Henry Eric Magezi, Taner Okan[1]

A Gravity Model Analysis of Forest Products Trade Between Turkey and European Union Countries

Gravitacijski model analize trgovine drvnim proizvodima između Turske i zemalja Europske unije

ORIGINAL SCIENTIFIC PAPER
Izvorni znanstveni rad
Received – prispjelo: 15. 8. 2022.
Accepted – prihvaćeno: 21. 12. 2022.
UDK: 630*88
https://doi.org/10.5552/drvind.2023.0057

ABSTRACT • *The study aimed to understand the determining factors of the trade between Turkey and the European Union (EU) countries in the forest products sector and assess Turkey's forest product export potential to the EU. The study period was from 2005 to 2020 and focused on HS44, HS47, and HS48 forest product groups. A gravity model was estimated using panel data with the Ordinary Least Squares, Random Effects, and Hausman-Taylor estimation methods. Results indicate that the forest products exports from Turkey to the EU are significantly influenced by the Gross Domestic Product, the population of Turkey and the EU partner, and negatively by the relative forest endowment. The elasticities estimated were then used to predict the export potential of Turkey in the trade of forest products. The findings revealed that the predicted forest export value exceeded Turkey's actual forest products export to Denmark, France, Italy, Luxembourg, Poland, Slovenia and Spain from 2005 to 2020.*

KEYWORDS: *forest products trade, gravity model, export potential, Turkey, European Union*

SAŽETAK • *Cilj istraživanja bio je proučiti najvažnije čimbenike trgovinskih odnosa Turske i zemalja Europske unije (EU) u sektoru šumarstva i drvne industrije te procijeniti izvozni potencijal drvnih proizvoda iz Turske u EU. Istraživanje je trajalo od 2005. do 2020., a naglasak je bio na skupinama drvnih proizvoda HS44, HS47 i HS48. Gravitacijski model definiran je uz pomoć panel-podataka primjenom ovih metoda: metode najmanjih kvadrata, metode slučajnih efekata i Hausman-Taylorove metode. Rezultati su pokazali da je izvoz drvnih proizvoda iz Turske u EU pod znatnim utjecajem domaće bruto proizvodnje, broja stanovništva Turske i partnera iz EU-a te pod negativnim utjecajem relativne raznovrsnosti drvnih proizvoda. Ujedno su procijenjene elastičnosti primijenjene za predviđanje izvoznog potencijala drvnih proizvoda iz Turske. Utvrđeno je da predviđena vrijednost izvoza od 2005. do 2020. godine premašuje stvarni izvoz drvnih proizvoda iz Turske u Dansku, Francusku, Italiju, Luksemburg, Poljsku, Sloveniju i Španjolsku.*

KLJUČNE RIJEČI: *trgovina drvnim proizvodima, gravitacijski model, izvozni potencijal Turske, Europska unija*

[1] Authors are researchers at Istanbul University-Cerrahpaşa, Faculty of Forestry, Department of Forestry Economics, Istanbul, Turkey. https://orcid.org/0000-0003-3170-7159, https://orcid.org/0000-0001-7531-5662

1 INTRODUCTION
1. UVOD

Before the 1970s, Turkey used to pursue an inward-oriented import-substitution industrialization strategy for the economy. Nevertheless, from the 1980s, Turkey made a drastic turnaround to follow an export-focused growth approach with the majority of the country's economic policies focusing on the integration of the economy to world markets and promotion of export (Karagoz and Saray, 2010). With the increase in the openness of the economy, Turkey has become more critical of its export performance with the focus being the European Union market where it has wanted to be a member since the 1960s.

The EU is by far Turkey's most significant partner in trade in recent years, accounting for 41.3% of Turkey's exports and 33.4 % of Turkey's imports. According to European Commission, Turkey in 2020 ranked as the EU's sixth biggest trade partner with exports worth 62.6 billion Euros to the EU and imports worth 69.9 billion Euro from the EU (European Commission, 2021). This is one of the results of the Customs Union (CU) between Turkey and the EU that provided a significant impetus for trade facilitation and customs reform in Turkey including the modernization of the Turkish Customs Administration (TCA). These improvements are of great economic significance for Turkey and lie at the heart of Turkey's strong export performance over the past decade (World Bank, 2014).

Turkey's volume of exports declined by an unprecedented rate of 17.8 % in 2020 mainly due to Covid-19, whereas its imports contracted by 6.4 %. Turkey's Exports reached USD 170 billion in 2020 across Turkey's highly diversified export markets. In the EU, Germany continued to be Turkey's largest export market with a share of 9.2 % of all exports in 2020. Turkey's second largest export market was the United Kingdom (UK) with a share of 6.2 %, followed by Iraq and Italy (IMF, 2021). Concerning forest products trade, the export figures of the wood and forest products sector for Turkey, as a whole, was $ 4.9 billion in 2013, up by 15.7 % compared to 2012, with UK and Germany being top importers of Turkish wood and forest products in the EU.

Also, the exports of Turkish furniture increased from US $ 684,5 million in 2005 to US $ 2,2 billion in 2015 (Ministry of Trade, 2019). This is mainly due to improvements in capacity, quality and design. In 2015, Turkey exported furniture to 201 countries throughout the world as well as being the fifth largest source of furniture imported to the EU, with Germany and France being the main markets in the EU.

The Global Economic Dynamics (GED) Study 2016 applied the Grubel-Lloyd (GL) index to quantify the extent of bilateral EU-Turkish trade within the forest products sector and showed that in 2014 the GL index of Turkey and the EU in wood and forest products was 0.92. It also showed that the simple and the weighted average bilateral tariffs applied between the EU and Turkey on forestry and wood products are zero percent (GED Study, 2016). Turkey is in a competitive position to supply semi-processed wood products and furniture to the EU due to its relatively low labor costs. Turkish forest product-based industries, such as the panel and furniture industries, have increased their capacity over the last decade, allowing them to take advantage of these regional opportunities (Ministry of Trade, 2019).

In recent times, several studies have attempted to assess the trade between Turkey (in general and some sectors in particular) and the EU and understand the key factors influencing the foreign trade of Turkey. However, the forest products sector has received limited attention in these studies, and its potential with the EU is yet to be fully understood. The trade of forest products is essential for the developed economies, and it is rapidly becoming a significant factor in the economic growth of many developing economies. Consequently, the increase in the demand for forest products has been recorded (Akyüz *et al*., 2020). Lundmark (2010) observed that the increasing use of and demand for forest products relative to the scarcity of forest resources in some countries has led to an increase in the import needs of such countries, at the same time increasing the forest products exports from those with comparatively high forest resources.

Anderson (2011) describes the gravity model as the most recognized empirical model to understand and analyze international trade. The gravity model defines the volume of trade between two partners as a function of push and pull factors, mainly the economic size of the exporting and importing trade partners, and the transactional distance in-between the partners (Patuelli *et al*., 2015).

Even though several studies like those of McCallum (1995), Marku (2014) and Yu Cheng (2016) have discussed the use of the gravity model in the analysis of international trade, just a few studies have estimated the trade flows of forestry products. Using panel data from 2001-2016, Vu *et al*. (2019) employed a gravity model to study the determinants of Vietnam's trade of wood products. Larson *et al*. (2018) estimated the impact of GDP of the importing partner and the exporting partner GDP together with the distance between the trading partners using FAO's dataset. Buongiorno (2016) studied trade flows of forest products, forecasting the trade value for three forestry product types amongst the Trans-Pacific Partnership (TPP) member countries. Buongiorno (2015) estimated a gravity model using OLS and

Fixed Effects methods to study the effects the monetary union introduction in Europe posed to the forest products trade flow. Similarly, Akyüz *et al*. (2010) used the gravity to study the trade of forest products of Turkey and the EU countries from 2000 to 2006. They used a logarithmic specification with a variable for population and three dummy variables for shared border, shared language, and for membership in the EU before 2004.

This study aimed to use the gravity model analysis of Turkey's forest products trade to identify important factors that determine Turkey's forest products exports to the EU. In addition, the study aimed to identify the export potential for Turkey forest products to the EU countries.

2 MATERIALS AND METHODS
2. MATERIJALI I METODE

2.1 Materials
2.1. Materijali

The study considered the 28 EU countries as of 2019 (EU-27 and UK from 2020). The data set contains the annual observations from 2005 to 2020. The study obtained annual Gross Domestic Product (GDP) data from the Economic Outlook Database (IMF, 2021). The UN Comtrade database was the source for the forest products trade data for three forest products groups. These followed the HS Codes 2017; HS44: Wood and articles of wood, wood charcoal; HS47: Pulp of wood or other fibrous cellulosic material, recovered (waste and scrap) paper or paperboard; and HS48: Paper and paperboard, articles of paper pulp, paper or paperboard (United Nations, 2021). The geographical distance between the EU capitals and Istanbul instead of Ankara was taken into consideration because it would be an overestimate to use Ankara, as Istanbul is the business hub of Turkey, and nearest to the EU capitals.

For the endowment variable, data was obtained from the FAOSTAT database, where the forest area in each country at a time (t) was used as a proxy for forestry endowment (FAO 2021). The study utsed STATA for the data analysis and the estimation of the Gravity Model.

2.2 Methods
2.2. Metode

2.2.1 Econometric specification
2.2.1. Ekonometrijska specifikacija

The most fundamental equation of the gravity model is structured as

$$T_{ij} = A\left(\frac{Y_i \cdot Y_j}{DIST_{ij}}\right) \quad (1)$$

Where T_{ij} stands for volume of trade between countries i and j, A a constant, Y_i and Y_j for the economic size of countries i and j, while $DIST_{ij}$ is for the distance between the countries i and j. A log-linear transformation of equation (1) leads to equation (2), which is the basis of

$$logT_{ijt} = logA + logY_{it} + logY_{jt} - logDIST_{ij} \quad (2)$$

Other independent variables have been added to equation (2). Our gravity model specification includes population variables for Turkey and EU country j, (POP_{it}) and (POP_{jt}) at time t, respectively. Population variables represent the market size of the countries and the bigger the market, the more it trades; hence the market size is expected to exert a positive sign. The Real Effective Exchange Rate of the Turkish Lira (TL) at time t ($REER_{ijt}$). An increase in the REER represents an appreciation of the TL in real terms. This indicates that Turkey's export is becoming expensive, thus losing its trade competitiveness. The dummy variable for common border ($BORD_{ij}$) is set at one if Turkey has a shared border with the EU country (e.g., McCallum 1995; Akyüz *et al.* 2010). It is expected to affect the trade value positively due to the closeness. ($EURO_j$) is the dummy for EU country j using EURO to capture the effect of the Euro (e.g., Buongiorno 2015) since only 19 out of 28 EU members use it as the official currency. And $LANDLKD_j$ is the dummy for country j being landlocked. Its effect is expected to be negative as it increases the transaction costs of the trade. The study includes an endowment variable (END_{jit}) which is the relative forest endowment in terms of the ratio of the forest area of EU partner(j) to Turkey(i). Its effect on trade is expected to be negative. Thus, the following gravity model specification:

$$logTRADE_{ijt} = \beta_0 + \beta_1 logGDP_{it} + \beta_2 logGDP_{jt} + \beta_3 logPOP_{it} + \beta_4 logPOP_{jt} - \beta_5 logDIST_{ij} + \beta_6 logEND_{jit} + \beta_7 logREER_{ijt} + \beta_8 BORD_{ij} + \beta_9 EURO_j + \beta_{10} LANDLKD_j + U_{ij} \quad (3)$$

Where GDP_{it} is Gross Domestic Product of Turkey and GDP_{jt} is for the EU country j at a time t. We excluded a dummy variable to cater for preferred trade agreements. The World Bank (2014), using a panel data set from 1990 to 2010, observed no significant Bilateral Preferential Trade Framework (BPTF) effect on the trade between Turkey and the EU. As of 1 January 2021, Turkey has an active Free Trade Agreement with the UK but this is out of context for this paper.

2.2.2 Gravity model estimation
2.2.2. Procjena uz pomoć gravitacijskog modela

We used Panel data to estimate the gravity model. a panel data set helps to observe the trend and evolution of the relevant variables over time and to identify the specific time and country effects. Our model estimation begins with a pooled OLS estimation of the empirical specification (3) as a startup estimation for other

estimators. Although many papers (e.g., McCallum 1995) have employed the OLS method, it ignores the heterogeneity among countries and tends to provide biased estimations since it does not cater for the individual effects and time effects.

The Random Effects Model (REM) assumes zero correlation amongst the individual effects and independent variables since it presumes a strictly exogenous (uncorrelated with the individual effects) unobserved heterogeneous component (Baltagi, 2001). Contrary, the Fixed Effects Model (FEM) presumes the presence of an unobserved heterogeneous component being constant over time. However, heterogeneity which is common across countries and time can be avoided when panel data is used with fixed effects, thus reducing the possibility for inconsistent estimators.

However, other researchers (e.g., Egger 2002) have opted to use Hausman and Taylor's estimator as a better estimator of panel data than both the REM and FEM. McPherson and Trumbull (2008) observe that the ability of the Hausman-Taylor method to include time-invariant variables in the estimations and its ability to avoid the problem of the country-specific dummy variables necessary in the FEM makes it an ideal estimation method. The Hausman-Taylor estimation also solves the correlation problem amongst the independent variables and the error term, which is common with the REM (McPherson and Trumbull 2008).

2.2.3 Estimation of export potential
2.2.3. Procjena izvoznog potencijala

The forest products export potential of Turkey is estimated based on the differences between the estimated and actual forest products exports from Turkey to the EU. The estimation of forest products export potential follows:

$$XP_{ijt} = \frac{\sum E_{ijt}}{\sum Ex_{ijt}} \quad (4)$$

Where the forest products export potential of Turkey is XP_{ijt}, $\sum E_{ijt}$ is Turkey's estimated forest products export flow, and $\sum Ex_{ijt}$ is Turkey's actual forest products export to the EU. XP_{ijt} greater than 1 shows that the actual forest products exports are less than the estimated forest products exports, which indicates the presence of untapped forest products export potential. Conversely a value less than 1 shows that the actual forest products exports from Turkey are greater than the estimated forest products exports, which indicates exhausted export potential.

3 RESULTS AND DISCUSSION
3. REZULTATI I RASPRAVA

3.1 Empirical results
3.1. Empirijski rezultati

The summary statistics of the dataset are presented in Table 1. Since there was no missing data, 448 potential observations were obtained for one exporting country, Turkey and 28 partner EU countries, which led to a maximum of 28 pairs and 16 years from 2005-2020. This was uniform for all our variables, which indicated a strongly balanced panel data set.

The Hausman test for the REM against FEM showed that the REM was more consistent and efficient to apply over fixed effects, hence only results of the estimations from the REM are included in the results (Tables 2 and 3). Even though the REM proved consistent and efficient for the study data, when the data were run with country dummy variables and parameter test for EU country and time dummies, variables tested to be significant indicating a presence of

Table 1 Summary statistics of gravity model
Tablica 1. Zbirna statistika gravitacijskog modela

Variable *Varijable*	Observations *Broj zapažanja*	Mean	Std. Dev.	Minimum	Maximum
log$TRADE_{ijt}$	448	17.43	1.89	4.76	20.47
log$EXPORTS_{ijt}$	448	15.52	1.95	4.76	19.25
log$IMPORTS_{ijt}$	441	16.89	2.34	5.05	20.41
logGDP_{it}	448	27.36	0.17	26.94	27.58
logGDP_{jt}	448	26.07	1.57	22.58	29.00
logPOP_{it}	448	18.14	0.07	18.03	18.25
logPOP_{jt}	448	15.88	1.39	12.91	18.24
log$DIST_{ij}$	448	7.33	0.50	6.10	8.08
logEND_{jit}	448	-2.38	2.16	-11.03	0.31
log$REER_{ijt}$	448	4.89	1.15	4.13	9.27
$LANDLKD_{j}$	448	0.18	0.38	0.00	1.00
$BORDER_{ij}$	448	0.14	0.35	0.00	1.00
$EURO_{j}$	448	0.68	0.47	0.00	1.00

Table 2 Regression results – dependent variable as bilateral trade, 2005–2020
Tablica 2. Rezultati regresije – zavisna varijabla *bilateralna trgovina*, 2005. – 2020.

log$TRAD_{Eij}$t	Pooled OLS	Random Effects	Hausman - Taylor
Observations	448	488	488
F/Wald Statistic	62.81	112.93	68.92
Prob > *F*	0.0000	0.0000	0.0000
R^2	0.59	0.58	
logGDP_{it}	0.22	0.11	0.10
logGDP_{jt}	0.94***	1.33***	1.34***
logPOP_{it}	2.31**	2.15***	3.21***
logPOP_{jt}	-0.32**	-0.84***	-4.98***
log$DIST_{ij}$	-0.75***	-1.20	-1.54
logEND_{jit}	-0.29***	-0.37***	-3.20***
log$REER_{ijt}$	-0.04	-0.38	-0.04
$LANDLKD_j$	-0.33**	-0.54*	-1.09
$BORDER_{ij}$	0.56**	0.25	1.57
$EURO_j$	-0.36***	-0.25**	-0.27
Constant	-43.71***	-36.00**	-22.03***
Hausman test			*P* > Chi2 = 0.1519***

***, **, * Significant at 1 %, 5 % and 10%, respectively */ značajno pri 1 %, 5 % odnosno 10 %*

fixed effects. The presence of both random and fixed effects is the reason the study applied a Hausman –Taylor estimation method. Since the Hausman-Taylor model was found to be most appropriate, the interpretation of the results was based on this model.

3.2 Results of gravity equations and bilateral trade
3.2. Rezultati gravitacijskih jednadžbi i bilateralne trgovine

Table 2 shows the estimates from the OLS, REM, and the Hausman-Taylor estimation methods of the gravity model from 2005 to 2020 data for Eq. 3.

The estimation of the gravity model gave signs of coefficients that are consistent with economic theory. Table 2 shows that Turkey trades more forest products to more developed EU countries. This was expressed through the positive coefficients on importer GDP and is highly significant at 0.01 level. Although, an increase in the GDP of Turkey's GDP increases the bilateral trade flows, its effect is insignificant on the forest products trade between Turkey and the EU countries. The coefficients on the population of Turkey and the EU partners are both highly significant. It is worth noting that, although the population of Turkey influences the trade positively, the population of the EU partners influences the bilateral forest trade negatively. This could mean that high population levels are expected to decrease the income per capita, which may hinder the demand for forest products by the EU partners.

The relative endowment factor has a negative significant effect on the forest trade between Turkey and the EU partners. The coefficients of the distance between Turkey and the EU partners, the real effective exchange rate, and the dummies for a landlocked EU partner, EURO users and sharing a border with Turkey are consistent with the data on gravity model in literature but were found insignificant in the model.

3.3 Results of gravity model estimations and bilateral exports
3.3. Rezultati procjene gravitacijskog modela i bilateralnog izvoza

Table 3 shows the estimates from the OLS, REM, and the Hausman-Taylor estimation methods of the gravity model from 2005 to 2020 data for Eq. 3.

The estimation results indicate that forest products exports are positively influenced by the demand (EU partner's GDP) and the supply capacity (Turkey's GDP). This is in line with the prior research, Buongiorno (2016), Buongiorno (2015), and Akyüz *et al.* (2010). However, the impact of Turkey's GDP is not significant. This implies that the EU countries with a higher GDP show a higher demand and more chances of import; however, an increase in the GDP of Turkey does not necessarily trigger additional forest products exports to the EU. This result is rather different from most prior research, where the domestic GDP tends to play a more significant role than that of the trading

Table 3 Regression results – dependent variable as bilateral Exports, 2005–2020
Tablica 3. Rezultati regresije – zavisna varijabla *bilateralni izvoz*, 2005. – 2020.

log$EXPORTS_{ijt}$	Pooled OLS	Random Effects	Hausman -Taylor
Observations	448	488	488
F/Wald Statistic	297.80	286.36	127.02
Prob > *F*	0.0000	0.0000	0.000
R^2	0.70	0.69	
logGDP_{it}	0.06	0.15	0.33
logGDP_{jt}	0.26***	0.58***	1.19***
logPOP_{it}	5.76***	5.61***	5.31***
logPOP_{jt}	0.89***	0.54**	0.11***
log$DIST_{ij}$	-0.14	-0.23	-0.96
logEND_{jit}	-0.23***	-0.21***	-0.1[8***]*
log*REERijt*	-0.03	-0.03	-0.02
LANDLKDj	-0.59***	-0.73***	-0.99
BORDERij	2.47***	2.23***	1.78
EUROj	-0.19	-0.25	-0.37
Constant	-109.71***	-104.34***	-94.21***
Hausman test			*P* > Chi2 = 0.2132***

***, **, * Significant at 1 %, 5 % and 10 %, respectively */ značajno pri 1 %, 5 % odnosno 10 %*

partner as observed by Head and Mayer (2013). In some cases, the increase in Turkey's GDP will tend to increase the per capita income of the population, which raises the domestic demand that can mostly be meet by the domestic supply, resulting in lower exports. This is also observed by Karamuriro (2015).

Following the argument by Olofsson *et al*. (2018), it is likely that the increase in the GDP of Turkey, reflecting times of economic growth, may instead result in Turkey choosing to use more forest products (e.g., roundwood) domestically to support production (e.g., pulp and sawn wood) rather than exporting. This is in line with Aksu *et al*. (2010), who observed that majority of the investments that have led to the significant development of the Turkish forest product sector since 1980 targeted the domestic market more than foreign markets.

The coefficients of the population of both Turkey and the EU partner, as expected, positively influence the forest exports, and are significant at 0.01 percent.

As expected, the distance coefficient is negative and an increase in distance of 1 percent reduces trade by about 0.96 percent. The reason why the coefficient of distance is statistically insignificant may be due to geographical closeness of European countries. This is in line with Anaman and Al-Kharusi (2003), who observed that this might be due to the fact that the majority of European countries are geographically very close.

Although distance between countries harms the export flows, its effects were insignificant. Different theorists like Marku (2014) have also highlighted that globalization has weakened the significance of distance as the determining factor of trade. Borchert and Yotov (2017) also agree that with time the significance of distance in international trade has decreased, possibly reflecting the decreasing communication costs, and technological advances, which are commonly associated with 'globalization. However, the globalization process has not yet been fully achieved, so the importance of distance might have been reduced but it has not yet lost its power.

The EU countries with a shared border with Turkey had more trade than those without a common border. This is consistent with theory but interestingly just with the effect of distance; the effect of a common border is also insignificant according to the estimate of Hausman- Taylor. This may be for the same reason as the distance effect. At the same time, the Euro effect was negative on the forest products exports from Turkey to the EU countries with a coefficient of -0.37 and this can be because in recent years the Turkish lira has been weak compared to Euro. Similarly, the forest products trade with landlocked EU countries was lower than with those that have access to open waters. This is consistent with the literature as access to open waters avails an alternative of water transport, which reduces the transportation costs since the marginal cost of shipping transportation is low (Wu, 2015).

The coefficient of the relative endowment effect was negative, implying that Turkey exported more to EU partners with less forest resource endowments. The negative sign on the endowment factor shows that countries with considerably more forest resources tend to be more self-sufficient, which reduces their demand for foreign forest products. This explains why the exports of forest products from Turkey decrease as forest resources of the EU countries increase. The forest area first affects the country's forest products output and then the demand of forest products in the trading nation as observed by Yu Cheng (2016). This is also in line with Uusivuori and Tervo (2002), who observe that such countries have relatively large net forest products exports. Even though the endowment effect is highly significant, countries can still import forest products irrespective of their abundant forest resources. This is due to the fact that the forest area may not directly translate to productivity.

3.4 Results of forest products export potential
3.4. Rezultati analize potencijala izvoza drvnih proizvoda

In order to explore the unrealized forest products trade potential of Turkey with its EU partners, trade volumes estimated from the gravity model were compared with the actual trade volumes from 2005 to 2020 and the results of mean values of periods 2005-2009, 2010-2014, and 2015-2020 are given in Table 4.

Turkey's actual forest products exports increased throughout the study period from an average of 396.8 million USD in the period of 2005-2009 to an average of 433.6 million USD and 733.1 million USD in the periods of 2010-2014 and 2015-2020, respectively. Also, the average export potential increased from 320.2 million USD between 2005-2009 to 743.8 million USD over the study period with an average untapped export potential of 10.8 million USD in the period of 2015-2020.

Turkey's predicted exports exceeded its forest products actual exports to Poland, Spain, Italy, France, Slovenia, Luxembourg, and Denmark throughout the study period. This implies that Turkey had untapped forest products export potential with these EU countries from 2005 to 2020.

On the other hand, Turkey's actual forest products exports exceeded the predicted export value with Austria, Bulgaria, Hungary, Ireland, and Lithuania throughout the study from 2005-2020. This implies that Turkey exhausted its forest products export potential with these countries during this period. Akyüz *et al*. (2010) also observed that there were some countries

Table 4 Turkey's forest products export actual and potential values (1000 USD)
Tablica 4. Stvarne i potencijalne vrijednosti izvoza drvnih proizvoda iz Turske (1000 USD)

Country *Država*	2005-2009			2010-2014			2015-2020		
	XP	Actual	Potential	*XP*	Actual	Potential	*XP*	Actual	Potential
Austria	0.71	2657.233	1706.068	0.71	4013.960	2772.556	0.78	6247.090	4780.713
Belgium	1.58	4776.022	7480.218	0.83	10638.412	8663.375	0.75	21180.091	16000.602
Bulgaria	0.23	67553.533	15232.438	0.46	51793.270	23528.207	0.56	74433.428	41617.799
Croatia	2.39	729.005	1338.558	1.41	1550.169	1836.228	0.95	3492.122	3081.759
Cyprus	0.12	38992.255	4739.911	68.01	29455.607	7178.427	19397.71	24631.464	11522.889
Czech	0.98	2404.098	1692.419	1.82	1584.929	2764.995	1.01	4810.024	4858.124
Denmark	2.16	2627.325	5573.901	2.95	2702.946	7845.866	2.42	5469.842	13275.688
Estonia	1.68	188.457	252.483	1.12	882.501	374.832	0.73	956.098	675.309
Finland	0.96	1678.996	1525.977	1.90	1279.859	2268.554	2.03	1767.694	3513.359
France	1.37	17347.649	23392.417	1.14	27333.499	30955.266	1.35	39415.445	53696.415
Germany	1.26	28932.849	36626.729	0.97	45805.860	43921.831	1.34	63867.907	84926.321
Greece	1.04	54343.720	50865.761	1.20	51450.387	59693.240	0.92	84433.217	74101.156
Hungary	0.46	4150.138	1665.529	0.47	5365.199	2422.859	0.63	7623.816	4294.764
Ireland	0.34	7493.055	2294.916	0.30	11940.315	3536.833	0.40	19019.345	7611.188
Italy	1.34	20123.519	26546.995	1.59	23788.585	36838.936	1.32	44499.400	58563.336
Latvia	1.37	368.467	373.958	1.39	533.719	515.318	0.69	1309.980	888.417
Lithuania	0.39	1720.601	631.472	0.51	1832.806	937.797	0.35	4457.175	1517.564
Luxembourg	9.34	108.424	432.932	5.80	90.027	478.973	3.50	407.702	934.223
Malta	0.75	547.196	359.244	0.76	1108.778	837.374	0.66	2876.567	1732.570
Netherlands	0.98	11803.373	11600.029	1.02	16946.609	17454.568	1.21	24857.668	30385.016
Poland	1.72	5508.313	9512.953	2.29	6510.124	14725.237	2.94	9428.035	26551.856
Portugal	1.73	1775.817	2678.754	0.87	4314.815	3656.062	0.45	15601.605	6100.140
Romania	0.86	59347.495	50486.438	2.37	8515.018	73421.297	2.95	46301.985	138353.686
Slovakia	3.37	220.900	696.940	0.41	2748.673	1042.600	0.62	3842.385	2339.851
Slovenia	1.46	451.170	660.313	1.38	930.645	1308.429	1.54	1125.829	1749.426
Spain	2.02	8102.697	14928.171	1.88	9112.649	16542.429	1.55	23292.263	36992.285
Sweden	1.24	3437.432	3827.142	0.87	7495.853	6267.848	0.73	13751.790	10094.287
UK	0.97	49452.960	43073.342	0.57	103909.497	56658.332	0.56	183969.517	103661.891
TOTAL		396842.699	320196.008		433634.711	428448.269		733069.484	743820.634

XP – mean values of export potentials in that period / *XP – srednje vrijednosti izvoznih potencijala u promatranom razdoblju*

where Turkey's actual forest exports exceeded the predicted forest exports. These included only two countries - Bulgaria and Cyprus.

Even though Turkey had exceeded its forest products export potential with Belgium, Portugal, Slovakia, Sweden, Latvia, Greece, Estonia and Croatia at the beginning of the study, gradually this trend changed. The actual forest products exports from Turkey to these countries exceeded the predicted export value in the last periods. On the contrary, there some countries like Romania, Finland, and Czech Republic, where Turkey's actual forest products exports to these countries exceeded the predicted value at the beginning of the study (Table 4).

Similarly, the Turkey's forest products actual exports to Cyprus generally exceeded the predicted exports in the period of 2005-2009. However, in the next periods of 2010-2014 and 2015-2020, there is a huge difference as the predicted export value exceeded the actual forest products exports by an average XP of 68.01 and 19397.71 in the respective periods (Table 4). This increase in the untapped export potential between Turkey and Cyprus can be explained by the big fall in forest products exports from Turkey to Cyprus from 2013. The UN Comtrade database reports that the total forest products exports fell from over 34 million USD in 2013 to just 22,346 USD in 2014 and this fall continued through to 2016 (United Nations, 2021).

4 CONCLUSIONS
4. ZAKLJUČAK

In this study, gravity models were applied and estimated to analyse the forest products trade between Turkey and EU countries from 2005 to 2020. The findings of the study highlight that the GDP of EU partner countries, and the population of the exporting and importing countries were highly significant determinants of the volume of forest products exports from Turkey to the EU, while the endowment factor of the EU countries relative to Turkey deters the forest products exports from Turkey to the EU countries.

The derived elasticities were applied to analyse the export potential of Turkey to the EU and findings highlight that there is untapped export potential that

Turkey has to utilize to benefit from the foreign forest products trade.

The study provides significant results that can help policy makers to obtain a clearer view on how to improve Turkey's forest products trade with the EU. Emphasis should be given to EU countries with higher GDP and higher GDP growth. Turkey should take full advantage of the deepening bilateral trade relationship with the EU to serve as an instrument for the expansion of forest products trade. Besides, the promotion of forest products exports is important in the economic growth of the country and improves the international competitiveness of its forest sector. As such, more export-focused schemes should be directed to the forest products trade with the EU market.

Acknowledgements – Zahvala

This article includes a part of the results from a master's thesis of Henry Eric Magezi titled "Foreign Trade Analysis between Turkey and European Union Countries in Forest Products Sector" under the supervision of Assoc. Prof. Dr. Taner Okan at the Institute of Graduate Studies, Istanbul University-Cerrahpaşa.

5 REFERENCES
5. LITERATURA

1. Aksu, B.; Hüseyin, K.; Kurtoğlu, A., 2010: The forest products industry in Turkey. African Journal of Business Management, 5 (6): 2363-2369.
2. Akyüz, K. C.; Yıldırım, I.; Balaban, Y.; Gedik, T.; Korkut, S., 2010: Examination of forest products trade between Turkey and European Union countries with gravity model approach. African Journal of Biotechnology, 9 (16): 2375-2380.
3. Akyüz, K. C.; Yıldırım, I.; Ersen, N.; Akyüz, I.; Memiş, D., 2020: Competitiveness of the forest products industry in turkey: the revealed comparative advantage index. Drewno, 63 (205): 155-170. https://doi.org/10.12841/wood.1644-3985.333.09
4. Anaman, K. A.; Al-Kharusi, L. H. S., 2003: Analysis of trade flows between Brunei Darussalam and the European Union. ASEAN Economic Bulletin, 20 (1): 60-73.
5. Anderson, J. E., 2011: The gravity model, annual review of economics. Annual Reviews, 3 (1): 133-160. https://doi.org/10.1146/annurev-economics-111809-125114
6. Baltagi, B. H., 2001: Econometric analysis of panel data, 2nd ed. John Wiley & Sons, New York, USA.
7. Borchert, I.; Yotov, Y. V., 2017: Distance, globalization, and international trade. Economics Letters, 153: 32-38. https://doi.org/10.1016/j.econlet.2017.01.023
8. Buongiorno, J., 2015: Monetary union and forest products trade – The case of the Euro. Journal of Forest Economics, 21 (4): 238-249. https://doi.org/10.1016/j.jfe.2015.09.005
9. Buongiorno, J., 2016: Gravity model of forest products trade: application to forecasting and policy analysis. Forestry, 89 (2): 117-126. https://doi.org/10.1093/forestry/cpw005
10. Egger, P., 2002: An econometric view on the estimation of gravity models and the calculation of trade potentials. The World Economy, 25 (2): 297-312. https://doi.org/10.1111/1467-9701.00432
11. Head, K.; Mayer, T., 2013: Gravity equations: Workhorse, toolkit, and cookbook. CEPII Working Paper, 2013-2027.
12. Karagoz, K.; Saray, M. O., 2010: Trade potential of Turkey with Asia-Pacific Countries: Evidence from panel gravity model. International Economic Studies, 36 (1): 19-26.
13. Karamuriro, H. T., 2015: Determinants of Uganda's export performance; a gravity model approach. International Journal of Economics and Business Research, 4 (2): 45-54. https://doi.org/10.11648/j.ijber.20150402.14
14. Larson, J.; Baker, J.; Latta, G.; Ohrel, S.; Wade, C., 2018: Modeling international trade of forest products: Application of PPML to a gravity model of trade. Forest Products Journal, 68 (3): 303-316.
15. Lundmark, R., 2010: European trade in forests products and fuels. Journal of Forest Economics, 16 (3): 235-251. https://doi.org/10.1016/j.jfe.2009.11.007
16. Marku, M., 2014: The gravity model on EU countries – An econometric approach. European Journal of Sustainable Development, 3 (3): 149. https://doi.org/10.14207/ejsd.2014.v3n3p149
17. McCallum, J., 1995: National borders matters: Canada – U.S. regional trade patterns. The American Economic Review, 85 (3): 615-623.
18. McPherson, M. Q.; Trumbull, W. N., 2008: Rescuing observed fixed effects: Using the Hausman-Taylor method for out-of-sample trade projections. The International Trade Journal, 22 (3): 315-340. https://doi.org/10.1080/08853900802191389
19. Olofsson, C.; Wadsten, J.; Lundmark, J., 2018: European trade and projections in forest-based feed-stocks. Scandinavian Journal of Forest Research, 33 (8): 809-814. https://doi.org/10.1080/02827581.2018.1495255
20. Patuelli, R.; Linders, G.; Metulini, R.; Griffith, D. A., 2015: The space of gravity: Spatial filtering estimation of a gravity model for bilateral trade. Working Paper series 15-27, Rimini Centre for Economic Analysis.
21. Uusivuori, J.; Tervo, M., 2002: Comparative advantage and forest endowment in forest products trade: Evidence from panel data of OECD countries. Journal of Forest Economics, 8 (1): 53-75. https://doi.org/10.1078/1104-6899-00004
22. Vu, T. H.; Tian, G.; Zhang, B.; Nguyen, T. V., 2019: Determinants of Vietnam's wood products trade: application of the gravity model. Journal of Sustainable Forestry, 39 (5): 1 445-460. https://doi.org/10.1080/10549811.2019.1682011
23. Wu, H., 2015: Revisiting the distance coefficient in gravity model. New York, USA: Cornel University Library (online). https://arxiv.org/abs/1503.05283 (Accessed May 19, 2021).
24. Yu Cheng, Y., 2016: An influence factor analysis of international trade flow using a gravity model. International Journal of Simulation: Systems, Science & Technology, 1473-8031. https://doi.org/10.5013/IJSSST.a.17.36.23
25. ***European Commission, 2021: European Commission, Directorate-General for Trade 2021, European Union, Trade with Turkey (online). https://webgate.ec.europa.eu/isdb_results/factsheets-/country/details_turkey_en.pdf (Accessed May 15, 2021).
26. ***FAO, 2021: Food and agriculture organization of the United Nations (online). http://www.fao.org/faostat/en/#data/FO (Accessed May 20, 2021).

27. ***GED Study, 2016: Turkey's EU integration at a crossroads. Global Economic Dynamics (GED), Bertelsmann Stiftung. April 2016.
28. ***IMF, 2021: The international monetary fund – economic outlook database (online). https://www.imf.org/en/Data (Accessed May 23, 2021).
29. ***Ministry of Trade, 2019: Industry Furniture, Directorate General of Exports, Ministry of Trade, Republic of Turkey.
30. ***United Nations, 2021: UN Comtrade Database – International Trade Statistics – Import/Export Data (online). https://comtrade.un.org/data (Accessed May 19, 2021).
31. ***World Bank, 2014: Evaluation of the EU-TURKEY Customs Union, Report No. 85830-TR, March 28, 2014.

Corresponding address:

HENRY ERIC MAGEZI
Istanbul University – Cerrahpaşa, Faculty of Forestry, Department of Forestry Economics, Bahçeköy Merkez Mah., Valide Sultan Caddesi No: 2, 34473, Istanbul, TURKEY, e-mail: henryeric.magezi@ogr.iuc.edu.tr