PANOECONOMICUS, 2025, Vol. 72, Issue 4, pp. 605-622
Received: 19 July 2021; Accepted: 20 November 2023.

UDC 339.542:330.43(560)
https://doi.org/10.2298/PAN210719004A
Original scientific paper

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This study was prepared by making use of the Doctoral Thesis entitled "Determinants of Bilateral Trade Flows: A Structural Gravity Model Approach for Turkey".

Economic, Geographical, Institutional, and Political Determinants of Bilateral Manufacturing Exports: A Structural Gravity Model Approach for Türkiye

Summary: The study investigates the economic, geographical, institutional, and political determinants of Türkiye's bilateral manufacturing exports for 2003-2018, applying the structural gravity model and considering 30 main export partners of Türkiye. The Poisson pseudo maximum likelihood method results reveal that Türkiye's manufacturing exports are mostly directed by its own and partners' economic sizes. While common borders and cultural similarity positively impact manufacturing exports, distance and landlocked position affect it negatively. The degrees of institutional quality, trade freedom in Türkiye, and membership of the partner countries in the World Trade Organization are resistance factors against manufacturing exports, whereas trade agreements encourage it. As the bilateral or multilateral trade agreements turned out to be the driving forces of manufacturing exports, Türkiye should sign additional trade agreements and/or amplify trade agreements that have already been signed rather than standard trade policy implementations.

Keywords: Bilateral manufacturing exports, Structural gravity model, Multilateral resistance terms, Poisson pseudo maximum likelihood, Türkiye.

JEL: C23, F14.

International trade has become one of the most important components in the economic growth process of many countries. According to the World Trade Organization - WTO (2021)[1] statistics, total merchandise trade accounted for almost 44% of the world's total gross domestic product (GDP) in 2019. However, merchandise trade decreased to 7.5% in 2020 because of the devastating COVID-19 pandemic around the world. This conjuncture has negatively affected most countries, particularly the ones that follow the export-led growth path. Generally, it is accepted that an increment in exports results in economic growth by promoting economies of scale, lessening capital constraint, and raising capacity utilization, which generates technological improvements through competitiveness and raises efficiency (Bela Balassa 1978; Elhanan Helpman and Paul R. Krugman 1985; Paul M. Romer 1987; Andrew Berg and Anne Krueger 2003). In this regard, by liberalizing its economy and adopting an export-led growth

[1] **World Trade Organization.** 2021. https://data.wto.org/ (accessed February 15, 2021).

policy at the beginning of the 1980s, Türkiye has continuously targeted increasing its exports to promote economic growth.

Merchandise exports of Türkiye have remarkably increased ever since the beginning of the 2000s and almost reached 181 billion United States (US) dollars in 2019. The export/import coverage rate and the trade deficit were approximately at 86% and 30 billion US dollars, respectively, in 2019. In the same period, while the share of Türkiye's exports in the global markets was at 0.95%, its total trade volume reached 391 billion US dollars. In conjunction with increasing exports, the product structure of exports has shifted from labor-intensive goods to capital-intensive goods. Accordingly, the share of primary products, including agricultural products, fuels, and mining products, in total exports decreased considerably. On the other hand, the manufacturing industry has dramatically enhanced its share in total exports from 26.8% to 77.9% from 1980 to 2019. Overall, trade statistics illustrate the remarkable improvements in Türkiye's exports during the 2000s. In this context, the challenges and the secret of the success of exports in the 2000s may guide one to accomplish higher objectives in the future. Therefore, analyzing the determinants of exports would shed light on the underlying dynamics of export flows. Based on this motivation, the study examines the determinants of Türkiye's bilateral manufacturing exports by applying the structural gravity model (SGM), constructed through multilateral resistance terms (MRTs)[2] from 2003 to 2018. The study only focuses on the exports of manufacturing products as they account for most of the exports. It ignores the primary products as they have peculiar properties (e.g., low demand elasticities) that are difficult to explain by the gravity model.

For the following reasons, the study is novel and is considerably expected to contribute to the literature. Firstly, as far as is known, there is no study analyzing Türkiye's bilateral manufacturing exports by SGM, including institutional and political variables. The SGM considers the MRTs and bilateral resistance terms (BRTs) among countries. Not involving MRTs in empirical studies is called the gold medal mistake by Richard Baldwin and Daria Taglioni (2006). Secondly, studies exist analyzing Türkiye's total trade volume, namely exports plus imports, using the gravity model. As the gravity model explains the one-way bilateral trade flows between countries, empirical studies considering the total or average of two-way bilateral trade flows cannot most likely produce reliable and unbiased results. This fact is denominated as the silver medal mistake by Baldwin and Taglioni (2006). Thirdly, some empirical studies on the gravity model use the trade flows in real values, which are deflated by using the consumer price index of the US, quoted as the bronze medal mistake by Baldwin and Taglioni (2006). Herewith, by considering MRTs with exporter/importer fixed effects which is the most useful and efficient method (Robert C. Feenstra 2004), and modeling the bilateral manufacturing exports solely in nominal terms, the present study abstains from these three potential mistakes. Finally, SGM here is estimated by the Poisson pseudo maximum likelihood (PPML) estimator, which has been accepted as the best estimator of the gravity model (Salvador Gil-Pareja, Rafael Llorca-Vivero, and José

[2] MRTs mean that trade between countries *i* and *j* increases (decreases) depending on the increase (decrease) in trade resistance of countries *i* and *j* with all other trade partners individually (James E. Anderson and Eric van Wincoop 2003).

A. Martínez-Serrano 2019), which identifies the econometric model in an exponential form. Hereby, the study is the first to contribute to the literature in these respects.

The outline of the study is as follows. Section 1 is dedicated to a review of previous studies, followed by Section 2, in which the theoretical framework of the gravity model approach is introduced. The empirical framework of the study is outlined in Section 3. Following the presentation of empirical results in Section 4, the study ends with insightful remarks and conclusions in Section 5.

1. Literature Review

Empirical studies investigating the relationship between trade and various parameters have increased following Türkiye's adoption of an outward-oriented trade policy that increased trade volume. While a group of studies addresses the socio-economic impacts of trade, other studies have particularly focused on potential determinants of trade. When the literature has been investigated in detail, it is generally observed that these potential determinants are tackled individually. Strikingly, the gravity model has been a workhorse in these studies in line with the global stream.

As for economic determinants of trade, economic sizes of country pairs have been considered in the gravity model applications as basic gravity variables. The gravity model approach leads to the main inference that trade volume would be higher between relatively economically larger country pairs. Accordingly, larger countries both export more to the rest of the world because they have many producers and a wide range of products and import more from the rest of the world as they have a broad market (Krugman and Maurice Obstfeld 2006; Yoto V. Yotov et al. 2016). Farrukh Suvankulov and Wazir Ali (2012), Ali Polat and Mehmet Yeşilyaprak (2017) and Memduh A. Demir, Mustafa Bilik, and Utku Utkulu (2019) are a few studies proving the positive effect of economic sizes of country pairs on Türkiye's trade flows.

Geographical features matter for any country trading with the rest of the world as they remarkably affect transportation costs. In the empirical setting, geographical factors like physical distance and common border, cultural similarity between country pairs, and landlocked positions of countries are among the most employing gravity variables. As a basic gravity variable, the distance is almost included in all the gravity models and has been mostly proven to be a resistance factor against trade flows (see Kadir Karagöz and Mehmet O. Saray 2010; Suvankulov, Alisher Akhmedjonov, and Fatme Ogucu 2012; Demir, Bilik, and Utkulu 2019). A variety of explanations on the importance of distance in international trade were made by Keith Head (2000), Karagöz and Saray (2010) and Anna Golovko and Hasan Sahin (2021). One of these explanations is about the transportation of non-durables. As the distance gets longer between home and destinations, many risks regarding the transportation of non-durables are evident. Among these risks, loss of goods because of weather conditions (e.g., shipwreck by storm) and spoiling of goods because of getting wormy may exemplify. Longer distances give rise to synchronization costs as well. The firms employing multiple inputs request timely delivery of these inputs. However, as the distance gets longer, synchronization risk increases. Even though some firms hold their inputs in the storehouse, this solution involves some costs like storehouse renting. Additionally, distance matters for communication between countries. Even if communication is no longer hard through inventions such as the telephone, e-mail, Zoom, and Microsoft Teams, they cannot substitute face-to-face meetings. As the distance gets longer, the costs of face-to-face meetings increase. In addition, distance is related to transaction costs for market research and gaining trust.

Other geographical variables are included in the augmented gravity models. Following the seminal study about the border puzzle of John McCallum (1995), the entity of borders between countries and their impact on trade flows have been increasingly investigated. Intuitively, the country pairs sharing a border are expected to trade with each other more than other country pairs (Roberta Piermartini and Robert Teh 2005). As for the impact of the common border on Türkiye's trade flows, Mehmet H. Bilgin, Giray Gozgor, and Ender Demir (2018) and Emrah Eray Akça (2021) got evidence indicating that entity of a common border between Türkiye and its partners encourage the trade flows between them. In contrast, Demir, Bilik, and Utkulu (2019) found a negative association between the two variables. The variable of cultural similarity represented with common colonial history and/or common language is also inserted into augmented gravity models. Talking the same language and having a historical colonial relationship are evaluated as encouraging factors of trade because of the idea that they would diminish the trade costs (Piermartini and Teh 2005). The findings of Bilgin, Gozgor, and Demir (2018) and Suvankulov, Akhmedjonov, and Ogucu (2012) refer to the cultural similarity between Türkiye and its partners that encourages trade flows between two parties, while Julian Frede and Hakan Yetkiner (2017) reached a similar finding for just import flow. In addition to all these geographical variables, whether a country is landlocked or not matters for trade flows as transportation is cheaper by sea. Polat and Yeşilyaprak (2017) concluded that the landlocked trading partners of Türkiye are a resistance factor, as expected, against the export flows of Türkiye.

Hidden transaction costs exist resulting from confidence problems between two parties. Not entering into force of contracts, accepting a bribe by the customs officers, and stealing traded goods during transportation may be shown as motives for confidence problems (Anderson and Douglas Marcouiller 2002). As international trade transactions require multiple management systems, the effectiveness of institutions of both home and destination countries markedly matters for trading costs at the point of protection of property rights and ensuring bilateral confidence. Therefore, any country's institutional quality affects traders' preferences because it affects risk perception in international transactions. In this context, it is expected that as governance quality improves, transaction costs in trade will diminish, and as a result, institutional quality and trade flows are likely to be positively associated. The connection between trade and institutions makes it possible to infer that country pairs with similar institutional qualities trade each other more than other partners because they are more familiar with doing international business with each other, which brings about diminishing transaction costs (Henri L. F. De Groot et al. 2004; Martijn Burger, Frank van Oort, and Gert-Jan Linders 2009). Suvankulov and Ali (2012) concluded that institutional similarity between Türkiye and Pakistan encourages the trade flows from Türkiye to Pakistan from 1996 through 2009; whereas Suvankulov, Akhmedjonov, and Ogucu (2012) did not find any significant effect of institutional similarity for the case of Türkiye's trade with Syria, Lebanon, and Jordan from 2000 to 2010.

One of the important factors affecting trade flows is the implementation of trade policies because they unusually change trade costs. Among the variety of policy variables, the level of trade freedom (or trade openness), membership to WTO, and international trade agreements draw attention as potential factors affecting trade flows. The level of trade freedom is directly measured by the degree of tariff and non-tariff barriers. As higher trade freedom means lower tariff and non-tariff barriers, the general sense is that higher trade freedom would create more trade volume. Analyzing the effects of quotas imposed on Turkish exports, Füsun Ülengin et al. (2015) from 2005 to 2012 and Bora Çekyay et al. (2017) for the 2005-2014 period concluded that increasing bilateral quotas brought about the loss of Turkish exports via road transportation. The WTO membership of any country is also identified as a potential trade determinant in the gravity model framework. Even though the general expectation is that WTO membership is a driving force of trade flows due to the idea that member countries implement more liberal trade policies (Arvind Subramanian and Shang-Jin Wei 2007), some empirical studies (e.g., Andrew K. Rose 2004; Sedat Aybar 2017) highlighted its insignificant or negative effect on trade flows. International trade agreements have been the most considered policy variable while explaining trade flows. Investigating the potential determinants of trade flows from Türkiye to Black Sea countries in the 1992-2010 period, Aybar (2017) demonstrated that there is no association between free trade agreements and trade flows at the aggregate level, but there is a positive association in the case of machine trade.

While some of the studies cited above employed the basic-gravity model (see Karagöz and Saray 2010; Ülengin et al. 2015; Çekyay et al. 2017), other studies considered the augmented-gravity model (see Suvankulov, Akhmedjonov, and Ogucu 2012; Suvankulov and Ali 2012; Polat and Yeşilyaprak 2017; Bilgin, Gozgor, and Demir 2018). While ordinary least squares (OLS) estimation methods such as panel fixed effects, panel random effects, panel pooled OLS, and panel system generalized method of moments were mostly used in these studies, the technique of PPML was only employed in Ülengin et al. (2015) and Çekyay et al. (2017), which particularly focus on the impact of quotas with basic gravity variables. Frede and Yetkiner (2017) is the only study considering a structural version of the gravity model, utilizing the remoteness index, which has no theoretical background and is not an efficient method.

2. Gravity Model Approach

The gravity model approach of international trade is an adaptation of the law of universal gravitation[3] to socio-economic issues (Piermartini and Teh 2005). The primary initiatives of the gravity model on trade analysis were carried out at the beginning of the 1960s. Among these initiatives, Jan Tinbergen (1962), Pentti Pöyhönen (1963) and

[3] The law of universal gravitation asserts that gravitation forces between two objects in the universe are positively associated with their mass magnitudes, whereas it is negatively associated with the square of the distance between them. This observation was formulated in the study entitled *Philosophiæ Naturalist Principia Mathematica* (1687) by S. I. Newton.

Hans Linneman (1966) are pioneer studies. With reference to Tinbergen (1962), the basic gravity model is shown as follows:

$$Xij = C\frac{Yi^{a}Yj^{b}}{Dij^{d}}. \quad (1)$$

In Equation (1), while X_{ij} shows the trade flows from country i to country j; Y_i, Y_j, and D_{ij} are the economic size of country i, the economic size of country j, and the distance between country i and j, respectively. C is a constant term of gravitation, and superscripts are coefficients to be estimated of relevant parameters. The basic gravity model is defined as an empirical model that accounts for bilateral trade flows as a function of exporter and importer countries' (hereafter country pairs) economic sizes and physical distance between them. Accordingly, country pairs that have larger economies and are geographically closer trade more than other country pairs. Over time, the basic gravity model has been extended with some geographical, institutional, political, and cultural variables. Thus, the basic gravity model was replaced by the augmented gravity model. Accordingly, the trade flows between two countries are a function of the economic sizes of these countries, the physical distance between them, and several variables (e.g., common border, trade agreements, institutional quality, etc.) that affect the bilateral trade costs (resistances).

The gravity model has gained a strong theoretical background through the studies of Anderson (1979), Jeffrey H. Bergstrand (1985), Helpman (1987), Alan Deardorff (1998), Anderson and van Wincoop (2003), Feenstra (2004) and Helpman, March Melitz, and Yona Rubinstein (2008), among the others. Following the seminal study of Anderson (1979), the gravity model has been popular and has shown a successful performance in an empirical setting. In this context, basic and/or augmented versions of the gravity model, which are called traditional gravity models (Joao Santos Silva and Silvana Tenreyno 2006), have been typically used to examine bilateral trade flows. However, Anderson and van Wincoop (2003) seriously criticized these empirical studies.

According to Anderson and van Wincoop (2003), traditional gravity models consider only the interactions between two countries and their country-specific characteristics by ignoring the rest of the world; hence, the estimation results of traditional gravity models are not reliable and healthy. Therefore, Anderson and van Wincoop (2003) developed the modern version of the gravity model, the SGM, by including the MRTs in the gravity model. The MRTs refer to changing trade volume between countries i and j due to increasing or decreasing trade resistances of countries i and j individually with the rest of the world. They are split into outward- and inward-MRTs. Outward-MRTs express the average trade resistance that the exporter country encounters in the global market, while inward-MRTs indicate the overall trade resistance that the importer country imposes on the rest of the world.

The constant elasticity of substitution-based SGM is shown as follows:

$$Xij = \frac{yiyj}{y^{w}}\left(\frac{tij}{PiPj}\right)^{1-\sigma}. \quad (2)$$

In Equation (2), X_{ij} refers to export flows from country i to country j, while y_i, y_j, and y^w represent the GDP of country i, GDP of country j, and the world output[4], respectively. While t_{ij} shows the BRTs between countries i and j, P_i and P_j represent the outward- and inward-MRTs, respectively. Lastly, σ denotes the inter-sectoral elasticity of substitution. The outward- and inward-MRTs are formulated as follows:

$$Pi = \left[\sum_j \Theta j \left(\frac{tij}{Pj}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}},$$
$$Pj = \left[\sum_i \Theta i \left(\frac{tij}{Pi}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}. \quad (3)$$

In Equation (3), while P_i and P_j are unobservable price indexes of countries i and j, which reflect the outward- and inward-MRTs, respectively,Θj and Θis how the shares of GDPs of countries j and i in the world output, respectively.

In the modern version of the gravity model, bilateral trade flows are explained by conventional gravity variables like economic sizes and distance and the proportion of BRTs to MRTs (Christopher Adam and David Cobham 2007). In other words, trade between countries i and j is a function of relative trade costs, which all trade partners of countries i and j are considered, as well as absolute trade costs between countries i and j. This argument implies that after controlling the economic sizes of country pairs and BRTs, trade volume between country pairs that are far from the rest of the world would be more than the country pairs closer to the rest of the world (Piermartini and Teh 2005). To illustrate, all else equal, trade between ocean-surrounded New Zealand and Australia or trade between Kazakhstan and Kyrgyzstan surrounded by huge mountains and deserts, is higher than trade between the Netherlands and Belgium, which are neighbored by two large economies, Germany and France, respectively (Mark Bacchetta et al. 2008).

3. Empirical Framework

3.1 Econometric Model Specification

The econometric model of the study is based on the SGM specification of Anderson and van Wincoop (2003). Accordingly, in our case, manufacturing exports are modeled as a function of GDPs of country pairs, BRTs between country pairs, and outward- and inward-MRTs, as shown in Equation (4).

$$MANEXPORTijt = f\,(GDPit\,, GDPjt\,, BRTsijt\,, MRTsit\,, MRTsjt). \quad (4)$$

In Equation (4), subscripts i, j (1,…,30), and t (2003,…,2018) symbolize Türkiye, partner countries, and period, respectively. $MANEXPORT_{ijt}$ refers to bilateral manufacturing exports from Türkiye to its partners, while GDP_{it} and GDP_{jt} represent the economic sizes of Türkiye and its partners, respectively. The BRTs include the following: *geographical variables*: distance ($DIST_{ij}$); common border (CB_{ij}); cultural similarity (CS_{ij}); landlocked (LL_j); *institutional variables*: institutional qualities (INQ_{it} and INQ_{jt}); institutional dissimilarity ($INDIS_{ijt}$); and *political variables*: WTO

[4] World output does not explicitly appear in general discussions of SGM (Yotov et al. 2016).

membership (WTO_{jt}); trade agreements (TA_{ijt}); trade freedom indexes (TFI_{it} and TFI_{jt}). On the other hand, $MRTs_{it}$ and $MRTs_{jt}$ symbolize Türkiye's MRTs (outward-MRTs) and partner countries' MRTs (inward-MRTs), respectively. Outward- and inward-MRTs are unobservable variables that are taken by the method of exporter/importer-specific fixed effects into account in the estimation process. Accordingly, one indicator (or dummy) variable of which the value is unity if country *i* is the exporter, otherwise zero, is generated to consider the outward MRTs. Similarly, another indicator (or dummy) variable of which value is unity if country *j* is the importer, otherwise zero, is generated to consider the inward MRTs. This method is accepted as the most efficient approach for considering the MRTs (Feenstra 2004; Yotov et al. 2016). In this context, the panel regression model of the study is as follows:

$$MANEXPORTijt = exp\ (\beta 0 + \beta 1 \ln GDPit + \beta 2 \ln GDPjt + \beta 3\ \ln DISTij + \beta 4CBij + \beta 5CSij + \beta 6LLj + \beta 7INQit + \beta 8INQjt + \beta 9INDISijt + \beta 10WTOjt + \beta 11TAijt + \beta 12 \ln TFIit + \beta 13 \ln TFIjt + \mu i + \lambda j)\ \varepsilon ijt. \quad (5)$$

Where notations of exp, ln, and ε_{ijt} denote the exponential function, natural logarithm operator, and error term, respectively. Outward and inward MRTs are represented with μ_i and λ_j, respectively. Finally, β_k (k=1,2,…,13) parameters are the coefficients to be estimated.

3.2 Dataset and Variables

The study uses annual balanced panel data of Türkiye and its main 30 trade partners from 2003 through 2018. While the partner countries[5] are, on average, ranked in the top 30 among all the manufacturing export markets of Türkiye in 2003-2018, the period is determined by considering data availability and Türkiye's notable performance in the manufacturing exports over this period. The partner countries here correspond to about 78% of Türkiye's total manufacturing exports in the analysis period (World Integrated Trade Solution - WITS 2021)[6].

Bilateral manufacturing export data were extracted from the WITS (2021) as the nominal value in terms of US dollars with prices of free on board and analyzed at the level form. GDP data were taken from World Development Indicators of the World Bank (2020a)[7] as the nominal value in terms of the US dollars and transformed into the natural logarithm. The data concerning geographical variables (i.e., distance, common border, cultural similarity, and landlocked position) were compiled from the CEPII database of Thierry Mayer and Soledad Zignago (2011). The distance is computed by the method of the great circle considering the shortest physical distance between Istanbul (Türkiye's trade center) and the trade centers of partner countries and transformed into the natural logarithm. The variables of the common border, cultural

[5] The partner countries are Algeria, Austria, Azerbaijan, Belgium, Bulgaria, China, Egypt, France, Georgia, Germany, Greece, Iran, Iraq, Israel, Italy, Morocco, Netherlands, Poland, Romania, Russia, Saudi Arabia, Slovenia, Spain, Sweden, Switzerland, Turkmenistan, Ukraine, United Arab Emirates, United Kingdom, and the United States.
[6] **World Integrated Trade Solution.** 2021. https://wits.worldbank.org/ (accessed February 18, 2021).
[7] **World Bank.** 2020a. World Development Indicators.
https://databank.worldbank.org/source/world-development-indicators (accessed November 22, 2020).

similarity, and landlocked position are proxied by dummy variables. The data on institutional quality is represented with the averages of worldwide governance indicators, which are six broad dimensions of governance (i.e., voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption). Ranging from approximately -2.5 (weak) to 2.5 (strong) governance performance, these data were retrieved from the Worldwide Governance Indicators of the World Bank (2020b)[8]. Additionally, the data on institutional dissimilarity was generated by considering the difference in institutional qualities of Türkiye and its partners. The data of the trade freedom index calculated by the weighted average tariff rate and non-tariff barriers were extracted from the Heritage Foundation (2020)[9] and transformed into a natural logarithm. The WTO membership is proxied with dummies, based on information from WTO (2021). Lastly, the data of bilateral and/or multilateral trade agreements that are binding for both Türkiye and its partners were compiled from information in the Republic of Türkiye - Ministry of Trade (2020)[10], which comprises free-trade agreements, customs union agreements, and trade-oriented economic cooperation organizations.

3.3 Estimation Method

Conventionally, gravity models are linearized via logarithmic transformation and then estimated using OLS estimators like fixed effects and random effects in which the variance of the error term is assumed to be constant. However, this traditional approach has been severely criticized by recent contributors following the seminal study of Santos Silva and Tenreyno (2006). Regarding Jensen's inequality referring to the expected value of the logarithm of a random variable being different from the logarithm of its expected value, namely E(lnY) ≠ ln E(Y), Santos Silva and Tenreyno (2006) highlighted that OLS yields are misleading and offer inconsistent estimates of the parameters when the disturbance in Equation (5) is heteroscedastic, in which its variance depends upon one or more of regressors. To deal with this problem, Santos Silva and Tenreyno (2006) proposed that the gravity model should be estimated in a non-linearly multiplicative form by using the PPML estimation technique that performs well in non-heteroscedasticity. The stochastic model in multiplicative form is shown as

$$yi \; = \; exp \;\; (xi\tilde{\beta})] \; \varepsilon i. \tag{6}$$

Where y_i and x_i denote the dependent variable and vector of explanatory variables, respectively. The sufficient condition for the consistency of the PPML estimator is the correct specification of conditional mean, that is, $E[y_i/x] = \exp(x_i\beta)$. The PPML estimation approach, which is often used for the count data can be shown as follows:

$$\textstyle\sum_{i=1}^{n}[yi \; - \; exp \;\; (xi\tilde{\beta})] \; xi \;\; = \; 0. \tag{7}$$

[8] **World Bank.** 2020b. Worldwide Governance Indicators. https://info.worldbank.org/governance/wgi/ (accessed November 25, 2020).
[9] **Heritage Foundation.** 2020. https://www.heritage.org/index/trade-freedom (accessed December 18, 2020).
[10] **Republic of Turkey - Ministry of Trade.** 2020. https://www.ticaret.gov.tr/ (accessed October 12, 2020).

Given that condition, neither the data have to possess the properties of Poisson distribution nor does the dependent variable have to be an integer. In this case, Equation (6) may be written as follows:

$$MANEXPORTij = exp \ \ (xij\tilde{\beta})] \ \varepsilon ij. \tag{8}$$

The simulation results of Santos Silva and Tenreyno (2011) confirm that the PPML estimator is generally well-natured even if the conditional variance is far from being proportional to the conditional mean. Also, it is stated that the PPML estimator is robust against potential endogeneity problems resulting from trade policy variables (Peter H. Egger and Filip Tarlea 2015). Hence, the PPML estimator has recently been accepted as a workhorse for estimating gravity models (Yotov et al. 2016). Hereby, the study follows the PPML method in the estimation process of the SGM in Equation (5).

4. Analysis Results

The study follows the hierarchical regression analysis. Namely, the SGM of the study was constructed in five different specifications to illuminate the degree of robustness of explanatory variables and then estimated gradually. Firstly, the basic gravity model was estimated (column 1), and then it was extended with other geographical variables (column 2) and institutional variables (column 3). Owing to the high correlation (0.98) between the institutional quality of partner countries and institutional dissimilarity between country pairs, the effect of institutional dissimilarity was separately estimated from the variables of country pairs' institutional quality (column 4). Lastly, the model, including the variables of institutional quality of country pairs (excluding institutional dissimilarity), was estimated together with political variables (column 5).

The entity of heteroscedasticity matters quantitatively and qualitatively for the consistency of parameters. Even though the PPML estimation approach used in the study has been accepted as the most efficient method to deal with this problem, it does not take complete heteroscedasticity into account. For this reason, as Santos Silva and Tenyerno (2006) suggested, all model inference was based on the Eicker-Huber-White robust covariance matrix estimator, whereby the study reported the corrected standard errors. Additionally, clustering was applied to take the possible correlation of the error terms within groups into account. Non-clustering or amiss clustering might cause the underestimation of standard errors. As the clustering should be based on one variable in the model, the distance, which is the same for both export and import flows, and different for all country pairs, were employed to address this issue. Eventually, the results of estimated SGM by PPML were hierarchically presented in Table 1.

Table 1 Estimation Results of Structural Gravity Model by PPML

Variables	(I)	(II)	(III)	(IV)	(V)
GDPi	0.371* (0.075)	0.371* (0.075)	0.314* (0.069)	0.364* (0.076)	0.501* (0.073)
GDPj	0.914* (0.056)	0.914* (0.056)	0.912* (0.048)	0.866* (0.058)	0.927* (0.054)
DISTij	-1.212* (0.088)	-1.212* (0.088)	-1.188* (0.088)	-1.235* (0.087)	-1.817* (0.094)

CBij	-	2.589* (0.243)	2.557* (0.203)	2.487* (0.239)	2.858* (0.456)
CSij	-	0.554* (0.077)	0.478** (0.231)	0.824* (0.143)	1.066* (0.122)
LLj	-	-0.277* (0.049)	-0.961* (0.209)	-1.335* (0.146)	-0.082 (0.361)
INQi	-	-	-0.325* (0.123)	-	-0.242* (0.092)
INQj	-	-	-0.054 (0.181)	-	-0.043 (0.182)
IDISij	-	-	-	0.256** (0.112)	-
TFi	-	-	-	-	-0.899** (0.445)
TFj	-	-	-	-	-0.365 (0.309)
TAij	-	-	-	-	0.193** (0.084)
WTOj	-	-	-	-	-0.324* (0.122)
Constant	-4.811* (1.477)	-4.811* (1.477)	-3.376** (1.343)	-3.304** (1.456)	0.682 (1.611)
Observations	480	480	480	480	480
Fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.953	0.953	0.959	0.958	0.965
RESET test p-values	0.000*	0.000*	0.002*	0.199	0.779

Notes: * and ** indicate the statistical significance at the level of 1% and 5%, respectively. Values in parenthesis are the robust standard errors. The null hypothesis of the Wald test is that all coefficients are equal to zero. In all the model specifications, MRTs are considered with exporter/importer fixed effects.

Source: Author's calculations.

A heteroscedasticity-robust RESET test (James B. Ramsey 1969), which essentially controls whether the conditional mean is correctly specified or not, was performed to all the model specifications to check the adequacies of estimated models. The results presented at the bottom of Table 1 show evidence of misspecification for the first three models (columns 1, 2, and 3), but no evidence of misspecification for the last two models (columns 4 and 5), which are our most extended models. These results justify the following hierarchical regression analysis in the estimation process. Therefore, the study particularly focuses on the findings of the last two models (columns 4 and 5) while interpreting the coefficients.

According to estimation results[11], as an indicator of supply size, Türkiye's GDP has a statistically significant and positive impact on its manufacturing exports. This result is robust for all model specifications. Also, it means that the growth-driven export hypothesis, which refers to facilitating exports due to reduced unit costs or improving productivity through output growth (Abdulnasser Hatemi-J and Manuchehr Irandoust 2000), is valid for Türkiye. As Türkiye grows by 1%, its manufacturing exports increase by 0.501%. Similarly, to a greater extent, as an indicator of demand size,

[11] The interpretation of coefficients obtained from PPML is analogous to those of OLS. Although the dependent variable is in level form, coefficients of any independent variables in logarithms may be interpreted as simple elasticities. In the case of independent variables entered in levels, coefficients are interpreted as semi-elasticities, as under OLS (Ben Shepherd 2016).

the GDPs of trade partners are statistically significant and positively associated with Türkiye's manufacturing exports in all model specifications. The magnitude of impact is close to unity and about twice the coefficient reported for Türkiye's GDP. An increment of 1% of partner countries' GDPs leads to an increment of 0.927% in Türkiye's manufacturing exports. These results satisfy the theoretical expectations and align with those of Polat and Yeşilyaprak (2017) and Demir, Bilik, and Utkulu (2019).

The distance was found to be, as expected, a statistically significant resistance factor against manufacturing exports in all model specifications. Accordingly, as the distance gets longer by 1%, Türkiye's manufacturing exports decrease by about 1.817%. This result supports the findings of Suvankulov, Akhmedjonov, and Ogucu (2012) and refuses the premise that "distance is dead" through globalization. Also, the common border was found to be statistically significant and one of the most encouraging factors of Türkiye's manufacturing exports in all model specifications. Accordingly, Türkiye considerably exports its manufactured goods to neighboring countries more in comparison with countries that do not share a border with Türkiye. This result, which is coherent with theoretical expectations, is similar to the findings of Bilgin, Gozgor, and Demir (2018) and Akça (2021), but opposite to those of Demir, Bilik, and Utkulu (2019). Besides, as expected, the cultural similarity found to be statistically significant for all model specifications tends to stimulate Türkiye's manufacturing exports by cutting trade costs. This result supports the findings of Suvankulov, Akhmedjonov, and Ogucu (2012) and Bilgin, Gozgor, and Demir (2018), whereas it contradicts the findings of Frede and Yetkiner (2017). Furthermore, the landlocked position (lacking direct access to water like sea and ocean) was detected as a resistance factor against Türkiye's manufacturing exports, albeit its trivial magnitude, and found to be insignificant when political factors are considered. This result covers the expectations as the landlocked position raises transportation costs and also coincides with the finding of Polat and Yeşilyaprak (2017).

The estimation results concerning institutional variables do not fulfill theoretical expectations. While Türkiye's institutional quality was found to be statistically significant and negatively associated with its manufacturing exports by a coefficient of -0.242, meaning that the manufacturing exports fall by 0.242% in response to a one-unit improvement in institutional quality of Türkiye, trade partners' institutional quality was found to be statistically insignificant. Moreover, as institutional dissimilarity (similarity) between country pairs deepens by one unit, Türkiye's manufacturing exports go up (diminish) by 0.256%. These results are opposite to those of Suvankulov, Akhmedjonov, and Ogucu (2012) and Suvankulov and Ali (2012) and implicate that institutional improvements of Türkiye and its partners did not lead to more manufacturing exports by way of cutting down transaction costs.

The estimation results regarding trade policy variables make it possible to offer striking inferences. Accordingly, while the degree of Türkiye's trade freedom and its manufacturing exports are statistically significant and negatively associated, partner countries' degree of trade freedom has no impact on manufacturing exports. The coefficient indicates that as the degree of Türkiye's trade freedom improves by 1%, its manufacturing exports reduce by 0.889%. These results are opposite to the findings of Ülengin et al. (2015), Çekyay et al. (2017), Demir, Bilik, and Utkulu (2019) and Akça

(2021). However, the existence of bilateral or multilateral trade agreements between two parties is statistically significant and helps to enhance, as expected, Türkiye's manufacturing exports by 21.28%[12]. This finding contradicts the findings of Frede and Yetkiner (2017). Lastly, the WTO membership of trade partners is statistically significant and brings about a decrease in manufacturing exports by 0.324. This finding is in line with the findings reported by Aybar (2017), but opposite to the findings of Suvankulov and Ali (2012).

5. Conclusion

This study empirically investigates the potential determinants of Türkiye's manufacturing exports in the framework of SGM by using the PPML estimator from 2003 through 2018. The estimation results showed that as trading partners' economies grew, Türkiye's manufacturing exports markedly increased. Besides, the growing economy of Türkiye indirectly increases manufacturing exports by possibly enhancing production capacity and productivity. Distance still maintains its importance as a resistance factor against manufacturing exports. On the other hand, common borders and cultural similarities tend to stimulate manufacturing exports. The landlocked position of partner countries hurts Türkiye's manufacturing exports as it raises the transportation costs; however, this impact becomes insignificant when the policy implementations are considered. In this context, seeking markets in countries that are geographically closer to Türkiye, affiliating the strong social and political relationships with contiguous countries, and concentrating on the countries where Türkiye has historical ties can help to increase manufacturing exports.

Improvements in Türkiye's institutional quality seem to be a resistance factor against its manufacturing exports, while its partners' institutional qualities were not found to have a significant effect on manufacturing exports. Additionally, as the institutional dissimilarity (similarity) between Türkiye and its partners deepens further, Türkiye's manufacturing exports rise (reduce). Consequently, institutions' expected positive side effects on trade flows through mitigating the transaction costs do not show themselves in the case of Türkiye's manufacturing exports. As the indicator of institutional quality employed here is the average of six sub-indicators, further research is required to address institutional indicators individually to see a more clear impact of institutions on Türkiye's manufacturing exports.

The study put forward the evidence that the partner countries' WTO membership negatively affects Türkiye's manufacturing exports. This finding implies that the trade diversion effect of partner countries' WTO membership outweighs the trade creation effect for Türkiye. In other words, WTO membership of partner countries emerges as the new partners for them, reducing manufacturing imports from Türkiye. Moreover, the improvements in Türkiye's trade freedom decrease its manufacturing exports, whereas partner countries' trade freedom does not significantly affect manufacturing exports. On the contrary, the study puts forward that bilateral or multilateral trade agreements have been one of the main driving forces of manufacturing exports rather than standard trade policy implementations. When the effects of trade freedom on

[12] This effect is computed by using this formula: $(e^{\beta_i} -1)*100$, β_i is the estimated coefficient.

manufacturing exports are evaluated together with those of trade agreements, the results seem rational, as the main reason for signing a trade agreement is to remove or ease the strict implementations of protectionism. From the policy perspective, it is proposed that Türkiye should sign more trade agreements and/or amplify the agreements that have already been signed.

References

Adam, Christopher, and David Cobham. 2007. "Modelling Multilateral Trade Resistance in a Gravity Model with Exchange Rate Regimes." Paper presented at the Centre for Dynamic Macroeconomic Analysis Conference, St Andrews.

Akça, Emrah Eray. 2021. "Determinants of Export Flows from Turkey to BRICS Countries: The Findings from the Augmented-Gravity Model Approach." *Ekonomik Yaklasim*, 32(118): 27-46. http://dx.doi.org/10.5455/ey.17502

Anderson, James E. 1979. "A Theoretical Foundation for the Gravity Equation." *The American Economic Review*, 69(1): 106-116.

Anderson, James E., and Dougles Marcouiller. 2002. "Insecurity and the Pattern of Trade: An Empirical Investigation." *Review of Economics and Statistics*, 84(2): 342-352. http://dx.doi.org/10.1162/003465302317411587

Anderson, James E., and Eric van Wincoop. 2003. "Gravity with Gravitas: A Solution to the Border Puzzle." *American Economic Review*, 93(1): 170-192. http://dx.doi.org/10.1257/000282803321455214

Aybar, Sedat. 2017. "Can Turkish and US Co-operation in the Black Sea Region Increase Efficiency Gains?" *Outlines of Global Transformations: Politics, Economics, Law*, 10(2): 34-49. http://dx.doi.org/10.23932/2542-0240-2017-10-2-34-49

Bacchetta, Mark, Cosimo Beverelli, Olivier Cadot, Marco Fugazza, Jean-Marie Grether, Matthias Helble, Alessandro Nicita, and Roberta Piermartini. 2008. *A Practical Guide to Trade Policy Analysis: Analyzing Bilateral Trade Using the Gravity Equation*. Geneva: World Trade Organization.

Balassa, Bela. 1978. "Exports and Economic Growth: Further Evidence." *Journal of Development Economics*, 5(2): 181-189. http://dx.doi.org/10.1016/0304-3878(78)90006-8

Baldwin, Richard, and Daria Taglioni. 2006. "Gravity for Dummies and Dummies for Gravity Equations." National Bureau of Economic Research Working Paper 12516. http://dx.doi.org/10.3386/w12516

Berg, Andrew, and Anne Krueger. 2003. "Trade, Growth, and Poverty: A Selective Survey." In *Annual World Bank Conference on Development Economics: The New Reform Agenda*, ed. Boris Pleskovic and Nicholas Stern, 47-90. New York: A Co-publication of the World Bank and Oxford University Press.

Bergstrand, Jeffrey H. 1985. "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence." *The Review of Economics and Statistics*, 67(3): 474-481. http://dx.doi.org/10.2307/1925976

Bilgin, Mehmet H., Giray Gozgor, and Ender Demir. 2018. "The Determinants of Turkey's Exports to Islamic Countries: The Impact of Political Risks." *The Journal of International Trade & Economic Development*, 27(5): 486-503. http://dx.doi.org/10.1080/09638199.2017.1396489

Burger, Martijn, Frank van Oort, and Gert-Jan Linders. 2009. "On the Specification of the Gravity Model of Trade: Zeros, Excess Zeros and Zero-Inflated Estimation." *Spatial Economic Analysis*, 4(2): 167-190. http://dx.doi.org/10.1080/17421770902834327

Çekyay, Bora, Peral T. Palut, Özgür Kabak, Füsun Ülengin, Özay Özaydın, and Burç Ülengin. 2017. "Analysis of the Impact of Bilateral and Transit Quotas on Turkey's International Trade by Road Transportation: An Integrated Maximum Flow and

Gravity Model Approach." *Research in Transportationation Economics*, 66(C): 70-77. http://dx.doi.org/10.1016/j.retrec.2017.04.006

Deardorff, Alan. 1998. "Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World?" In *The Regionalization of the World Economy*, ed. Jeffrey A. Frankel, 7-32. Chicago: University of Chicago Press.

De Groot, Henri L. F., Gert-Jan Linders, Piet Rietveld, and Uma Subramanian. 2004. "The Institutional Determinants of Bilateral Trade Patterns." *Kyklos*, 57(1): 103-123. http://dx.doi.org/10.1111/j.0023-5962.2004.00245.x

Demir, Memduh A., Mustafa Bilik, and Utku Utkulu. 2019. "The Efficiency of Manufacturing Trade between Turkey and the European Union." *Business & Management Studies: An International Journal*, 7(2): 591-608. http://dx.doi.org/10.15295/bmij.v7i2.1114

Egger, Peter H., and Filip Tarlea. 2015. "Multi-Way Clustering Estimation of Standard Errors in Gravity Models." *Economics Letters*, 134(C): 144-147. http://dx.doi.org/10.1016/j.econlet.2015.06.023

Feenstra, Robert C. 2004. *Advanced International Trade: Theory and Evidence*. New Jersey: Princeton University Press.

Frede, Julian, and Hakan Yetkiner. 2017. "The Regional Trade Dynamics of Turkey: A Panel Data Gravity Model." *The Journal of International Trade & Economic Development*, 26(6): 633-648. http://dx.doi.org/10.1080/09638199.2017.1279205

Gil-Pareja, Salvador, Rafael Llorca-Vivero, and José A. Martínez-Serrano. 2019. "Corruption and International Trade: A Comprehensive Analysis with Gravity." *Applied Economic Analysis*, 27(79): 3-20. http://dx.doi.org/10.1108/AEA-06-2019-0003

Golovko, Anna, and Hasan Sahin. 2021. "Analysis of International Trade Integration of Eurasian Countries: Gravity Model Approach." *Eurasian Economic Review*, 11(3): 519-548. http://dx.doi.org/10.1007/s40822-021-00168-3

Hatemi-J, Abdulnasser, and Manuchehr Irandoust. 2000. "Time-Series Evidence for Balassa's Export-Led Growth Hypothesis." *The Journal of International Trade & Economic Development*, 9(3): 355-365. http://dx.doi.org/10.1080/09638190050086195

Head, Keith. 2000. "Gravity for Beginners." https://artnet.unescap.org/tid/artnet/mtg/gravity10_reading1.pdf.

Helpman, Elhanan, and Paul R. Krugman. 1985. *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition and the International Economy*. Cambridge, M. A.: MIT Press.

Helpman, Elhanan. 1987. "Imperfect Competition and International Trade: Evidence from Fourteen Industrial Countries." *Journal of the Japanese and International Economies*, 1(1): 62-81. http://dx.doi.org/10.1016/0889-1583(87)90027-X

Helpman, Elhanan, March Melitz, and Yona Rubinstein. 2008. "Estimating Trade Flows: Trading Partners and Trading Volumes." *Quarterly Journal of Economics*, 123(2): 441-487. http://dx.doi.org/10.1162/qjec.2008.123.2.441

Karagöz, Kadir, and Mehmet O. Saray. 2010. "Trade Potential of Turkey with Asia-Pacific Countries: Evidence from Panel Gravity Model." *International Economics Studies*, 36(1): 19-26. http://dx.doi.org/10.22108/ies.2022.15523

Krugman, Paul R., and Maurice Obstfeld. 2006. *International Economics Theory & Policy*. 7th ed. Boston: Addison Wesley.

Linneman, Hans. 1966. *An Econometric Study of International Trade Flows*. Amsterdam: North-Holland Publishing Company.

Mayer, Thierry, and Soledad Zignago. 2011. "Notes on CEPII's Distances Measures: The Geodist Database." Centre d'Etudes Prospectives et d'Informations Internationales Working Paper 25.

McCallum, John. 1995. "National Borders Matter: Canada-US Regional Trade Patterns." *The American Economic Review*, 85(3): 615-623.

Piermartini, Roberta, and Robert Teh. 2005. "Demystifying Modelling Methods for Trade Policy." World Trade Organization Discussion Paper 10.

Polat, Ali, and Mehmet Yeşilyaprak. 2017. "Export Credit Insurance and Export Performance: An Empirical Gravity Analysis for Turkey." *International Journal of Economics and Finance*, 9(8): 12-24. http://dx.doi.org/10.5539/ijef.v9n8p12

Pöyhönen, Pentti. 1963. "A Tentative Model for the Volume of Trade between Countries." *Weltwirtschaftliches Archiv*, 90: 93-100.

Ramsey, James B. 1969. "Tests for Specification Errors in Classical Linear Least-Squares Regression Analysis." *Journal of the Royal Statistical Society: Series B (Methodological)*, 31(2): 350-371. http://dx.doi.org/10.1111/j.2517-6161.1969.tb00796.x

Romer, Paul M. 1987. "Growth based on Increasing Returns Due to Specialization." *The American Economic Review*, 77(2): 56-62.

Rose, Andrew K. 2004. "Do We Really Know That the WTO Increases Trade?" *American Economic Review*, 94(1): 98-114. http://dx.doi.org/10.1257/000282804322970724

Santos Silva, Joao, and Silvana Tenreyro. 2006. "The Log of Gravity." *The Review of Economics and Statistics*, 88(4): 641-658. http://dx.doi.org/10.1162/rest.88.4.641

Santos Silva, Joao, and Silvana Tenreyro. 2011. "Further Simulation Evidence on the Performance of the Poisson Pseudo-Maximum Likelihood Estimator." *Economics Letters*, 112(2): 220-222. http://dx.doi.org/10.1016/j.econlet.2011.05.008

Shepherd, Ben. 2016. *Gravity Model of International Trade: A User Guide*. Thailand: United Nations Publications.

Subramanian, Arvind, and Shang-Jin Wei. 2007. "The WTO Promotes Trade, Strongly but Unevenly." *Journal of International Economics*, 72(1): 151-175. http://dx.doi.org/10.1016/j.jinteco.2006.07.007

Suvankulov, Farrukh, Alisher Akhmedjonov, and Fatme Ogucu. 2012. "Restoring Forgotten Ties: Recent Trends and Prospects of Turkey's Trade with Syria, Lebanon and Jordan." *Turkish Studies*, 13(3): 343-361. http://dx.doi.org/10.1080/14683849.2012.717840

Suvankulov, Farrukh, and Wazir Ali. 2012. "Recent Trends and Prospects of Bilateral Trade between Pakistan and Turkey: A Gravity Model Approach." *Journal of International and Global Economic Studies*, 5(1): 57-72.

Tinbergen, Jan. 1962. *Shaping the World Economy: Suggestions for an International Economic Policy*. New York: The Twentieth Century Fund.

Ülengin, Füsun, Bora Çekyay, Peral T. Palut, Burç Ülengin, Özgür Kabak, Özay Özaydın, and Şule Ö. Ekici. 2015. "Effects of Quotas on Turkish Foreign Trade: A Gravity Model." *Transportation Policy*, 38(C): 1-7. http://dx.doi.org/10.1016/j.tranpol.2014.09.006

Yotov, Yoto V., Roberta Piermartini, José-Antonio Monteiro, and Mario Larch. 2016. *An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model*. Geneva: World Trade Organization.