing a cooperative trade environment, in addition to cultural and geographical proximity) have been analysed many times in the literature. According to Tinbergen, the magnitude of trade flows between partners can be approximated by these key factors (Balogh, 2015: 516). At the same time, regional trade initiatives and geo-political tools such as pipeline projects, maritime silk roads, or iron silk roads, are very useful for creating trade facilitation between partners. In this frame, geopolitical and infrastructural initiatives like BRI have introduced new paradigms to improve trade in manufactured goods, raw materials, and natural resources between partners. The BRI strategy also aims to harmonize partners' trade policies and promote interconnection and cooperation in the community. Second, the framing of particular policy initiatives by external agents is also important. From this perspective, it appears to be some kind of economic integration (Qoraboyev, 2018: 2).

In the literature, Economic Integration (EI) is described as agreements between countries that allow the flow of capital, labor, goods, and services across their respective international borders by eliminating trade barriers. According to Balassa (1987), economic integration can be defined as a process and a state of affairs. It points out bilateral trade in the absence of various forms of discrimination and trade barriers. Theoretically, the EI idea is based on comparative advantages and differences between countries in terms of labor, natural resources, or capital stock. Countries will capitalize on advantages from these factors if labor and capital are free to move across international borders. In the

end, world GDP, economic growth, unemployment, or other macroeconomic indicators will be better and price differences in capital and labor will be eliminated. Viner (1950) underlined that the removal of some tariffs in this process has resulted in economic welfare. (Arguello, 2000: 4).

EI is a kind of process that involves different degrees of cooperation, lessening discrimination and eliminating trade barriers between partner countries. In this framework, there are several forms of integration (Balassa, 1961: 2). Preferential Trade Agreements (members dismantle some trade barriers and tariffs or preferential treatment within quantitative constraints, but they retain their own national tariffs against non-members), Free Trade Areas (members eliminate trade barriers but continue to hold against third parties), Customs Unions (members eliminate all trade barriers and establish a common set of external tariffs on non-members), Common Market (in addition, members establish a common set of external tariffs on non-members) (Mikic, 1998: 442). The basic theory of integration was introduced by Viner in 1950 and later extended by Meade (1955) and Lipsey (1957).

The success of the integration depends on some factors. First, the economic area must be large enough. Second, the range of products should be wider and there should be considerable differences in unit costs of production for export industries. In this way, member countries utilize economies of scale (a cost reduction effect), and trade creation will be predominant. After the EI is formed, the increase in welfare appears as a consequence of expanded output and the decrease in average costs of production (Arguello, 2000: 23). An important role in this respect has been played by the emergence of infrastructure projects like the BRI initiatives. The project's launch will contribute to lower production costs through economies of scale, lower trade barriers, improved trade creation, better resource allocation, and regional growth (Marinov, 2014: 165–167).

The BRI project can also be evaluated in terms of its geo-economic aspects. In this regard, we can consider three theoretical perspectives. The first one is the spillover effect over the logistic route. The EU and China in the project have formed an oversized economy with their population, GDP volume, value chain, and economies of scale. The BRI project facilitates spillover of production capacity, know-how, and technological transfers, and foreign direct investments (especially in transportation infrastructure). The second aspect is improvement in the value chain. Economic zones in the BRI program participant countries find an opportunity to climb from the low to high levels in the global value chain, including production and logistic processes. It may lead to a gradual shift in traditional industries toward modern industries, scientific research, talent exchange, and training programs. In the end, it has evolved into a new industrial value chain. Lastly, the BRI program has been evaluated in terms of channel suitability and location orientation.

Channel suitability means the objective demand for geo-economic development should be considered, because this project is not only based on the geographic aspects but also based on geo-economic demand. Trade volume between developed markets and Southeast Asia and Western markets

has reached a certain potential and it seems like a large market scale has been reached. So it's better to step up trade growth with Central Asian or African countries, which have maintained relatively faster growth than developed markets. This project connects economic corridors, various producers, resources, and consumers, as well as support facilities, and in the long run, it will strengthen trade ties with the rest of the world (Mengzi, 2019: 22-23).

3. LITERATURE REVIEW AND CONTRIBUTION

Since the beginning of the project in 2013, scholars have been increasingly focused on the BRI initiative. Furthermore, it is a source of concern for policymakers and provides an opportunity to conduct in-depth research into its implications and challenges. In this respect, some studies aim to understand the economic significance of the project and to indicate economic effects (international trade, foreign direct investment, economic growth, per capita income, or employment) on member countries. Guoqiang (2015), Barton (2015), Fang (2015), Djankov (2016), Putten et al. (2016), Rolland (2016), Pradhan (2017), Qoraboyev (2018), Aybar and Gürel (2018), Alon, Chen and Thees (2020), Karpathiotaki et al. (2021) indicate that the BRI Initiative contributes greatly to development and it is supportive of common economic prosperity and foreign policy service both for China and other participants. Especially for developing countries, the program offers many commercial and economic advantages, and it is a useful tool to increase their weight in and share in the global economic system. On the other hand, Cai (2017), Mobley (2019), Geeraerts (2019), and Gong (2020), describe the BRI project as a Chinese club that represents mainly China's strategic effort to gain predominance and military purposes in the Asia-Pacific region. China is using BRI to assert its regional leadership through a vast program of economic integration. It will eventually bring BRI nations into China's orbit, both politically and economically. Besides, because of this project, relationships between China and other major players can evolve in a more competitive manner.

Some studies handle the subject in terms of geopolitical and geo-economic perspectives. The route (both sea, railway and land) passes from East Asia to Europe throughout the Heartland and the Rimland. It encompasses dozens of countries, maritime routes, critical straits, certain ports, economic zones, and strategic gateways. From this aspect, it has the potential to reshuffle the regional and global geopolitical landscape and has the potential to affect the status quo of key powers such as the USA, India, Japan, Russia, and China. Equations within this strategic pentagon will profoundly influence Asian geopolitics and the BRI project is accepted as a game-changing initiative in Asian geopolitics. They also argue that the BRI project is becoming a new lever in the balance of power between East Asia and Western economies. Minghao (2015), Callahan (2016), Krukowska (2016), Küçükcan (2017), Yu-Source (2017), Clarke (2017), Nurmuhammedov (2017), Deng (2018), Yeghiazaryan (2021), Koçakolu (2021), Azer, Min, and Ülker (2021), Zreik (2022) try to explain the strategies and policies of regional (Turkey, Japan, India, Pakistan, Iran, Vietnam) and global (China, Russia, European Union, USA)

geopolitical actors under the BRI project and analyze long-term plans to maximize their economic and political interests and minimize national risks on the geopolitical chessboard.

Lastly, some papers have assessed the effect of the BRI project by econometric methods. Chung and Voon (2017) used two stage least square methods (2SLS) and indicated that the BRI project has a positive effect on Asia-China trade, investment, and GDP for participant countries. Zhao (2020) evaluates and measures its influential factors on trade between China and coastal and inland countries using a gravity model. Based on the results, per capita income, consumer groups, and additional factors affect the scale of trade under the BRI significantly just like traditional trade on a global scale. Li (2020) examines the effect of trade facilitation measures of BRI coastal countries on China's cross-border e-commerce by adopting the panel data within ten years from 2009 to 2018. The researcher based his analysis on infrastructure, rules and regulations, customs environment, and e-commerce indexes. The results verify that trade facilitation has a positive effect on China's exports.

We have some contributions to this paper. First, the majority of studies cited above handle the subject in geopolitical and geo-economic terms. Only a few of them assessed the BRI project by employing econometric methods. Second, they use the same traditional gravity models. They generally use fixed or random effect models through two-stage least squares. But dummies in the model do not change over time. So it will be unable to estimate the model by using fixed effects. Third, it is important to take into account the unobserved (omitted or excluded) heterogeneity. Omitting country-specific bilateral effects and time-dependent effects may yield biased estimates and heteroscedasticity problems. Also, dummy variable traps cause multicollinearity. Forth, zero trade value is another problem. In this manner, we use the Poisson Pseudo Maximum Likelihood (PPML) procedure, which is free from autocorrelation, asymptotic bias, multicollinearity, and heteroscedasticity problems in the residuals. Lastly, we added new explanatory variables, such as GDP per capita distance, capital endowment ratio, land endowment ratio, and scale effect. Thus, it will help us to understand the basic dynamics of trade relations in the BRI nations. The *"main question"* we address in this paper is what the rising economic prosperity in the BRI project implies for Turkey's external trade and testing the validity and correlation of the model for the Turkish economy on the basis of independent variables. This is important in light of Turkey's medium and long-term trade policy objectives. So, in this research, we intend to fill these gaps in the literature, addressing the following *research questions*: what are the economic effects of the BRI program on trade flows of Turkish economy and policy implications?

4. RESEARCH METHODOLOGY

We employed a balanced panel that is based on annual observations of 9 countries (China, Russia, Turkey, Kazakhstan, Kyrgyzstan, Georgia, European Union, Azerbaijan, Turkmenistan, Uzbekistan) over a 20-year period (2000–2020). We determine them on the basis of trading importance in the BRI

initiative with respect to Turkey. We get the data from the World Bank database, the IMF's Direction of Trade Statistics and the Turkish Statistical Institute.

In this study, we design our research according to the gravity model in the panel data methodology. In other words, the model specification is based on the standard gravity equation of international trade. This approach takes its roots from the *Newtonian* law of gravity. According to the rule, the gravity force (F_{ij}) between two objects is directly proportional to the product of their masses (M_i ; M_j) and inversely proportional to the square of the distance (R_{ij}) between their centers (Sandalcılar, 2012: 4168); $F_{ij} = c * (M_i * M_j / R_{ij}^2)$. After WWII, under GATT (General Agreement on Tariff and Trade) rules, the global economy was about to embark on economic integration among the liberal capitalist countries, and trade relations had been intensified. Over time, an increasing number of countries have been undertaking a transition to more open and integrated markets. Due to the increasing trends in globalization and trade flows, Tinbergen (1962), Poyhonen (1963) and Linnemann (1966) first introduced gravity model to predict international trade flows and focused on the effects of preferential trade agreements (PTA) and regional economic integration.

The gravity model of trade is based on general equilibrium models that allow to derive implications for bilateral trade (Kabir, Salim and Mawali, 2017: 61). In this manner, it is proposed that the volume of trade flows between two partners can be estimated by the gravity equation of trade. When we discussed pre-gravity models such as Heckscher-Ohlin or Ricardian models, the size of an economy was not considered. On the one hand, this model argues that relative economic size (GDP) attracts countries to trade with each other and on the other hand, greater geographical distance makes it difficult (Anderson, 2011: 135). We transform physical entities into trading partners and their masses will be their GDP in the context of equation (1);

$$T_{ij} = c * \frac{GDP_i^{\beta_1} * GDP_j^{\beta_2}}{D_{ij}^{\beta_3}} \qquad [1]$$

Where T_{ij} represents bilateral trade flow or trade volume (sum of export and import) between countries i and j, c is a normalizing constant term (allowed to calculate linear model), and D_{ij} represents bilateral distance in the denominator. The parameters β_1, β_2, and β_3 (which are often assumed to be positive) are estimated in log-linear form. Real GDP represents national output for countries i and j. The output of the exporting country represents the ability to supply, and the output of the importing country represents the propensity to demand. As seen from equation (1), trade flows are positively correlated (the bigger is GDP of partner countries, the higher the volume of trade) with real GDP, and negatively correlated with distance. The rationale behind this model is simple. We expect bigger economies (higher income) to trade more and the bigger distance between the two countries, the higher the transportation cost and time of delivery (Shigheru, Otsubo and Umemura, 2003: 136-137). In the literature, there are some papers that estimate the gravity equation on trade flows across a number of countries and include

a dummy variable in the regression. But before regression, we can take a natural log for both sides of the equation (1) to avoid heteroscedasticity. The logarithmic transformation also allows the coefficients to be interpreted as trade flow elasticities in relation to the explanatory variables (Antonucci and Manzocchi, 2006: s.159-162).

$$\ln T_{ij} = c + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j - \beta_3 \ln D_{ij} \quad [2]$$

In the linear form of the gravity model in equation (2), T_{ij} indicates trade flows from country i to country j, GDP_I and GDP_J are each country's real gross domestic product and again, D_{ij} represents bilateral distance (Gervais, 2015: 456). However, international trade has been affected by many factors. We can extend the model to express in econometric form;

$$\ln T_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j - \beta_3 \ln D_{ij} + \ln \varepsilon_{ij} \quad [3]$$

The stochastic component of equation (3) is assumed to be independent and identically distributed with zero mean. For this paper, we can transform equation (3) as a general model by including other factors (adjacency, a common language or border, capital stock, trade integration, population, economic scale, remoteness etc.) that affect trade as follows;

$$\ln TV_{ijt} = \beta_0 + \beta_1 \ln RMT_{ijt} + \beta_2 \ln GDPPCD + \beta_3 \ln SCL_{ijt} + \beta_4 \ln CAPEND_{ijt} + \beta_5 LNDEND_{ijt} + \beta_6 PTA_{ij} + \beta_7 LANG_{ij} + \beta_8 BORD_{ij} + \ln \varepsilon_{ij} \quad [4]$$

Where i, j denotes the exporter, the importer respectively, and t denotes time. TV_{ij} models trade volume (sum of export and import in billions of USD) of country i to partner country j at time t. β_0 is an unknown constant.

The **Remoteness** (RMT: ln [Dist*$GDP_{Partner}$ / GDP_{World}] is the simple average of the distances between partner countries i and j. The Distance (Dist) variable comprises the bilateral distance between Turkey's and a partner's capital city. Other sub-variables are GDP of the partner country and global GDP. Remoteness variable was introduced into the gravity model by Deardorff (1995). Not only does geographic distance matter but also the relative importance of trade partners also matters. Because trade is more intense between countries which are far from the economic centers with high GDP than trading partners, which they are geographically close to them (Trotignon, 2010: 233; Mulabadic and Yaşar, 2021: 7).

The **GDP Per Capita Distance** (GDPPCD: ln [(max ($GDPPCD_{Turkey;}$;$GDPPCD_{Partner}$)) – min ($GDPPCD_{Turkey;}$;$GDPPCD_{Partner}$)] variable is added to the model to capture the difference in the level of economic development between countries. At that point, gross GDP (in usd) is generally employed in gravity models, but it would be better to decompose as GDP per capita and population. Gross GDP is the product of these two variables but in this case we have a different effect because a bigger country usually tends to trade proportionally less than a smaller country because of factor endowment (Zarzoso

and Lehman, 2003: 296-297). According to the new trade theories, it should have a negative effect, and as for the Ricardian theory, it should have a positive effect on trade.

The **Scale** (SCL_{ij}: ln [Pop_{Turkey}*$Pop_{Partner}$]) represents the scale effect between countries i and j and it is calculated at the natural log multiplicative product of population of two partner countries.

The **Capital Endowment** (CAPEND: ln [(max (Capital $Ratio_{Turkey;}$;Capital $Ratio_{Partner}$))-min (Capital $Ratio_{Turkey;}$; Capital $Ratio_{Partner}$)] is calculated by the capital ratio. We calculate the natural log of Turkey's capital ratio (physical capital stock in U.S. Dollars is divided by labor force stock in person) and partners capital ratio. It shows feasible capital stock for per worker. We divide the maximum value of a capital endowment by the minimum value depending on who has the maximum and who has the minimum value of Turkey and the trade partner. The resulting variable indicates the difference between the two countries in terms of capital endowment.

The **Land Endowment** is measured as (LANDEND: ln [(max (Land $Ratio_{Turkey;}$;Land $Ratio_{Partner}$)) - min (Land $Ratio_{Turkey;}$;Land $Ratio_{Partner}$)] and stands for absolute land in endowment. It is calculated analogously for Turkey and her trade partner. We take the maximum value of Turkey's land ratio (arable land in sq. kilometer is divided by labor stock) divided by the minimum value of partner's land ratio and take the natural log (see, for instance, Arnon et al.,1996). The sign of endowment should be positive according to neoclassical theories of international trade and negative according to new trade theories.

In the last section of the specification, we have three dummies. The **PTA** indicates a variable for countries with preferential trade agreements that takes a value of 1 if the two countries have a trade agreement and 0 if not. The **LANG** variable is proxied for a common language that takes the value of 1 if the two trading partners share the same language and 0 if not. The **BORD** variable is an adjacent dummy taking value 1, when Turkey and partner i share the same border (land or sea) and zero otherwise.

There is variety of estimation methods for gravity equations like Negative Binomal Model, standard Ordinary Least Squares (OLS), Random Effect, and Fixed Effect models. However, Silva and Tenreyro (2006), Francois and Manchin (2007), pointed out some problems. First, taking the natural log leads to drop observations for which the reported trade value is zero (really zero or systematic rounding below $0.5 million) and zeros are very common (Arvis and Shepherd, 2011: 3). Second, observations in gravity data are heterogeneous in a variety of ways. As it is seen from equation 5, the mean of $\ln\varepsilon_{ij}$ depends on the higher moment of ε_{ij} thus including its variance. In that case, we expected value of the error term depends on one or more of the explanatory variables. It means a violation of the first assumption of OLS and suggests that the estimator may be biased and inconsistent. Interpreting the parameters of the model estimated by OLS as elasticities may be misleading. Thus, OLS gives inconsistent parameter estimates (Shepherd, 2016: 51; Balogh, 2015: 517).

The Poisson Pseudo Maximum Likelihood (PPML) estimation procedure, which was introduced by Anderson and Van Wincoop (2003), is an advised estimator for dealing with these problems. It provides consistent estimates of the original nonlinear model. Dummy variables do not change over time. We will be unable to estimate our model using fixed effects. But PPML is consistent with the presence of fixed effects. Second, the zero trade value (the nominal trade value was less than US$0.5 million for those years) problem is solved by naturally including these observations. Indeed, they are relatively common in the trade matrix, since not all countries trade all products with all partners (see e.g., Haveman and Hummels, 2004). Third, the interpretation of the beta coefficients in the PPML model is the same as under OLS. Lastly, PPML estimation delivers consistent predictions even in the case of missing trade flows and measurement errors. As a result, the PPML estimator is more robust and it is free from the problems of autocorrelation, asymptotic bias, multicollinearity and heteroscedasticity in the residuals for estimation and inference. (Anderson and Yotov 2012: 5-6; Martin and Pham, 2015: 3-5 ; Gül and Tatoğlu, 2019: 53; Pfaffermayr, 2020: 188-189). We can model standard OLS as $y_i = e^{x_i'\beta_i}\eta_i$. Where y_i is an independent variable and x_i is a dependent variable. $\eta_i = 1 + (\varepsilon_i / e^{x_i'\beta_i})$ and E [η_i | x]=1 is the expected value of the residual. We make this model linear by taking logarithms. But it is not feasible when $y_i = 0$. So, a consistent model in this case yields to;

$$\ln y_i = x_i'\beta_i + \ln \eta_i \qquad [5]$$

For this model, the expected values of residuals should not depend on x_i and it should be zero to get a consistent estimator. However, when the conditional variance of y_i on x_i (E [y_i | x_i]) is close to zero, it tends to disappear. If this deviation is large enough, the expected value of y_i will be far away from its lower bound and the residual term ε_i is likely heteroskedastic and its variance will depend on $e^{x_i'\beta_i}$. Consequently, regressing lny_i on x_i leads to inconsistency. To deal with this problem in gravity estimation, we can utilize some assumptions about the functional form of the Vector Autoregressive (VAR) (y_i | x_i) approaches. First, we solve the following set of first order conditions under the assumption of $E[y_i|x_i] = e^{x_i'\beta_i}$ α Var[y_i|x_i] . It yields $\sum_{i=1}^{n}\left[y_i - e^{x_i'\bar{\beta}}\right]x_i = 0$. This Equation is numerically equal to PPML for counting data, but it implies that the correct specification of the conditional mean, E [y_i | x_i] = $e^{x_i'\beta_i}$. In this case, observed data does not have a Poisson distribution and y_i does not I (1). However, it is required that the dependent variable should be an integer to estimate PPML. Due to the assumption of $E[y_i|x_i] = e^{x_i'\beta_i}$ α Var[y_i|x_i], it is unlikely to be estimate. In this case, to define Poisson regression, we can use Eicker–White (discrete distribution) robust covariance estimator (Motta, 2019: 510-511);

$$\Pr(y_i = j \mid x_i) = \frac{e^{-\lambda}\lambda^j}{j!}, \qquad j = 0,1,2.... \qquad [6]$$

Where $\lambda = e^{x_i'\beta_i} = e^{\beta_0+\beta_1 x_{1i}+\ldots..}$. The regression parameters of β can be estimated by maximizing the log-likelihood function as follows;

$$\ln L(\beta) = \sum_{1}^{n}\left[-e^{x_i'\beta} + (x_i'\beta)y_i - \ln(y_i!)\right] \quad [7]$$

Equation 9 can be defined as exponential form as (Manning and Mullahy, 2001: 467);

$$L(\beta) = \exp\sum_{1}^{n}\left[(x_i'\beta)\right] \quad [8]$$

Where, X's are the independent variables matrix and β's are the coefficients. Equation 9 is obtained by in the exponential form of Equation (8). Lastly, adding the error term ε_{ij} and independent variables, it implies for our study as follows (Prehn, Brümmer and Glauben, 2019: 762);

$$TV_{ijt} = \exp\left[\beta_0 + \beta_1 \ln RMT_{ijt} + \beta_2 \ln GDPPCDIST + \beta_3 \ln SCL_{ijt} + \beta_4 \ln CAPEND_{ijt} + \beta_5 \ln LNDEND_{ijt} + \beta_6 PTA_{ij} + \beta_7 LANG_{ij} + \beta_8 BORD_{ij}\right] + \varepsilon_{ij} \quad [9]$$

5. EMPIRICAL EVIDENCE

In this section, we estimate the equation (9) by employing the PPML estimator. But before estimating, we need to check the unit root properties. It is the first step is to check a co-integration between the variables. If all variables are stationary, the gravity model is conducted consistently by the traditional regression method and there is no need for a co-integration test. For this purpose, we employed Leven-Lin-Chu (LLC, Levin et al. 2002), Im-Pesaran-Shin (IPS, Im et al. 2003), Fischer ADF (Maddala and Wu,1999), and Fischer PP (Choi, 2001) test statistics.

Table 1. Stationary Test Results

Variable	Original Sequence			
	LLC	IPS	Fischer ADF	Fischer PP
lnRmt	-4.824 (0.00)***	-2.657 (0.00)***	32.544 (0.02)**	20.349 (0.31)
lnGDPpcdist	-6.481 (0.00)***	-4.672 (00)***	19.214 (0.37)	27.947 (0.09)*
lnScl	-1.784 (0.08)*	-1.536 (0.06)*	24.102 (0.15)	32.461 (0.03)**
lnCapend	-1.892 (0.02)**	-2.882 (0.00)***	37.804 (0.00)***	41.899 (0.00)***
lnLandend	-1.604 (0.05)*	-0.112 (0.45)	29.474 (0.09)*	16.53 (0.57)

The values in bracket shows the probability value and '*', ''**'' and '***'' shows the significance level at 1%, 5% and 10% respectively.

Table 3 shows the results of the panel unit root tests. The results indicate that variables are stationary at level except ''lnRmt'' and ''lnlandend'' in Fischer PP test, ''lnGDPpcdist'' in Fischer ADF test, ''lnScl'' in the Fischer ADF test and ''lnLand'' in IPS test. However, it is not contradictory with the results of all panels that independent variables follow the I (0) process, and it can be said that there is no unit root due to the majority of the other results. After determining the unit root properties of our

variables, we can proceed to build a PPML model. By this way, we define how and to what extent the independent variables affect trade volume between the BRI economies.

Table 2. Estimation Results of The Gravity Models

Variable	PPML	Pooled Model (OLS)	Random Effects	Fixed Effects	2SLS
lnRmt	0.405 (0.00)***	0.561 (0.00)***	0.582 (0.00)***	0.404 (0.00)***	0.404 (0.00)***
lnGDPpcdist	-0.167 (0.07)*	-0.177 (0.15)	-0.288 (0.00)***	-0.181 (0.45)	-0.181 (0.00)***
lnScl	1.147 (0.04)**	6.254 (0.07)*	2.701 (0.53)	2.209 (0.01)**	2.209 (0.27)
lnCapend	-0.857 (0.00)***	-0.699 (0.00)***	-0.837 (0.00)***	-0.802 (0.03)**	-0.802 (0.03)**
lnLandend	0.921 (0.01)**	-0.788 (0.38)	-0.710 (0.00)***	-0.828 (0.00)**	-0.828 (0.00)***
PTA	0.446 (0.00)***	0.825 (0.00)***	0.799 (0.07)*	-	0.546 (0.29)
LANG	0.945 (0.66)	0.614 (0.8)*	0.936 (0.04)**	-	0.874 (0.02)**
BORD	0.461 (0.00)***	0.910 (0.00)***	0.981 (0.19)	-	0.623 (0.00)***
Constant	23.57 (0.01)**	29.35 (0.23)	27.66 (0.33)	37.46 (0.07)**	37.46 (0.07)*
R^2	0.972	0.879	0.758	0.797	0.845
Adjusted R^2	0.971	0.876	0.749	0.794	0.841

The values in bracket shows the probability value and '*', ''**'' and '***'' shows the coefficients are statistically significant at 1%, 5% and 10% respectively. t statistics are heteroscedasticity robust.

The estimated results of the regression analysis are shown in Table 2 for PPML and other models. The goodness of fit of the PPML model measured with the R^2 and adjusted R^2 indicates that the variables included in the model explain 97% of the observed variation in trade flows between BRI countries. Hence, the variables included in the regression explain very well the movements in the trade variables. The regression results show that only the estimated coefficient of the language (LANG) dummy is not significant, but other coefficients are significant at conventional levels.

The first variable is lnRmt (Remoteness), which refers to the relative importance of a trade partner. Relative distance (remoteness) is significant and highly explanatory of international trade. In our case, it is positively associated with trade and has a significant (indicated by a probability value of 1%, 5% and 10%) impact with a coefficient of 0,405 that can be inferred as a 1% unit increase in remoteness increases the trade volume up to %0,405 unit. The sign indicates that the partner's GDP acts positively. Positive effects may arise from a trade partners advantage in terms of better income, infrastructure, capital stocks, trade ties, technology, and better access to world markets. When we consider all the methods, the magnitude of the estimated coefficient remains fairly constant within the range of 0,4 and 0,6. Second, the GDPpcdist variable has a negative and significant impact with a coefficient of 0.167 (far from unit elasticity) which shows that a 1% unit increase in GDPpcdist, reduces the trade volume by %0.167 unit. It ranges between 0.1-0.3 for all models. It captures the differences in the level of economic development between countries. According to Linder's trade view (it argues that the trade diminishes in proportion with increase in the difference in per capita income), bilateral trade will be greater when the per capita GDP of the trading countries are more similar and its expected negative sign in the Linder's model (Zarzoso and Lehman, 2003: 305). Also, the negative sign is consistent with new trade theories. The third is the scale effect, which has a coefficient of 1.147 and can

be interpreted as a 1% unit increase in lnScl, raising the trade volume by %1.147 unit. Accordingly, it has a significant and positive effect on trade. The relative size of the population encourages division of labor and the size of the market, implying economies of scale in production and opportunities as well as a desire to trade with a wider range of goods (Nasrullah, Chang, Khan, Rizwanullah and Ishfaq, 2020: 6).

The following variables are capital endowment and land endowment. It can be deduced that a 1% unit increase in ''lnCapend'', reduces the trade volume up to %-0.857 unit (close to unit elasticity). It is estimated to decrease trade by 0.7 to 0.8 units for all models. The land endowment's coefficient is 0.921 and its value ranges between 0.7 and 0.9. It suggests that a 1% unit increase in lnLandend, increases the trade volume by %0.921 units. Heckscher (1919) and Ohlin (1933) model, which stresses the differences in factor endowment affect international trade. A larger country and a larger domestic market may indicate a large endowment. In that case, the domestic market may be less dependent on international trade. In this case, a negative sign would be justified. In addition, a negative sign is compatible with the thesis of Linder (1961), which asserts that income per capita is one of the determinants of intra-industry trade (Trotignon, 2010: 232, Eita 2016: 276). Capital endowment has contributed to a negative effect on bilateral trade, and the negative sign is consistent with new trade theories. On the one hand, differences in factor composition impede bilateral trade, and on the other hand, increasing similarities boost it in our case. A negative coefficient would also point towards an intra-industry trade structure, and a positive coefficient would suggest that an inter-industry trade structure prevails (Antonucci and Manzocchi, 2006: 161). In this sense, it would be better for Turkish industrial sectors to integrate and expand commercially more with the other BRI nations. Land endowment affects trade volume positively, and its sign is consistent with neo-classical trade theories. For the land endowment, one of the trading partners which intends to get the advantages of economies of scale is to be fully exploited only owing to the large domestic market. It then follows that opportunities for trade with foreign partners in a wide variety of goods will increase, and the expected sign of this coefficient would be positive.

Lastly, we have three dummies. The first dummy is a PTA. This is included in the model to capture the creation of intra-BRI trade. If a coefficient on this dummy is positive and statistically significant, it can show that the members of the integration facilitate trade and that they have traded with each other more than the hypothetical level predicted by basic explanatory variables. The well-known concepts of trade creation and trade diversion are examples of such effects. As can be seen from Table 2, the ''PTA'' variable with a coefficient of 0.446 can be interpreted as a 1% unit increase in ''PTA'', which increases the trade volume up to %0.446 unit. Accordingly, it has a statistically significant and positive effect on trade. The second dummy is language. The estimated coefficient of the language dummy, ''LANG'' is positive as expected, but it is not statistically significant. The last variable is the border dummy ''BORD''. Unlike sharing common borders, in the general gravity equation, trade between a pair of countries is modeled as a decreasing function of the distance between the two

countries. Common border is likely to affects international trade positively due to lower transportation and transaction costs. Cross-border service trade does not directly involve transport costs, which tends to reduce the impact of geographical distance. In our PPML model, ‘’BORD’’ dummy has a positive sign as expected with a coefficient of 0.461, which means that a 1% unit increase in ‘’BORD’’, increases the trade flows by %0.461 unit.

6. CONCLUSION AND SUGGESTIONS

This paper provides a deeper understanding of the One Belt and One Road (BRI) Initiative launched by China in 2013 and bilateral trade flows of nine BRI countries with Turkey by using a gravity model approach. In particular, we employed PPML estimator for the gravity model, which is superior to other methods econometrically. The investigation covered the 2000-2021 period. Our results show that all variables are statistically significant and present the expected signs, except for the language dummy. If we consider variables in the model, remoteness, scale, land endowment and two dummies (Preferential Trade Agreement and Border) have a positive impact, while GDP Distance and Capital Endowment have a negative effect on bilateral trade flows.

When considering scale and border variables, it would be better to promote trade volume with BRI countries having large economies (e.g. Russia or China) or having nearby countries (e.g. Georgia or Azerbaijan). The significant negative impact of GDP per capita distance shows that an increase in this variable has affected trade negatively. It means an increase in population (induces a decrease per capita income) of partners leads to a rise in demand for Turkish exports or it would be better to start trade with populated counties in order to increase the trade flow. Also, according to the absorption effect, the larger the size of the exporter, the lower the exports. The significant negative impact of capital endowment implies that Turkey has room for improving trade flows with countries that have smaller domestic markets, such as Turkic Republics in the project. The negative coefficient of capital endowment suggests that increasing similarity in capital stock composition fosters Turkey’s exports. In this context, bolstering the infrastructure construction in the BRI project along the route (especially in the transportation and maritime sectors) to promote trade follows through on capital ratio. So we should emphasis on the construction of strategic port, railway and aviation infrastructure and strengthen cooperation with the economies along the BRI route. When we consider land endowment, it exerts a positive influence on trade flows and suggests that increasing similarity in land ratio between Turkey and partners will boost trade flows. According to preferential trade agreements (PTA) variable with a positive coefficient implies that belonging to a trade integration or facilitation initiative (like BRI) fosters trade.

As a result, the BRI initiative will become a game-changer for the future in terms of the larger picture of the economy. Participants will benefit from more infrastructure investments, better market access, and expand their exports by providing a cost-effective economic corridor to major markets. In

particular, as a key attendant due to its geographical position as located in the middle corridor, Turkey can boost their economy and significantly increase their trade volume in addition to strengthening its geo-economic and geo-strategic importance.

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