INVESTIGATION ON TRADE OF ÇORUM WITH SURROUNDING PROVINCES BY GRAVITY MODEL

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Abstract: In this study, the trade relationship of Çorum province with the surrounding provinces was examined by using Newton's Gravity Model. Newton's Gravity Model is used to model the gravitational forces of planets and their physical states in space. It is possible to adapt this model to inter-provincial or inter-country trade relations. The analysis results show that the Gravity Model has a strong representation property in explaining inter-provincial trade of Çorum where has a great potential to further develop the commercial relations it has with its neighbours. In addition, it was found that Nevşehir and Karabük are, two neighbours but close cities to Çorum, remained below the potential and the sales volume of Çorum to these provinces was low.

Keywords: Gravity Model, Çorum, Inter-Provincial Trade, Newton, OLS.

Çorum'un Çevre İller ile Olan Ticaretinin Çekim Modeli ile İncelenmesi

Özet: Bu çalışmada Çorum ilinin çevre iller ile olan ticaret ilişkisi Newton'un Çekim Modeli ile incelenmiştir. Newton'un Çekim Modeli gezegenlerin çekim kuvvetlerini ve uzaydaki fiziki durumlarını modellemek için kullanılmaktadır. Bu modeli iller arası ya da ülkeler arası ticari ilişkilere uyarlamak mümkündür. Bu çalışmada ise 2017 yılına ait Çorum ve diğer iller arası ticaret verileri kullanılmıştır. Analiz sonucunda iller arası ticareti açıklamada Çekim Modeli'nin güçlü bir temsiliyet özelliğine sahip olduğu görülmüştür. Bu analize göre Çorum'un komşuları ile sahip olduğu ticari ilişkileri daha da geliştirebileceği yönünde büyük bir potansiyele sahip olduğu ortaya konmuştur. Ek olarak Çorum'a komşu olmayıp görece yakın olan Nevşehir ve Karabük'ün Çorum ile ticaretlerinin potansiyelin altında kaldığı, Çorum'un bu illere satış miktarının düşük olduğu tespit edilmiştir.

Anahtar Kelimeler: Çekim Modeli, Çorum, İller Arası Ticaret, Newton, OLS.

1. INTRODUCTION

The factors hindering international relations reduces the commercial potential of countries. By the international trade agreements made and, especially after the 1980s, with the acceleration of globalization, international commercial, social, cultural and political interactions have increased. The distance of the trade centers to each other, their production capacities, income levels and their location on trade routes determine the trade volume. In this article, the commercial relationship of a trade center with its surrounding trade centers is examined by the Gravity Model.

The Gravity Model was first used in economics by Jan Tinbergen in 1962. Using this model, Jan Tinbergen stated that countries can be perceived as objects with physical weight, upon considering the GDP data, and commercial relations with each other can be physically realized by considering the distance between them (Golovko, 2009, p.3). As the distance between countries

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increases due to transport costs, the trade volume decreases. As countries' national incomes increase, their purchasing power will increase, so will trade volume. In other words, there is a negative relationship between the trade volume among countries and the distance, whereas there is a positive relationship between national income and the distance (Tatlıcı and Kızıltan, 2011, p.288).

This model is named after Newton's famous Law of Gravity. According to this law, there is a gravitational force between two bodies with mass, and this gravitational force is directly proportional to the masses of the bodies, inversely proportional to the distance between the bodies. Upon adapting it to the science of economics, there is a gravitational force between two economic units that is directly proportional to the trading capacities of the units, while there is a gravitational force inversely proportional to the distance between them.

$$F = G \frac{m_1 m_2}{r^2} \tag{1}$$

Newton's Law of Gravity formula is shown in Equation (1). The mathematical meaning of this equation is that the gravitational force between two bodies with a mass of m_1 and m_2 is inversely proportional to the square of the distance between them (r^2). In this study, it is tried to explain the trade relations between Çorum province and the surrounding provinces using the Gravity Model.

Çorum province is bordered by the Central Black Sea region and the Central Anatolia region by Amasya, Çankırı, Yozgat, Sinop, Samsun, Kastamonu and Kırıkkale provinces. Çorum is a gateway connecting Central Anatolia to the Black Sea (Çorum Provincial Food and Livestock Report, 2017, p.1).

According to the Entrepreneur Information System 2017 data of the Ministry of Science of TR, Industry and Technology, ten provinces have sales surpluses while Kocaeli, İstanbul and İzmir are the first three provinces with sales surplus. 71 provinces have deficits in total while Antalya, Konya and Trabzon are among the top three provinces with the highest deficit. The total domestic trade volume is 4 trillion 323 billion TL which İstanbul provides approximately 49% of this trade volume alone. İstanbul, Ankara and İzmir, three metropolitan cities, provide 66% of the total trade volume.

Table 1. Top 10 Provinces with Trade Surplus and Deficit in Inter-Provincial Trade Relations (2017) (Million TL)

Trade Surplus Provinces (Sale-Purchase)		Trade Deficit Provinces (Sale-Purchase)	
Kocaeli	91.712	Antalya	-17.790
İstanbul	81.364	Konya	-10.119
İzmir	27.370	Trabzon	-9.534
Hatay	7.471	Bursa	-9.069
Zonguldak	3.451	Sakarya	-8.598
Karabük	1.705	Gaziantep	-7.916
Osmaniye	588	Denizli	-6.873
Bolu	226	Adana	-6.106
Yalova	202	Ankara	-5.997
Kilis	25	Samsun	-5.897

Source: T.C. Ministry of Science, Industry and Technology, Entrepreneur Information System 2017 (https://gbs.sanayi.gov.tr).

Commercial sales volumes of Çorum throughout Turkey rank second after Samsun, which has metropolitan status compared to its neighbors. In Table 2, it is seen that Sinop performs the least "sales and purchase volume" in inter-provincial trade while the largest trade deficit occurs in Samsun, whereas the least occurs in Sinop.

Table 2. Inter-Provincial Trade of Çorum and Its Neighbors (2017) (Million TL)

Provinces	Total Sales	Total Purchase	Sales-Purchase
Samsun	27.011	32.908	-5.896
Çorum	9.984	12.768	-2.783
Yozgat	5.839	7.468	-1.629
Kastamonu	4.562	6.026	-1.464
Kırıkkale	4.190	5.148	-957
Amasya	3.689	4.937	-1.248
Çankırı	2.633	3.372	-739
Sinop	951	1.676	-725

Source: T.C. Ministry of Science, Industry and Technology, Entrepreneur Information System 2017 (https://gbs.sanayi.gov.tr).

When it is looked at the Entrepreneurial Information System (2017) data, the total volume of trade between Çorum and other neighboring provinces was 23.306 million TL. There are only two provinces between Çorum and neighboring provinces that do trade deficits Çorum (336 million TL) and Samsun (192 million TL). Table 3 shows the trade volumes between Çorum and other provinces.

Table 3. Trade of Çorum and its Neighbors with Each Other (2017) (Million TL)

Selling Provinces	Purchasing Provinces							
	Amasya	Çankırı	Çorum	Kastamonu	Kırıkkale	Samsun	Sinop	Yozgat
Amasya	1.038	3	131	11	69	375	9	15
Çankırı	10	466	28	82	11	60	2	3
Çorum	169	109	3.845	71	98	493	20	133
Kastamonu	3	29	25	1.028	2	204	50	6
Kırıkkale	27	29	49	3	906	109	2	23
Samsun	483	55	472	201	81	9.299	229	52
Sinop	6	0,8	8	25	1	78	263	1,7
Yozgat	5	14	43	7	26	60	2	2.145

Source: T.C. Ministry of Science, Industry and Technology, Entrepreneur Information System 2017 (https://gbs.sanayi.gov.tr).

Compared to its neighbors, Çorum has the highest ratio of commercial sales to commercial purchases. As can be calculated from Table 4, the share of Çorum in the total trade volume in its region is approximately 21%. Considering the commercial relations among themselves, Çorum ranks first in terms of income per capita with 9.346 TL 2017, Samsun ranked second with 8.280 TL and Yozgat ranked third with 5.500 TL. Sinop is in the last place with 1.850 TL.

Table 4. Trade Volumes Between Çorum and its Neighbors (2017) (TL)

Provinces	Total Sales	Total Purchase	Surplus	Population	Per Capita Income
Çorum	4.938.538.699	4.601.791.911	336.746.788	528422	9.346
Samsun	10.871.722.434	10.679.048.310	192.674.124	1312990	8.280
Çankırı	662.771.043	705.621.204	-42.850.161	186074	3.562
Kırıkkale	1.148.429.662	1.194.008.779	-45.579.117	278749	4.120
Yozgat	2.302.759.631	2.380.185.134	-77.425.503	418650	5.500
Kastamonu	1.347.488.058	1.427.450.786	-79.962.728	372373	3.619
Amasya	1.650.477.014	1.740.804.780	-90.327.766	329888	5.003
Sinop	383.819.025	577.094.662	-193.275.637	207427	1.850

Source: T.C. Ministry of Science, Industry and Technology, Entrepreneur Information System 2017 (https://gbs.sanayi.gov.tr).

Table 5 shows that the contribution of the income obtained from the sales made with Amasya, which is the closest province to Çorum, to the per capita income of Çorum is 320 TL per year. The highest contribution to annual per capita income for Çorum is obtained from the trade made with Samsun, among the first five provinces closest to Çorum. The income from this trade is 933 TL per person per year. Çorum's income from trade throughout Turkey is 18.895 TL per person. 5.547 TL of which is coming from trade with İstanbul and Ankara. Among the top five provinces closest to Çorum, Samsun is the province with the most annual per capita income derived from trade volume throughout Turkey with 20.572 TL followed by Kırıkkale with 15.035 TL. The contribution of the top five provinces farthest to Çorum to the annual per capita income of Çorum is about 52 TL in total.

Table 5. Commercial Sales Volume of Çorum with the Top 5 Provinces Closest and Furthest to Çorum (2017) (TL)

	Sales Volume	Distance (km)	Per Capita Sales Volume
Amasya	169.147.928	92	320
Yozgat	133.110.103	108	252
Çankırı	109.289.670	156	207
Kırıkkale	97.795.177	166	185
Samsun	492.887.111	172	933
Iğdır	11.657.576	939	22
Siirt	1.713.664	949	3
Şırnak	3.278.421	1045	6
Van	11.199.189	1058	21
Hakkâri	203.582	1230	0,4

Source: T.C. Ministry of Science, Industry and Technology, Entrepreneur Information System 2017 (https://gbs.sanayi.gov.tr), General Directorate of Highways, TurkStat (Address Based Population Registration System, 2017).

Note: The population of Çorum in 2017 is 528.422 people.

2. LITERATURE REVIEW

The Gravity Model has been used often in international trade, tourism and migration studies in the literature. However, this model was used only in one study to examine the structure of trade relations between provinces in Turkey as far as it is found. In this respect, it can be said that this study will be the second study (The First Study; Yaşar ve Korkmaz, 2018) and will contribute to the literature in terms of being a more up-to-date are using 2017 data. In addition, this study is the first study on this subject for Çorum. When it is looked at the literature, there are many studies in which the scope is different but the model is the same.

Ratnayake and Townsend (1999) analyzed the geographical pattern of New Zealand's foreign trade using the Gravity Model. In their study, to explain New Zealand's exports and imports, basic explanatory variables such as income and population, as well as some dummy variables were used to capture the special relationship between New Zealand trading partners. The Model was estimated for each year from 1987 to 1992, using pooled cross-sectional and time-series data, and the stability of the coefficients of the independent variables was tested. While most of the previous studies were done for a single year, ignoring fluctuations over time, this study focused on a six-year period. In the study, it has been determined that the transition of socialist market economies to a market-oriented economic structure will increase the trade volume between New Zealand and the west to a higher level. Besides, it was emphasized that trade liberalization initiatives proposed within the scope of Asia Pacific Economic Cooperation (APEC) will directly affect the countries with which New Zealand does trade above average will positively change New Zealand trade.

Abraham and Hove (2005), in their study, used a 9-year (1992-2000) panel dataset of 23 countries. It was determined that China benefited from the trade agreement with the Association of Southeast Asian Nations (ASEAN) in terms of export potential and at the same time, an agreement to be made with South and East Asian countries could have great export potential.

Kucharčuková et al. (2010) performed a panel data analysis using the Poisson and Tobit estimation techniques with an 8-year (1997-2004) data set of 82 countries. In the study using the Gravity Model, the reason why Southeast Europe (SEE) and Commonwealth of Independent States (CIS) countries trade significantly less with the world economy than the later participating Central and Eastern European (CEE) Countries was investigated. The main reason for this was seen as the presence of low-quality economic institutions in SEE and CIS countries. Also, the study found that for some CIS countries, the distance to markets and the case being surrounded by land are quantitatively less important than the weaknesses in the quality of institutions or infrastructure quality.

Tatlıcı and Kızıltan (2012), in their study, used 14 years of panel data covering 46 countries and 1994-2007. Turkey's export-dependent variable of the model is that the population of the country, from the capital Ankara and GDP were used as independent variables. In addition, in the model where customs union and common border dummy variables are used, the coefficients of the population variables of the countries are found to be meaningless, while the coefficients of the other variables are found to be significant and appropriate to the theory. Meaningless out of the common border dummy variable is linked to the problems experienced by Turkey's neighboring countries. Finally, there is no significant impact on the customs union and the common border of Turkey's exports.

Gencer and Öngel (2011) investigated the potential trade volume between Syria, Lebanon and Jordan within the framework of the free trade zone. The model used in the study of the Gravity Model of the foreign trade volume between Turkey and these countries was found to be lower than expected. Thus, a free trade zone agreement between these countries and Turkey is expected to be beneficial for Turkey.

Ata (2013) analyzed the potential trade volume between Turkey's neighboring countries between 1980-2009 with using the Gravity Model. Ten countries with potential trade volume among 68 countries were analyzed. Turkey's neighboring countries with important findings of this study in terms of carry trade below its potential revealed. This shows that Turkey is not able to use the

trade advantage brought by its neighbourly situation. This has been linked to social and political instability in surrounding countries.

Bindak (2015) established a model using inter-provincial migration and happiness level, number of divorces, attraction coefficient of provinces, and other data from 2011-2012. An estimate of migration from any i province to j province can be made by means of the established model. In addition, Bindak calculated the attraction coefficient for each provinces. The attractiveness coefficient of a province is positively related to the rough divorce rate of that province and the unemployment rate in the province, and negatively related to the provincial ranking of the transition to higher education exam.

Yaşar and Korkmaz (2018) researched the trade with other provinces of Kütahya by the Gravity Model. In their study, which used inter-provincial trade data for 2013, GDP data was used to represent the economic size of the provinces, while the distance of the provinces in km terms was used for distance. The commercial relations of Kütahya province and other provinces yielded results consistent with the Gravity Model by them. According to this result, the GDP of the provinces positively affects the commercial sales between the province of Kütahya and the other provinces, while the distance between the provinces negatively affects the commercial sales among the other provinces. In the light of this information, it is concluded that Kütahya is prone to trade with developed provinces.

3. DATA, METHOD AND FINDINGS

The data of this study was taken from the Ministry of Science, Industry and Technology, Entrepreneur Information System. Since only data for 2017 are available, the study is limited to 2017 data. The distance between provinces is based on the data of the General Directorate of Highways. In this investigation, where the inter-provincial trade analysis of Çorum and 80 other provinces were conducted, the model based on the Gravity Model was estimated via the E-views software with Ordinary Least Squares Model.

Here is how Equation (1) in the introduction section of Newton's Law of Gravity is applied to inter-provincial trade;

- T_{ij}: Trade between provinces i (Çorum) and j (other provinces)

- Y_i ve Y_j: Per capita income of provinces i and j

- D_{ij}: Geographical distance between provinces i and j

$$T_{ij} = G \frac{Y_i^\alpha Y_j^\beta}{D_{ij}^\theta} \varepsilon_{ij} \tag{2}$$

The natural logarithm of Equation (2) was taken and converted to a linear equation. This equation shows how Çorum has a relationship with the sales amounts (T_{ij}) to other provinces and the per capita income (Y_j) of that province and the distance between them. In Equation (3) predicted with OLS, in line with the Gravity Model, the expected value of the coefficient β is positive while the expected value of the coefficient θ is negative. The β coefficient is the parameter that indicates income elasticity and the θ coefficient is the distance elasticity. The term G in Equation (2) is the constant term of the model. Since the per capita income of the province of Çorum is taken for 2017, it will take the value of Y_i each time for all equations. In other words, the value of Y_i is in the constant a along with the constant G (Yaşar and Korkmaz, 2018, p. 101).

$$log\, T_{ij} = \alpha + \beta\, log\, Y_j + \theta\, log\, D_{ij} + \varepsilon_{ij} \tag{3}$$

Table 6 with summary statistics of variables is given below. In the study involving 80 provinces, the average value of the logarithm of the distance of the province of Çorum to other provinces is 6,25 and the minimum and maximum values are 4,52 and 7,11 respectively. Data for other values can be seen in Table 6.

Table 6. Descriptive Statistics

	Obs.	Mean	Median	Max	Min	Std. Dev.
T_{ij}	80	16,538	16,395	21,305	11,050	1,802
Y_j	80	9,659	9,654	11,864	7,640	0,818
D_{ij}	80	6,251	6,371	7,114	4,521	0,543

Note: All variables are expressed in natural logarithm.

As can be seen from Table 7, the amount of sales made by Çorum is positively correlated with per capita income in the province where it sells, and is negatively correlated with the distance between the province it sells. According to OLS results, a 1% increase in per capita income in the province where Çorum is selling, increases the sales volume of Çorum by 1,22%. On the other hand, the increase in the distance between Çorum and the province it sells by 1%, reduces the sales volume of Çorum by 1,56%. Other OLS estimates also gave roughly the same results.

Table 7. Results of the OLS

	OLS	Robust OLS (M)	Robust OLS (S)	Robust OLS (MM)
Constant	14,518***	15,549***	14,348***	15,537***
	(0,000)	(0,000)	(0,000)	(0,000)
Y_j	1,223***	1,130***	1,286***	1,131***
	(0,000)	(0,000)	(0,000)	(0,000)
D_{ij}	-1,567***	-1,581***	-1,596***	-1,581***
	(0,000)	(0,000)	(0,000)	(0,000)
R^2	0,583	0,472	0,385	0,473
Adj-R^2	0,572	0,458	0,369	0,460
Prob(F-statistic)	0,000	0,000	0,000	0,000
Number Of Observations	80	80	80	80

Notes: All variables are in logs in the series. The values in parentheses give p-values. *, **, *** indicate 10%, 5% and 1% significance levels, respectively.

The 0,58 R^2 value of the OLS model shows 58% of the changes in the dependent variable in the model are explained by the independent variables. The estimation of this model by other econometric methods yielded similar results. R^2 values of Robust OLS results are also very close compared to normal OLS results.

The F statistic showing the significance of the OLS model was 53,88. Since the probability value of the F statistic is [P=0,000] <0,01, the model is completely meaningful. Other significance test results of the model are seen in the Table 8.

Table 8. Diagnostic Tests for OLS Regression

Test Statistics	Test Applied	Test-statistics	Prob.
VIF	Variance Inflation Factors	1,009	-
Normality	Test of Jarque-Bera	2,082	0,352
Heteroscedasticity	Glijser Test	1,995	0,142
Serial Correlation LM	Breusch-Godfrey	0,087	0,916

It is possible to determine whether the provinces are above or below their trade potential based on the studies of Batra (2004), Ram and Prasad (2007). The difference between the estimated

values (E) and the actual trade values (A) are looked according to the approach of the two authors. If E >A, the trade current remains below the potential. If E <A, the trade current is above the potential. In Graph 1 (in ANNEX-3), while Çorum conducts trade above its potential with provinces with a value above zero, it conducts trade below its potential with provinces below zero. It can be said that there are great trade potentials between Çorum and Karaman, Kilis, Tunceli. On the other hand, Çorum has a trading volume above its potential with Mardin, Istanbul and Kars.

When it is looked at the neighbors of Çorum, only Yozgat has a trade below its potential. In Table 9, the OLS results of Çorum's neighbors are shown numerically. Samsun became the province that carried out trade with Çorum far above its potential. Other neighboring provinces are slightly above the potential. Trade of Çorum with these provinces has the opportunity to increase much more with the commercial opportunities developed. As can be seen from the Annex-2 table, there are also non-neighboring provinces that are relatively close to Çorum and remain below the trade potential. The two most notable provinces are Nevşehir and Karabük. Although these two provinces are approximately 300 km away from Çorum, trade is far below the relative potential.

Table 9. Potential Trade with Neighbors of Çorum as a Result of OLS

Provinces	Actual Values	Estimated Values	Residuals
Samsun	20,02	18,60	1,41
Çankırı	18,51	18,30	0,21
Kırıkkale	18,40	18,28	0,12
Yozgat	18,71	18,86	-0,15
Kastamonu	18,08	17,76	0,33
Amasya	18,95	18,84	0,11
Sinop	16,79	16,08	0,70

Although the distance is not the only factor leading below potential trade, it cannot be denied that this factor is an important parameter affecting the trade volume. When evaluated from this point of view, there are many factors affecting the structure of commercial potential between provinces, but these are taken as ceteris-paribus in this study. The potential commercial status of Çorum with all other provinces is demonstrated in ANNEX-1 and ANNEX-2 tables.

4. CONCLUSION

The investigation, where the potential trade volume of Çorum was analyzed, concluded that results are coherent with the Gravity Model. In this study, similar results were obtained with other studies in the same field. For example; in a study conducted specifically for Kütahya province for Turkey (Yaşar and Korkmaz, 2018), a positive relationship between the GDP of the provinces and the commercial sales made between Kütahya was found. In addition, a negative relationship has been revealed with the commercial sales of Kütahya between provinces and the provinces distances. In another similar study (Kucharčuková et al., 2010), it was found that the distance to the markets is less important than the quality of the institutions on the trade volume. Again, in another study (Ata, 2013), the trade volume of Turkey with its neighbors was investigated with the Gravity Model and it was determined that Turkey could not fully use its neighborly advantage and conducts trade with its neighbors below its potential trade volume. In this study, the Gravity Model was applied in a similar way by adapting it to inter-provincial trade instead of international trade. The determinations made as a result of the application are in parallel with other studies in the literature.

The contribution of this study to the literature is being the first study conducted specifically for Çorum with 2017 data and being the second study (the first study is Yaşar and Korkmaz, 2018)

applied to trade between provinces in Turkey. According to OLS results, increase in per capita income in the province where Çorum is selling increases the sales volume of Çorum with that provinces. On the other hand, the increase in the distance between Çorum and the provinces it sells reduces the sales amount of Çorum.

Eventually Çorum has great potential to develop commercial relations with its neighbors. It has been determined that sales of Çorum to Yozgat, Amasya and Kırıkkale are below or slightly above the potential. It is thought that further deepening and development of existing commercial relations with these provinces will contribute more to the trade volume of Çorum. Commercial sales volume of Çorum to these provinces should be increased with an investment plan for certain products that these provinces transfer resources in the industry and agriculture sector. In this context, considering the needs of the foreign market, the product range produced for industry and agriculture in Çorum should be expanded. The deepening commercial relations of Çorum with these provinces will contribute more to its total sales. On the other side, Çorum perform commercial sales with Kayseri, Sivas, Nevşehir, Karabük, Aksaray, Niğde, Bartın, Düzce and Zonguldak, which are relatively close to Çorum, below its potential. The deepening of relations with these provinces may differentiate Çorum's economy from other cities in a positive way. It is thought that the sales of Çorum to these provinces will increase by increasing the agricultural productivity by using modern agricultural techniques. This may increase the commercial income of Çorum from its annual sales and per capita income of Çorum.

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Annex-1. The Differences Between the Real and Predicted Trade of the Provinces with Çorum

obs	Actual	Fitted	Residual	Residual Plot
ADANA	17.9494...	17.0603...	0.88911...	
ADIYAMAN	15.1753...	15.1413...	0.03399...	
AFYONKARAHİSAR	18.1722...	16.4846...	1.68763...	
AĞRI	15.2740...	14.2164...	1.05760...	
AKSARAY	16.4564...	17.3657...	-0.9093...	
AMASYA	18.9462...	18.8385...	0.10773...	
ANKARA	20.8553...	19.7681...	1.08719...	
ANTALYA	17.3685...	16.6507...	0.71776...	
ARDAHAN	12.8597...	13.3006...	-0.4408...	
ARTVİN	15.2239...	15.2696...	-0.0456...	
AYDIN	15.7973...	15.6246...	0.17270...	
BALIKESİR	17.1817...	16.1723...	1.00936...	
BARTIN	15.3758...	16.7010...	-1.3252...	
BATMAN	16.2036...	15.8687...	0.33492...	
BAYBURT	14.8912...	14.2266...	0.66458...	
BİLECİK	15.5055...	16.3978...	-0.8922...	
BİNGÖL	14.8549...	14.7201...	0.13480...	
BİTLİS	14.7984...	14.9992...	-0.2007...	
BOLU	17.7232...	17.8341...	-0.1109...	
BURDUR	15.1640...	16.4999...	-1.3358...	
BURSA	18.7655...	17.7525...	1.01300...	
ÇANAKKALE	15.5321...	15.4018...	0.13023...	
ÇANKIRI	18.5095...	18.2989...	0.21058...	
DENİZLİ	17.8584...	17.3865...	0.47187...	
DİYARBAKIR	17.6679...	15.9571...	1.71080...	
DÜZCE	15.6076...	17.2477...	-1.6400...	
EDİRNE	15.7414...	15.8275...	-0.0861...	
ELAZIĞ	15.9303...	16.2594...	-0.3291...	
ERZİNCAN	15.5288...	15.8084...	-0.2795...	
ERZURUM	16.9210...	15.7172...	1.20376...	
ESKİŞEHİR	16.9173...	17.2715...	-0.3542...	
GAZİANTEP	19.6367...	17.4940...	2.14268...	
GİRESUN	17.2847...	16.4914...	0.79324...	
GÜMÜŞHANE	15.1138...	14.5253...	0.58852...	
HAKKARİ	12.2238...	13.3367...	-1.1129...	
HATAY	16.2714...	17.1609...	-0.8895...	
IĞDIR	14.5492...	14.0897...	0.45949...	
ISPARTA	15.8617...	15.8353...	0.02639...	
İSTANBUL	21.3055...	18.9745...	2.33094...	
İZMİR	18.1048...	17.4391...	0.66561...	
KAHRAMANMARAŞ	16.8185...	16.9039...	-0.0853...	
KARABÜK	17.7384...	18.6443...	-0.9059...	
KARAMAN	14.7582...	16.9373...	-2.1790...	
KARS	15.9259...	13.7438...	2.18210...	
KASTAMONU	18.0838...	17.7568...	0.32706...	
KAYSERİ	18.4100...	18.4278...	-0.0177...	
KIRIKKALE	18.3983...	18.2756...	0.12272...	
KIRKLARELİ	16.5255...	15.8091...	0.71639...	
KIRŞEHİR	17.9808...	17.7033...	0.27746...	
KİLİS	13.2065...	16.0477...	-2.8412...	
KOCAELİ	17.4472...	19.0193...	-1.5721...	
KONYA	18.4870...	17.9031...	0.58397...	
KÜTAHYA	15.5502...	16.1069...	-0.5566...	
MALATYA	16.3345...	15.8869...	0.44765...	
MANİSA	17.2261...	16.2717...	0.95435...	
MARDİN	18.4382...	15.9627...	2.47545...	
MERSİN	17.7808...	17.0319...	0.74888...	
MUĞLA	15.4036...	15.8984...	-0.4947...	
MUŞ	14.1736...	16.4622...	-2.2886...	
NEVŞEHİR	16.6014...	17.5554...	-0.9539...	
NİĞDE	15.3249...	16.6934...	-1.3684...	
ORDU	17.9101...	17.0627...	0.84748...	
OSMANİYE	14.8433...	16.2981...	-1.4548...	
RİZE	17.1126...	16.6959...	0.41669...	
SAKARYA	16.8630...	17.8390...	-0.9760...	
SAMSUN	20.0157...	18.6037...	1.41206...	
SİİRT	14.3541...	15.2247...	-0.8706...	
SİNOP	16.7882...	16.0841...	0.70404...	
SİVAS	17.0078...	17.1459...	-0.1380...	
ŞANLIURFA	15.7429...	15.8899...	-0.1470...	
ŞIRNAK	15.0028...	14.8951...	0.10775...	
TEKİRDAĞ	16.2306...	16.8486...	-0.6179...	
TOKAT	18.4845...	17.3545...	1.13005...	
TRABZON	18.1085...	16.6817...	1.42684...	
TUNCELİ	11.0500...	14.4767...	-3.4267...	
UŞAK	15.3349...	16.7073...	-1.3724...	
VAN	16.2313...	14.8666...	1.36471...	
YALOVA	15.6604...	17.1392...	-1.4788...	
YOZGAT	18.7066...	18.8576...	-0.1509...	
ZONGULDAK	15.9355...	17.9759...	-2.0403...	

Annex-2. Potential Trade of Provinces by Distance to Çorum

Provinces	Residuals	Distances (Km)	Provinces	Residuals	Distances (Km)
Amasya	0,11	92	Tunceli	-3,43	589
Yozgat	-0,15	108	Elazığ	-0,33	610
Çankırı	0,21	156	İstanbul	2,33	614
Kırıkkale	0,12	166	Uşak	-1,37	616
Samsun	1,41	172	Gaziantep	2,14	618
Tokat	1,13	178	Bursa	1,01	626
Kastamonu	0,32	197	Isparta	0,03	627
Kırşehir	0,28	220	Osmaniye	-1,45	647
Ankara	1,09	241	Erzurum	1,20	648
Sinop	0,70	266	Burdur	-1,34	670
Kayseri	-0,02	281	Kilis	-2,84	678
Sivas	-0,14	284	Adıyaman	0,03	699
Nevşehir	-0,95	296	Hatay	-0,89	715
Karabük	-0,91	311	Denizli	0,47	723
Ordu	0,85	323	Antalya	0,72	733
Aksaray	-0,91	330	Bingöl	0,13	733
Bolu	-0,11	352	Artvin	-0,05	739
Giresun	0,79	367	Tekirdağ	-0,62	745
Niğde	-1,37	374	Şanlıurfa	-0,15	755
Bartın	-1,32	380	Diyarbakır	1,71	763
Düzce	-1,64	397	Balıkesir	1,01	777
Zonguldak	-2,04	411	Manisa	0,95	811
Konya	0,58	419	Kırklareli	0,72	825
Erzincan	-0,28	458	İzmir	0,67	827
Sakarya	-0,98	466	Ağrı	1,06	828
Eskişehir	-0,35	482	Muş	-2,29	840
Kocaeli	-1,57	503	Edirne	-0,09	844
Trabzon	1,43	503	Aydın	0,17	846
Afyonkarahisar	1,69	505	Ardahan	-0,44	847
Gümüşhane	0,59	525	Kars	2,18	851
Karaman	-2,18	530	Mardin	2,48	859
Malatya	0,45	530	Batman	0,33	863
Kahramanmaraş	-0,09	542	Muğla	-0,49	868
Bayburt	0,66	547	Çanakkale	0,13	897
Kütahya	-0,56	560	Bitlis	-0,20	923
Bilecik	-0,89	565	Iğdır	0,46	939
Yalova	-1,48	568	Siirt	-0,87	949
Mersin	0,75	574	Şırnak	0,10	1045
Rize	0,42	578	Van	1,36	1058
Adana	0,89	581	Hakkâri	-1,11	1230

Annex-3: **Graph 1**. Trade of Çorum Potential with Other Provinces
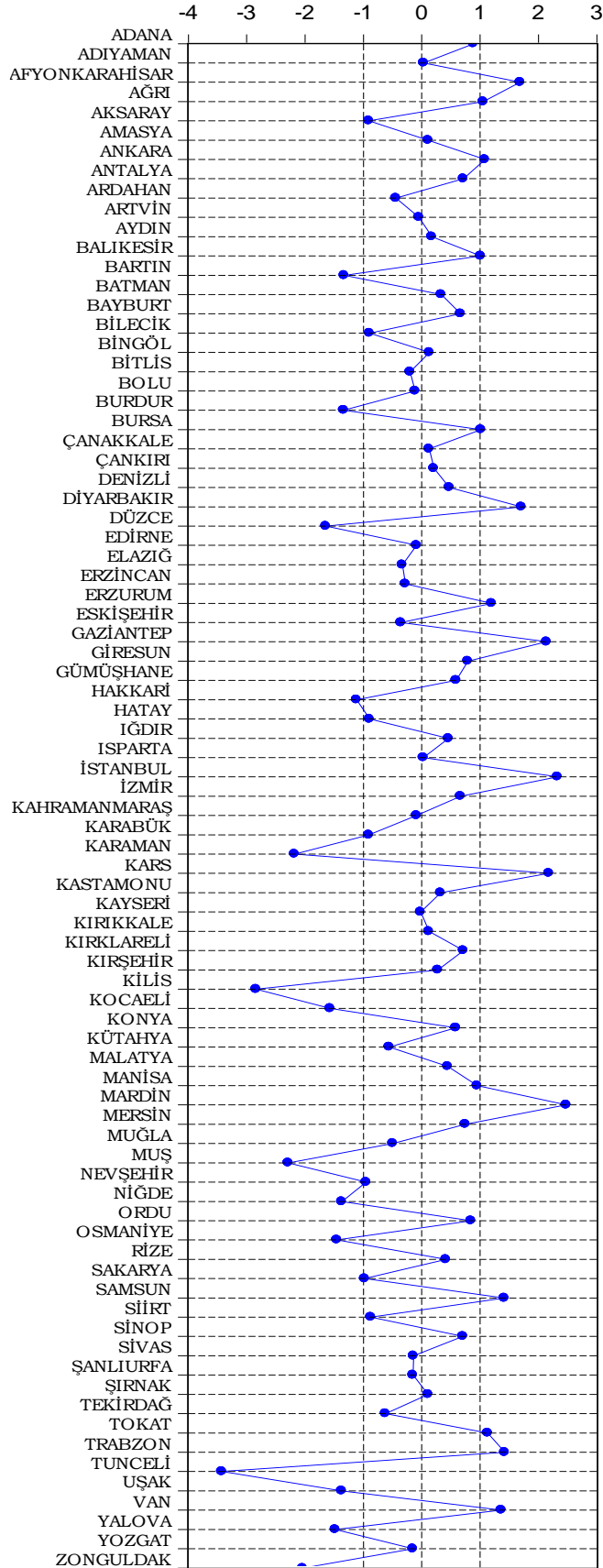
GENİŞLETİLMİŞ ÖZET

Giriş

Yerçekimi modeli ilk olarak 1962'de Jan Tinbergen tarafından ekonomide kullanılmıştır. Jan Tinbergen, bu modelle, ülkelerin GSYİH verileri göz önüne alındığında fiziksel ağırlığa sahip bir nesne olarak algılanabileceğini ve aralarındaki mesafeyi göz önünde bulundurarak birbirleriyle ticari ilişkilerin fiziksel olarak gerçekleştirilebileceğini ifade etmektedir.

Taşıma maliyetleri nedeniyle ülkeler arasındaki mesafe arttıkça, ticaret hacmi azalır. Ülkenin milli geliri arttıkça, alım gücü artacaktır. Alım gücü arttıkça da ticaret hacmi artacaktır. Başka bir ifade ile, ülkeler arasındaki ticaret hacmi ile mesafe arasında negatif yönlü bir ilişki bulunurken, milli gelir ile ticaret hacmi arasında pozitif yönlü bir ilişki vardır.

Bu ilişkiler Newton'un ünlü yerçekimi modeline uyarlanmıştır. Bu yasaya göre, kütleye sahip iki cisim arasında bir yerçekimi kuvveti vardır ve bu yerçekimi kuvveti, cisimlerin kütleleri ile doğru orantılı, cisimler arasındaki mesafe ile ters orantılıdır. Bu durumda ülkeler arasındaki mesafe gerçekleşen ticaret hacmi ile negatif yönde ilişkiliyken, ülkelerdeki insanların kişi başına gelirleri ile pozitif yönde ilişkili olmaktadır.

Bu çalışmada Çorum'un komşuları ve diğer iller ile olan ticari ilişkileri Çekim Modeli ile analiz edilmektedir. Yerçekimi Modeli, uluslararası ticaret, turizm ve göç çalışmalarında literatürde çokça kullanılmıştır. Ancak bu model iller arası ticari ilişkilerin yapısını incelemek için yalnızca bir çalışmada kullanılmıştır. Bu açıdan bu çalışmanın ikinci çalışma olacağı ve 2017 verileri kullanılarak daha güncel bir çalışma olması açısından literatüre katkı sağlayacağı söylenebilir. Ayrıca bu çalışma, Çorum için bu konuda yapılan ilk çalışmadır. Literatüre baktığımızda kapsamın farklı olduğu ancak modelin aynı olduğu birçok çalışma vardır.

Veri, Yöntem ve Bulgular

Bu çalışmanın verileri Bilim, Sanayi ve Teknoloji Bakanlığı, Girişimci Bilgi Sisteminden alınmıştır. Yalnızca 2017 verileri mevcut olduğundan, çalışma 2017 verileriyle sınırlıdır. İller arası uzaklık Karayolları Genel Müdürlüğü verilerine dayanmaktadır. Çorum ve diğer 80 ilin iller arası ticaret analizinin yapıldığı araştırmada, Yerçekimi Modeline dayalı analiz, Olağan En Küçük Kareler Yöntemi ile E-views programında tahmin edilmiştir.

Tahmin sonuçlarına göre, Çorum'un yaptığı satış miktarı, satış yaptığı ildeki kişi başına düşen gelir ile pozitif yönde, sattığı il arasındaki mesafe ile negatif yönde ilişkilidir. OLS sonuçlarına göre, Çorum'un satış yaptığı ilde kişi başına düşen gelirin %1 artması, Çorum'un yaptığı satış miktarını %1,22 arttırmaktadır. Öte yandan Çorum ile satış yaptığı il arasındaki mesafenin %1 artması, Çorum'un o ile yaptığı satış miktarını %1,56 düşürmektedir. Diğer OLS (Robust OLS (M), Robust OLS (S) ve Robust OLS (MM)) tahminleri de aşağı yukarı aynı sonuçları vermektedir.

İllerin ticaret potansiyelinin üstünde mi yoksa altında mı olduğunu tespit etmek mümkündür. Tahmin edilen değerler (E) ile gerçek ticaret değerleri (A) arasındaki farka bakılır. E> A ise, ticaret akımı potansiyelin altında kalır. E <A ise, ticaret akımı potansiyelin üzerindedir. Çorum, (E-A) değeri negatif olan illerle potansiyelinin üzerinde ticaret yaparken, pozitif olan illerle potansiyelinin altında ticaret yapmaktadır. Bu durumda Çorum ile Karaman, Kilis, Tunceli arasında büyük bir ticaret potansiyeli olduğu söylenebilir. Öte yandan Çorum, Mardin, İstanbul ve Kars ile potansiyelinin üzerinde bir ticarete sahiptir.

Çorum'un komşularına baktığımızda ise sadece Yozgat ile yaptığı ticaretin potansiyelinin altında kaldığı tespit edilmiştir. Samsun, Çorum ile potansiyelinin çok üzerinde ticaret yapan il olmuştur. Diğer komşu iller potansiyelin biraz üzerindedir. Çorum'un bu iller ile olan ticareti, gelişen ticari imkanlarla çok daha fazla artma eğilimine sahiptir. Ayrıca Çorum'a görece yakın olup komşu olmayan iller de ticaret potansiyelinin altında kalmaktadır. Bu duruma uyum sağlayan en önemli iki il Nevşehir ve Karabük'tür. Bu iki il, Çorum'a yaklaşık 300 km uzaklıkta olmasına rağmen ticaret potansiyelin çok altındadır.

Potansiyelin altında ticarete yol açan tek faktör mesafe olmasa da bu faktörün ticaret hacmini etkileyen önemli bir parametre olduğu inkâr edilemez. Bu açıdan değerlendirildiğinde iller arası ticari potansiyelin yapısını etkileyen pek çok faktör vardır ancak bunlar bu çalışmada ceteris-paribus olarak alınmıştır.

Sonuç

Çorum'un potansiyel ticaret hacminin incelendiği bu araştırmada, sonuçların Yerçekimi Modeli ile uyumlu olduğu tespit edilmiştir. Bu çalışmada aynı alandaki diğer çalışmalarla benzer sonuçlar elde edilmiştir. Örneğin; Türkiye için Kütahya ili özelinde yapılan bir çalışmada (Yaşar ve Korkmaz, 2018) illerin GSYH ile Kütahya ili arasında yapılan ticari satışlar arasında pozitif yönlü bir ilişki olduğu tespit edilmiştir. Ayrıca Kütahya'nın iller arası ticari satışları ve iller arasındaki mesafe ile negatif yönlü bir ilişki ortaya konulmuştur. Benzer başka bir çalışmada (Kucharčuková et al., 2010) ise ticaret hacmi üzerinde pazarlara olan uzaklığın kurumların kalitesinden daha az önemli olduğu sonucu tespit edilmiştir. Yine başka bir çalışmada (Ata, 2013) Türkiye'nin komşuları ile olan ticaret hacmi Yerçekimi Modeli ile araştırılmış ve Türkiye'nin komşuluk avantajını tam olarak kullanamadığı ve komşuları ile potansiyel ticaret hacminin altında bir ticaret gerçekleştirdiği tespit edilmiştir. Çalışmamızda ise Yerçekimi Modeli uluslararası ticaret yerine iller arası ticarete uyarlanarak benzer bir şekilde uygulanmıştır. Uygulama sonucunda yapılan tespitler literatürdeki diğer çalışmalar ile paralellik göstermektedir.

Bu çalışmanın literatüre katkısı, 2017 verileri ile Çorum özelinde yapılan ilk çalışma olmasıdır ve Türkiye'deki iller arası ticarete uygulanan ikinci (ilk çalışma Yaşar ve Korkmaz, 2018) çalışmadır. OLS sonuçlarına göre, Çorum'un satış yaptığı ilde kişi başına düşen gelirin artması, Çorum'un o il ile yaptığı satış miktarını arttırmaktadır. Öte yandan Çorum ile satış yaptığı iller arasındaki mesafenin artması da Çorum'un o illere yaptığı satış miktarını düşürmektedir.

Sonuç olarak Çorum, komşularıyla ticari ilişkiler geliştirme potansiyeline sahiptir. Çorum'un Yozgat, Amasya ve Kırıkkale'ye satışlarının potansiyel altında veya biraz üzerinde olduğu tespit edilmiştir. Bu iller ile mevcut ticari ilişkilerin daha da derinleşmesi ve geliştirilmesinin Çorum'un ticaret hacmine daha çok katkı sağlayacağı düşünülmektedir. Sanayi ve tarım sektöründe bu illerin kaynak aktardığı belirli ürünlere yönelik bir yatırım planlaması ile Çorum'un bu illere olan ticari satış hacmi arttırılmalıdır. Bu bağlamda dış pazar ihtiyaçları göz önünde bulundurularak Çorum'da sanayi ve tarıma dönük üretilen ürün yelpazesi genişletilmelidir. Çorum'un bu iller ile derinleşen ticari ilişkileri toplam satışlarına daha fazla katkı sağlayacaktır. Öte yandan Çorum, Çorum'a nispeten yakın olan Kayseri, Sivas, Nevşehir, Karabük, Aksaray, Niğde, Bartın, Düzce ve Zonguldak ile potansiyelinin altında ticari satışlar gerçekleştirmektedir. Bu iller ile olan ilişkilerin derinleşmesi ise, Çorum ekonomisini diğer illerden olumlu bir şekilde farklılaştırabilir. Modern tarım teknikleri kullanılarak tarımsal verimliliğin yükseltilmesi ile Çorum'un bu illere olan satışlarının artacağı düşünülmektedir. Bu durum, Çorum'un yıllık satışlarından elde ettiği ticari geliri ve Çorum'daki kişi başına düşen geliri artırabilir.