MODELLING TRADE FLOWS BETWEEN TURKEY AND FORMER SOVIET UNION COUNTRIES: A GRAVITY ANALYSIS

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Abstract

Gravity model has been long used in order to describe bilateral trade patterns by including incomes, populations and distance between countries. In this respect, the bilateral trade relationship between Turkey and former Soviet Union countries is examined. When dependent variable is the total trade volume, only GDP levels of the former Soviet Union countries and Turkey are significant. When EU and WTO dummies are added to the model, distance become significant at 10% and has a small negative impact. On the other hand, when nonoil trade volume is the dependent variable inclusion of dummies make distance significant. Although the significance levels do not change the magnitude of the coefficients and goodness of fit increases. Additionally, GDP per capita for Turkey has more impact on trade volume than GDP per capita of former Soviet Union countries.

Keywords: Gravity Model, Trade, Panel Data

JEL Classification: F10, C23

TÜRKİYE İLE ESKİ SOVYETLER BİRLİĞİ ÜLKELERİ ARASINDAKİ TİCARETİN MODELLENMESİ: BİR YERÇEKİMİ MODELİ ANALİZİ

Özet

Yerçekimi modeli, ülkeler arasındaki ikili ticareti gelir düzeyleri, nüfuslar ve aradaki mesafeyi kullanarak açıklayan bir model olarak literatürde uzun zamandır kullanılmaktadır. Bu bağlamda, Türkiye ile eski Sovyetler Birliği' ne dahil olan ülkeler arasındaki ticaret ilişkileri de bu modelle açıklanabilir. Bağımlı değişkenin toplam

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ticaret hacmi olduğu durumda modele dahil edilen ülkelerin GSYİH düzeyleri anlamlı bir değişken olarak ortaya çıkmakta, AB ve DTÖ kukla değişkenleri modele eklendiğinde ise ülkeler arası mesafenin yüzde 10 düzeyinde anlamlı olduğu görülmektedir. Öte yandan, petrol harici ürünlerin ticareti bağımlı değişken olarak seçildiğinde mesafe çok daha anlamlı çıkmaktadır. Anlamlılık düzeyi aynı kalsa da katsayıların değeri ve uyum düzeyi artmaktadır. Ayrıca Türkiye'nin kişi başına düşen GSYİH düzeyinin ticaret düzeyine olan etkisinin partner ülkelerin kişi başına düşen GSYİH düzeyinden daha fazla etkili olduğu görülmüştür.

__Anahtar Kelimeler:__ Yerçekimi Modeli, Dış Ticaret, Panel Very Analizi
__JEL Sınıflaması:__ F10, C23

1. Introduction

Gravity model has been long utilized in order to describe bilateral trade patterns between countries. The basic gravity model states that the volume of trade between two countries is positively related to their incomes, but inversely related to the distance between them, usually with a functional form that is reminiscent of Newton's gravity theory.

Furthermore, gravity equation has been recognized for its consistent empirical success in explaining many different types of flows such as migration, commuting, tourism and commodity shipping[1]. It used to be frequently stated that the gravity equation was without theoretical foundation. In particular, it was claimed that the Heckscher-Ohlin (HO) model of international trade was incapable of providing such a foundation, and perhaps even that the HO model was theoretically inconsistent with the gravity equation[2]. It is certainly no longer true that the gravity equation is without a theoretical basis, since a majority of the authors who previously noted its absence went on to provide one.

Since the discussions on gravity models have managed to constitute theoretical foundations, the aim of this study is to examine bilateral trade flows between Turkey and the former Soviet Union countries in the context of gravity models for the period 1992-2012. Before analyzing the trade flows empirically, theoretical foundations in which the gravity models evolved are presented in the following section. Third section presents the model and the estimation results. Finally in the last section, the main findings and conclusions of the study are described.

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[1] J. H. Bergstrand, "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence." **Review of Econometrics and Statistics**, 67, 1985, pp. 474-481

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

2. Theoretical Foundations of Gravity Equation

The application of gravity models to analyze international trade flows was pioneered by Tingerben[3] and then continued by Pöyhönen[4], Linnemann[5] and many other scholars. The model has also been successfully applied to flows of varying types such as migration and foreign direct investment[6]. In time, the other explanatory variables have been added to the model as the measures of size of economies, geographical positions, cultural proximities, religion, and economic and regional trading arrangements. According to Tingerben's model, exports from country i to country j are explained by their distances and a set of dummies incorporating some kind of institutional characteristics common to specific flows. Linnemann added more variables and went further toward a theoretical justification in terms of a Walrasian general equilibrium system, but the Walrasian model tends to include too many explanatory variables for each trade flow to be easily reduced to the gravity equation[7].

These contributions were followed by several more formal attempts to derive the gravity equation from models that assumed product differentiation. Among those efforts Anderson[8] made the first formal attempt to derive the gravity equation from a model that assumed product differentiation first under Cobb-Douglas and then constant elasticity of substitution (CES) preferences. In both cases he made what today would be called the Armington assumption, that products were differentiated by country of origin[9].

Bergstrand[10] also explored the theoretical determination of bilateral trade in a series of papers in which gravity equations were associated with simple monopolistic competition models. Bergstrand, like Anderson, used CES preferences over Armington-differentiated goods to derive a reduced form equation for bilateral trade involving price indices. Using GDP deflators to approximate these price indexes, he estimated his system in order to test his assumptions of product differentiation[11].

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

[4]   Deardorff, **Ibid.**

[5]   H. Linnemann, **An Econometric Study of International Trade Flows**, North Holland Publishing Company, Amsterdam, 1966

[6]   I. M. Zarzoso and F. N. Lehmann, "Augmented Gravity Model: An Empirical Application to Mercosur-European Union Trade Flows", **Journal of Applied Economics**, vol.6, no.2, 2003 pp. 291-316.

[7]   Deardorff, **Ibid**.

[8]   J. E. Anderson, "A Theoretical Foundation for The Gravity Model" **American Economic Review** 69, 1979, pp. 106-116.

[9]   Deardorff, **Ibid**.

[10] J. H. Bergstrand, "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence." **Review of Econometrics and Statistics** 67, 1985, pp. 474-481.

[11] P. Egger, "A Note on the Proper Econometric Specification of the Gravity Equation." **Economic Letters** 66, 2000, pp. 25-31.

2.1 Anderson's Gravity Equation

Anderson[12] begins his study by mentioning that applied to a wide variety of goods and factors moving over regional and national borders under differing circumstances gravity model produces a good fit.

The gravity equation is specified as:

(1) $M_{ijk} = \alpha_k Y_i^{\beta_k} Y_j^{\gamma_k} N_i^{\varepsilon_k} N_j^{e_k} d_{ij}^{\mu_k} U_{ijk}$

where M_{ijk} is the dollar flow of good or factor k from country or region i to country or region j, Y_i and Y_j are incomes in i and j, N_i and N_j are population in i and j, d_{ij} is the distance between countries or regions, U_{ijk} is a lognormally distributed error term.

Anderson uses the properties of expenditure system with a maintained hypothesis of identical homothetic preferences across regions. The gravity model constrains the pure expenditure system by specifying that the share of national expenditure accounted for by spending on tradable goods.

2.2. The Pure Expenditure System Model

The simplest possible gravity-type model stems from a rearrangement of a Cobb- Douglas expenditure system. There is one good where each country is specialized in its production and no tariffs or transport costs exist during their exchange between countries. The fraction of income spent on the product of country i is denoted as b_i and is the same in all countries. With cross-section analysis, prices are constant at equilibrium values and units are chosen such that they are all unity. Consumption in value and quantity terms of good i in country j (imports of good i by country j) is thus;

(2) $M_{ij} = b_i Y_j$

where Y_j is income in country j. The requirement that income must equal sales implies that:

(3) $Y_i = b_i \sum_j Y_j$

Solving (3) for b_i and substituting into (2) we obtain the simplest form of Gravity Model.

(4) $M_{ij} = \frac{Y_i Y_j}{\sum Y_j}$

A generalization of equation (4) can be estimated by ordinary least squares, with exponents on Y_i and Y_j unrestricted. The income elasticities produced should not differ significantly from unity.

2.3. The trade share expenditure system model

The previous gravity equation is based on identical Cobb-Douglas preferences, implying identical expenditure shares and gravity equation income elasticities of

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[12]   Anderson, **Ibid**.

unity. Anderson appends to the Cobb-Douglas expenditure system for traded goods a differing traded-nontraded goods split and produces an unrestricted gravity equation.

All countries produce a traded and a nontraded good. The overall preference function assumed in this formulation is weakly separable with respect to the partition between traded and nontraded goods. Then given the level of expenditure on traded goods, the demands for individual traded goods are determined as if a homothetic utility function in traded goods alone g(.) were maximized subject to a budget constraint involving the level of expenditure on traded goods.

Demand for i's tradable good in country j is

$$(5) \quad M_{ij} = \theta_i \phi_j Y_j$$

where θ_i is the expenditure on country i's tradable good divided by total expenditure in j on tradables. ϕ_j is the share of expenditure on all traded goods in total expenditure of country j and $\phi_j = F(Y_j ; N_j)$. The balance of trade relation for country i implies

$$(6) \quad Y_j \phi_i = (\Sigma_j Y_j \ \phi_j) \ \theta_i$$

Solving (6) for θ_j and substituting into (5) we have,

$$(7) \quad M_{ij} = \frac{\phi_i \ Y_i \phi_j Y_j}{\Sigma_j \ \phi_j Y_j} = \frac{\phi_i \ Y_i \phi_j Y_j}{\Sigma_i \Sigma_j \ M_{ij}}$$

With $F(Y_j ; N_j)$ taking on a log-linear form, (7) is the deterministic form of the gravity equation (1) with the distance terms suppressed and a scale term appended[13]. If trade imbalance due to long-term capital account transactions is a function of $(Y_i ; N_i)$, we may write the basic balance $Y_i \phi_i m_i = \left(\Sigma_j Y_j \ \phi_j \right) \theta_i$, with $m_i = m \ (Y_i ; N_i)$ and substitute into (6) and (7). This yields:

$$(8) \quad M_{ij} = \frac{m_i \phi_i \ Y_i \phi_j Y_j}{\Sigma_i \Sigma_j \ M_{ij}}$$

Equation (8) is the deterministic gravity equation.

2.4 The model with many goods, tariffs and distance

In the presence of tariffs and transportation costs, demand for import i_k is:

$$(9) \quad M_{ijk} = \frac{1}{\tau_{ijk}} \theta_{ik}(\tau_j) \ \phi_j Y_j$$

where τ_{ijk} is the transit cost factor that includes all border adjustments and transport costs. Trade balance relation here is:

$$(10) \quad m_i \phi_i \ Y_i = \ \Sigma_j M_{ij} = \Sigma_j \ \phi_j Y_j \Sigma_k \frac{1}{\tau_{ijk}} \theta_{ik}(\tau_j)$$

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[13]   Anderson, **Ibid**.

Previously we set all $\tau_{ijk} = 1$. Now with the τ_{ijk} departing from unity produces the gravity equation if transit costs of all sorts are an increasing function of distance and the same across commodities ($\tau_{ijk} = f(d_{ij})$ with $f(0) = 1$ and $f' > 0$):

$$(11) \quad M_{ij} = \frac{m_i \phi_i \, Y_i \phi_j Y_j}{\sum_j \phi_j Y_j} \frac{1}{f(d_{ij})} \left[\sum_j \frac{\phi_j Y_j}{\sum_j \phi_j Y_j} \frac{1}{f(d_{ij})} \right]^{-1} U_{ij}$$

Equation (11) resembles to equation (1) with three differences. First, (11) is an aggregate equation rather than commodity-specific (Anderson, 1979). Second, $\frac{1}{f(d_{ij})}$ is not a log-linear function. Finally the term in square brackets is missing in (1). It can be interpreted as saying that the flow from i to j depends on economic distance from i to j relative to a trade-weighted average of economic distance from i to all points in the system.

2.5. Augmented Gravity Models

In the recent literature of gravity models, distance has become the focus of discussion; it is argued that distance has been becoming less important in international trade, therefore decreasing, rather than increasing, values should be expected for the estimated coefficient of distance. Brun et al.[14] takes into account relative transport costs, and the real exchange rate that takes into account the effects of the evolution in relative prices.

$$(12) \quad \ln(M_{ijt}) = Z_1 \psi_1 + Z_2 \psi_2 + D_{ij}\beta_t + \alpha_1 \ln(R_{it}) + \alpha_2 \ln(R_{jt}) + \alpha_3 \ln(RER_{ijt}) + \varepsilon_{ijt}$$

$$= Z_1 \psi_1 + Z_2 \psi_2 + D_{ij}\beta_t + \varepsilon_{ijt}$$

where RER_{ijt} stands for bilateral real exchange rate, R_{ijt} is the remoteness index defined as the weighted distance to all trading partners. Z_1 1 and Z_2 covers the incomes and populations in country 1 and country 2.

$$(13) \quad \theta_{ijt} = (K_{it})^{\rho_1} (K_{jt})^{\rho_2} (P_{Ft})^{\rho_3} (\pi_{jt})^{\rho_4} (D_{ij})^{\gamma_1 + \gamma_2 + \gamma_3 \, t^2}$$

K_{it} is infrastructure index. P_{Ft} is world oil price indexi. π_{jt} is the ratio of primary export products to total export of the country j at date t. Finally equation (12) gives an "augmented" gravity model.

$$(14) \quad \ln(M_{ijt}) = Z_1 \psi_1 + Z_2 \psi_2 + D_{ij}\beta_t + \alpha_1 \ln(K_{it}) + \alpha_2 \ln(K_{jt}) + \alpha_3 \ln(P_{Ft}) + \alpha_4 \ln(\pi_{jt}) + \varepsilon_{ijt}$$

Egger[15] argues that panel framework reveals several advantages over cross-section

[14]   J. F. Brun, et al., 'Has Distance Died? Evidence from a Panel Gravity Model', **World Bank Economic Review**, vol. 3, no. 15, 2005, pp. 5-16.

[15]   P. Egger, "A Note on the Proper Econometric Specification of the Gravity Equation." **Economic Letters** 66, 2000, pp.25-31.

analysis in gravity modeling. The reduced form equation to estimate the world volume of trade is as the following:

$$(15) \quad X_{ijt} = \beta_0 + \beta_1 RLFAC_{ijt} + \beta_2 GDP_{ijt} + \beta_3 SIMILAR_{ijt} + \beta_4 DIST_{ij} + \alpha_i + \gamma_i + \delta_i + u_{ijt}$$

where X_{ijt} is the log of country i's exports to country j in year t.

$$(16) \quad RLFAC_{ijt} = \left| \ln \frac{K_{jt}}{N_{jt}} - \ln \frac{K_{it}}{N_{it}} \right|$$

measures the distance between the two countries in terms of relative factor endowments.

$$(17) \quad SIMILAR_{ijt} = \ln \left[\left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}} \right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}} \right)^2 \right]$$

captures the relative size of two countries in terms of GDP.

Wall[16] uses two simple models; restricted (traditional) and unrestricted gravity equations. Restricted model is the traditional gravity equation:

$$(18) \quad \ln X_{ij} = \alpha + \beta \ln Y_i + \gamma \ln Y_j - \delta \ln D_{ij}$$

The above equation assumes that trading-pair intercepts are all equal. However following equation relaxes this restriction:

$$(19) \quad \ln X_{ijt} = \alpha + \beta \ln Y_{it} + \gamma \ln Y_{jt} + \delta \ln D_{ij} + \lambda T_{jt} + \varepsilon_{ijt}$$

where T_{jt} is the trade policy index for the importing country at time t and ε_{jt} is the error term.

3. The Gravity Model for Trade Flows Between Turkey and Former Soviet Union Countries

3.1. Data

In order to assess the trade flows between Turkey and the former Soviet Union countries, the relationship between trade volume and variables such as GDP, population, distance are examined with the inclusion of selected dummy variables. Export and import data is extracted from the UN COMTRADE database, GDP data is taken from World Development Indicators, and distance between trade partners is from CEPII Gravity Dataset. The distance parameter used in this study is CEPII's weighted distance (distw) that calculates the distance between two countries based on bilateral distances between the biggest cities of those two countries, those inter-city distances being weighted by the share of the city in the overall country's population[17].

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[16]   H. J. Wall, "Using the Gravity Model to Estimate the Costs of Protection." **Federal Reserve Bank of St. Louis Discussion Paper** 1, 1999, pp. 33-40.

[17]   T. Mayer and S. Zignago, "Notes on CEPII's distances measures: The GeoDist database", **CEPII Working Paper** 2011-25

3.2. Panel Unit Root Tests

Five panel unit root tests are applied; LLC (Levin, Lin, and Chu), IPS (Im, Peseran, and Shin), Breitung, Fisher and Hadri. LLC and IPS are the generalizations of the ADF principle. LLC and IPS test null hypothesis of individual unit root process, whereas Breitung tests hypothesis of common unit root process. Null hypotheses of LLC, IPS, Fisher and Breitung is the existence of unit root, whereas the null hypothesis of Hadri unit root test is the stationarity of the data. Panel unit root test results are presented in Table 1. The levels for GDP per capita of Turkey GDP_{it}, GDP per capita of a Soviet Union Country GDP_{jt}, trade volume VOL_{ijt}, non oil trade volume $NVOL_{ijt}$, and similarity (SIM_{ijt}) across countries have unit roots according to the majority of the tests. Only Fisher test fails to reject the existence of unit root for VOL_{ijt} and $NVOL_{ijt}$.

In order to make the variables stationary and solve the problem of unit root, growth rates for the variables ($gGDP_{it}$, $gGDP_{jt}$, $gVOL_{ijt}$, $gNVOL_{ijt}$ and $gSIM_{ijt}$) are calculated. Table 2 shows the panel unit root test results for those variables. Unit root problem is solved when the growth rates of the variables are used. All variables become stationary at 5% significance level according to LLC, IPS, Fisher and Breitung except VOL_{ijt}, which is stationary at 10% significance level. However according to Hadri unit root test, $gGDP_{jt}$ and $gSIM_{ijt}$ still contain unit roots at 5% significance level.[18]

Table 1: Existence of Panel Unit Root –Levels

Variable-in level	Method				
	LLC	IPS	Fisher	Breitung	Hadri
GDP_{jt}	yes	yes	yes	yes	yes
GDP_{it}	yes	yes	yes	yes	yes
VOL_{ijt}	yes	yes	no	yes	yes
$NVOL_{ijt}$	yes	yes	no	yes	yes
SIM_{ijt}	yes	yes	yes	yes	yes

Table 2: Existence of Panel Unit Root -Growth Rates

Variable-in level	Method				
	LLC	IPS	Fisher	Breitung	Hadri
$gGDP_{jt}$	no	no	no	no	yes
$gGDP_{it}$	no	No	no	no	no
$gVOL_{ijt}$	no[*]	no	no	no	no
$gNVOL_{ijt}$	no	no	no	no	no
$gSIM_{ijt}$	no	no	no	no	yes

[*]denotes significance at 10%.

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[18]   See appendix for panel unit root test results.

3.3. The Model and Estimation Results

The estimation methodology applied in this study is the cross section random effects model with heteroskedasticity consistent estimators. We assume that each country differs in its error term. In other words, random effects method handles the constants for each section not as fixed, but as random parameters. Hence the equation to be estimated becomes as the following[19]:

$$(22) \quad gVOL_{ijt} = \alpha_0 + \alpha_2 wDIS_{ij} + \alpha_3 gGDP_{it} + \alpha_4 gGDP_{jt} + \alpha_5 POP_{ijt} +$$
$$\alpha_6 gSIM_{ijt} + DU1_{ij} + DU2_{ij} + (u_{it} + v_{it})$$

where v_{it} is a zero mean standard normal variable and shows the variability across countries, $wDIS_{ij}$ is the weighted distance, $gVOL_{ijt}$ is the growth rate of trade volume, $gGDP_{it}$ is the growth rate of GDP per capita for Turkey, $gGDP_{jt}$ is for growth rate of gdp per capita for a Soviet Union country and $gSIM_{ijt}$ is the growth rate for the similarity across countries calculated as the following:

$$(21) \quad SIM_{ijt} = \ln\left[\left(\frac{GDP_{it}}{GDP_{it}+GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it}+GDP_{jt}}\right)^2 \right]$$

Bilateral trade flows equation between Turkey and former Soviet Union countries are estimated by using cross section random effects model. In order to see the effect of European Union (EU) and membership to World Trade Organization (WTO) two equations are estimated, one includes EU and WTO dummies for the member countries and one does not. Additionally the equation is estimated for nonoil trade volume as well. The rationale behind this is that some of the analyzed countries are significant oil and natural gas exporters, and as oil exports are heavily made by only a few oil-producer countries, and distance is expected to lose its significance when oil trade is taken into consideration. Estimation results for all four models are presented in Table 3.

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Table 3: Random Effects Estimation with Heteroskedasticy Consistent Estimators

	(1) total trade volume as dependent variable	(2) total trade volume as dependent variable dummies included	(3) nonoil trade volume as dependent variable	(4) nonoil trade volume as dependent variable dummies included
$gGDP_{jt}$	0.040*** (0.002)	0.290*** (0.001)	0.240*** (0.002)	0.260*** (0.001)
$gGDP_{it}$	0.120*** (0.011)	0.157*** (0.021)	0.380*** (0.013)	0.42*** (0.007)
$gSIM_{ijt}$	4.320 (4.360)	0.030 (0.007)	0.710 (0.560)	0.077 (0.126)
$wDIS_{ij}$	-0.0005 (0.520)	-0.0001* (0.000)	-0.0003 (0.990)	-0.0008** (0.002)
POP_{ijt}	0.002 (0.240)	-0.021 (0.760)	-0.008 (0.049)	-0.0001 (0.070)
$DU1_{ij}$	-	0.020*** (0.006)	-	0.040*** (0.001)
$DU2_{ij}$	-	-0.006* (0.001)	-	-0.006* (0.001)
R^2	0.29	0.31	0.34	0.39
Obs	240	240	240	240

*** denotes 1%, ** denotes 5%, * denotes 10% significance levels.

When dependent variable is the total trade volume, only GDP levels of the former Soviet Union countries and Turkey are significant. When EU dummy and WTO dummy is added to the model, distance become significant at 10% and has a small negative impact. On the other hand, when nonoil trade volume is the dependent variable, inclusion of dummies make the distance variable significant. Although the significance levels do not change, the magnitude of the coefficients and goodness of fit increases. Furthermore, results in Table 3 show that the changes in the GDP per capita for Turkey has more impact on trade volume than those of GDP per capita of former Soviet Union countries.

3.4. Endogeneity Check

Robustness of random affects model in the gravity equation also needs to be tested. We believe that random effects specification is appropriate for individual effects in our model. We first fit a fixed effects model that will capture all temporally constant individual-level effects. Then we fit a random effects model as a fully efficient specification of the individual effects under the assumption that they are random and follow normal distribution. We then compare these estimates with former fixed effects results by using Hausman specification. The results are shown in Table 4. According

to the results, our initial hypothesis that the individual-level effects are adequately modeled by a random-effects model is accepted in all four of the specifications.

Table 4: Hausman Specification Test Results

	(1)	(2)	(3)	(4)
Test Summary	1.83	1.06	1.55	1.01
Probability	(0.7674)	(0.9573)	(0.8171)	(0.9615)

4. Conclusion

The purpose of this study was to examine the bilateral trade relationship between Turkey and former Soviet Union countries by employing a gravity model. The model examined the effects of the sizes of the economies of Turkey and the selected former Soviet Union countries, populations of both parties, economic similarity between the countries, the weighted distance between them and selected dummy variables to the trade volume between them.

By using a cross section random effects model with heteroskedasticity consistent estimators, the gravity equation shows that economic size of both Turkey and the former Soviet Union partners significantly affect the trade volume between those countries. Distance, however, is significant and negatively affects (albeit in small magnitude) the bilateral trade between the examined countries only when non-oil trade is taken into consideration. This is an expected result as the export side of oil trade is dominated by certain countries and is usually not significantly related with the distance between the partners. The inclusion of two dummy variables; EU membership and WTO membership increases the explanatory power of the model, where EU dummy is significant and positive, but WTO dummy is insignificant. A possible reason for this is that trade policy of Turkey is closely linked with that of the EU due to the Customs Union, and regulatory proximity between Turkey and the EU countries makes a easier and more smooth trade for Turkey after one of her trade partners' accession to the EU. WTO, on the other hand, brings tariff concessions between the members but as regulatory convergence takes more effort and time, has less effect on Turkey's trade with the former Soviet Union partners.

References

ANDERSON, J. E. "A Theoretical Foundation for The Gravity Model." **American Economic Review** vol. 69, 1979, pp. 106-116.

ANDERSON, J. E. and E. Van Wincoop, "Gravity with Gravitas: A Solution to the Border Puzzle." **Boston College Working Papers**, 2000

ANTONUCCI, D. and S. Manzocchi, "Does Turkey Have a Special Trade Relation with the EU? A Gravity Model Approach." **Economic Systems** vol. 30, 2006, pp. 157-169.

BERGSTRAND, J. H. "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence." **Review of Econometrics and Statistics** vol. 67, 1985, pp. 474-481.

BRUN J. F, C. Carrère, P. Guillaumont and J. De Melo. "Has Distance Died? Evidence from Panel Gravity Model." **World Bank Economic Review** vol. 19, 2003, pp. 99-120.

BUSSIERE, M., Fidrmuc, J. and B. Schnatz, "Trade Integration of Central and Eastern European Countries: Lessons from a Gravity Model." **European Central Bank Working Paper Series** no. 545, 2005

CHOI, C. "Linder Hypothesis Revisited." **Applied Economics Letters** vol. 9, 2002, pp. 601-605.

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

EGGER, P. "A Note on the Proper Econometric Specification of the Gravity Equation." **Economic Letters** vol. 66, 2000, pp. 25-31.

FILLIPPINI, C. and V. Molini. "The Determinants of East Asian Trade Flows: A Gravity Model Approach." **Journal of Asian Economies** vol. 14, 2003, pp. 695-711.

HUANG, R.R. "Distance and Trade: Disentangling Unfamiliarity Effects and Transport Cost Effects." **European Economic Review** vol. 51, 2007, pp. 161-181.

LINNEMANN, H. **An Econometric Study of International Trade Flows**, North Holland Publishing Company, Amsterdam, 1966

MAYER, T. and S. Zignago, "Notes on CEPII's distances measures: The GeoDist database", **CEPII Working Paper** 2011-25

MELITZ, J. "North, South and Distance in the Gravity Model." **European Economic Review** vol. 51, 2007, pp. 871-991.

OKUBO, T. "Trade Bloc Formation in Inter-War Japan: A Gravity Model Analysis." **Journal of Japanese and International Economies** vol. 21, 2006, pp. 214-236.

ROSE, A. K. and M. M. Spiegel "A Gravity Model of Sovereign Lending: Trade, Default, and Credit." **IMF Staff Papers** 51, 2004

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

WALL, H.J. "Using the Gravity Model to Estimate the Costs of Protection." **Federal Reserve Bank of St. Louis Discussion Paper** 1: 33-40, 1999.

WONG, W.K. "Comparing the fit of the gravity model for different cross-border flows." **Economic Letters** vol. 99, 2007, pp. 474-477.

ZARZOSO, I.M. and F.N. Lehmann. "Augmented Gravity Model: An Empirical Application to Mercosur- European Union Trade Flows." **Journal of Applied Economics** vol. 6, 2003, pp. 291-316.

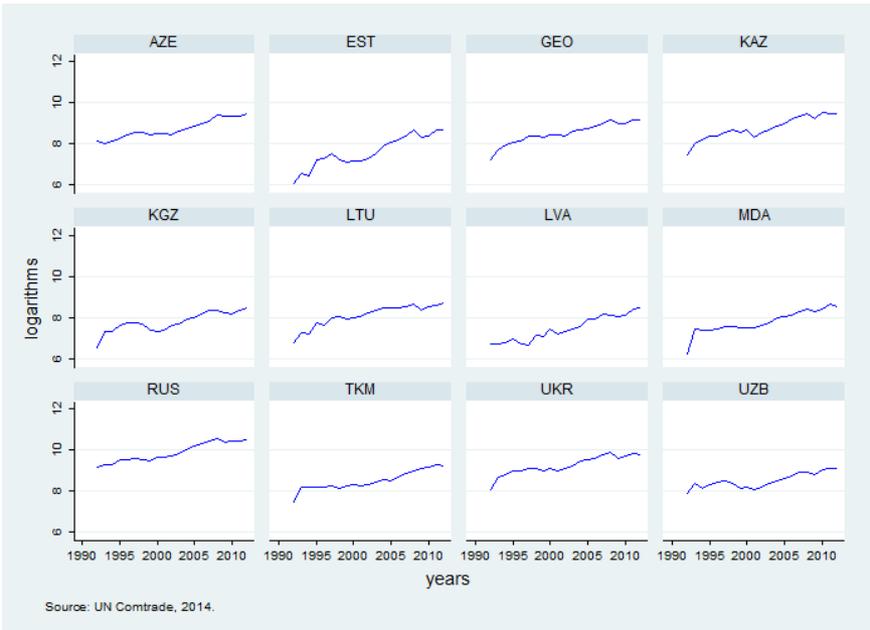**APPENDIX**

Appendix A: Figures
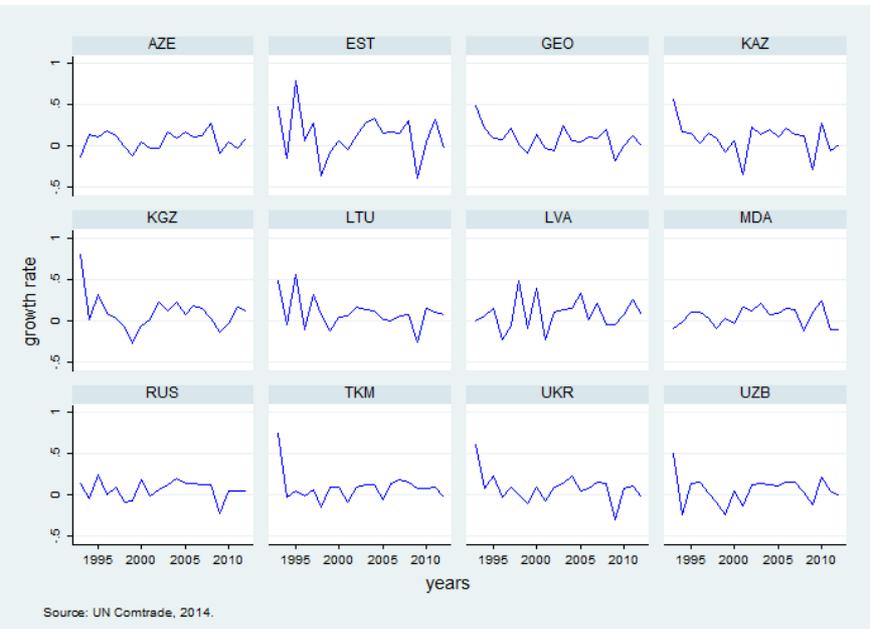**Figure 1: Individual Cross Sections for GDP (1992-2012)**
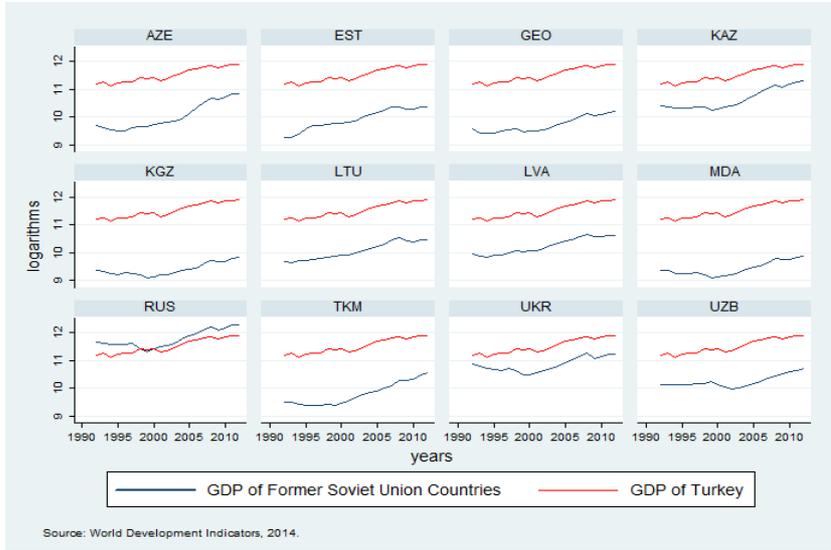
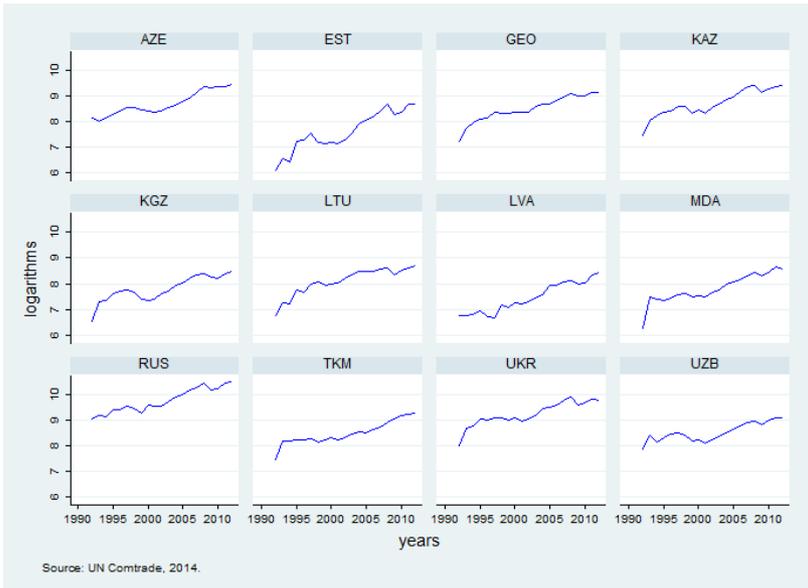**Figure 2: Individual Growth Rates for GDP (1993-2012)**
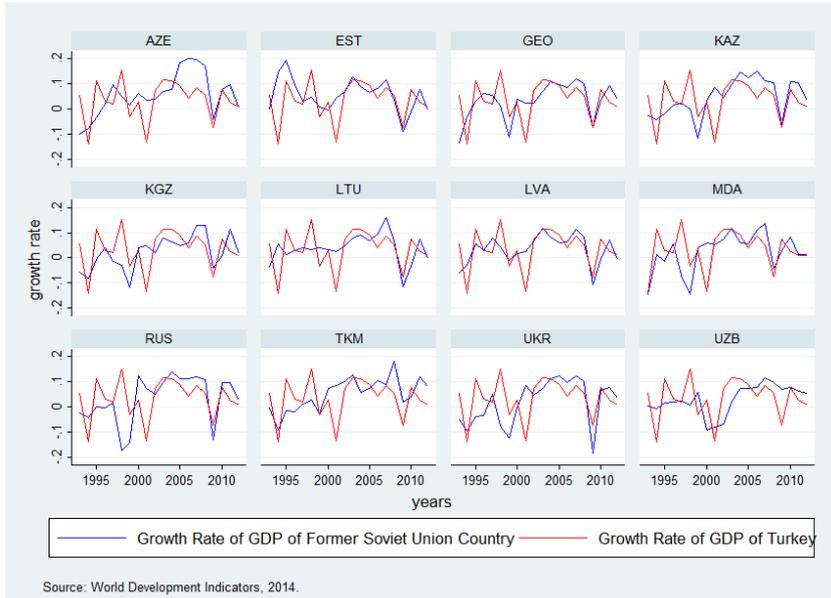
Figure 3: Individual Cross Sections for Total Trade Volumes (1992-2012)
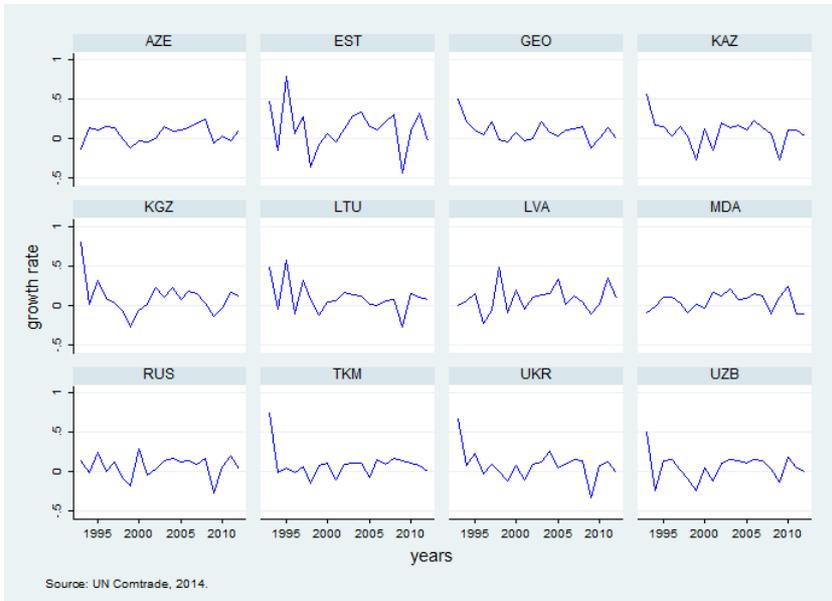

Source: UN Comtrade, 2014.

Figure 4: Individual Growth Rates for Total Trade Volumes (1993-2012)
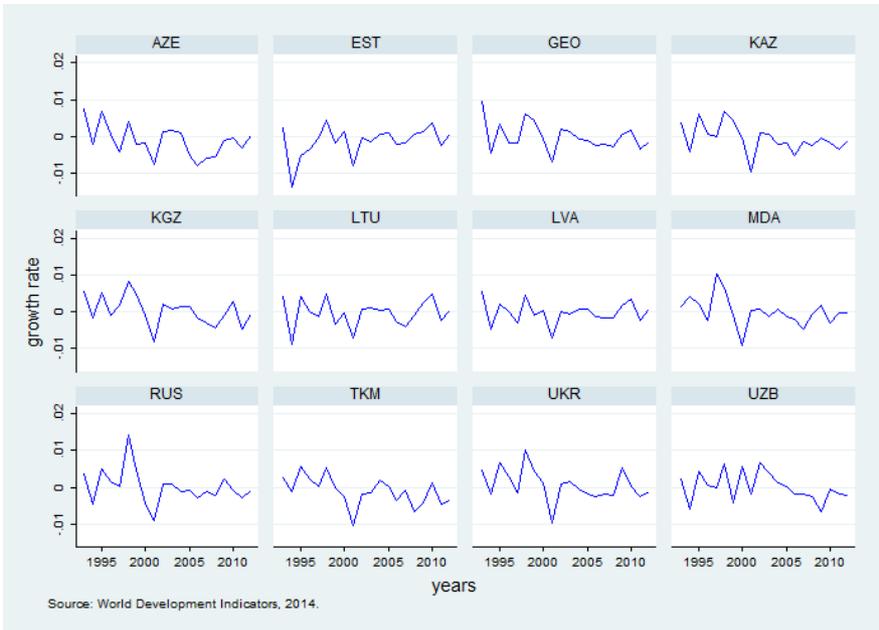

Source: UN Comtrade, 2014.

Figure 5: Individual Cross Sections for Non-Oil Trade Volumes (1992-2012)

Source: UN Comtrade, 2014.

Figure 6: Individual Growth Rates for Non-Oil Trade Volumes (1993-2012)

Source: UN Comtrade, 2014.

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Figure 7: Individual Cross Sections for Similarity Among Countries (1992-2012)

Source: World Development Indicators, 2014.
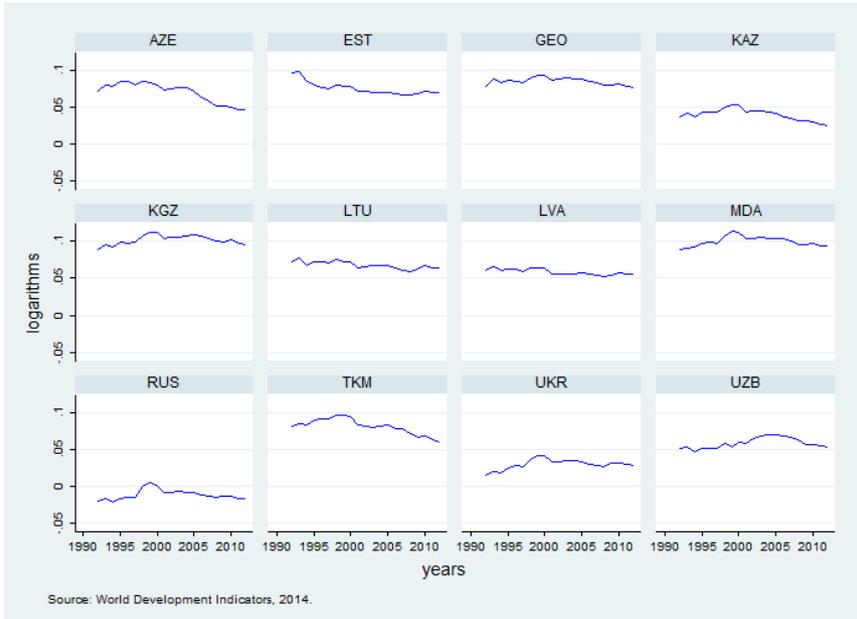
Figure 8: Individual Growth Rates for Similarity Among Countries (1993-2012)

Source: World Development Indicators, 2014.

Appendix B: Panel Unit Root Test Results

Table B.1: Existence of Panel Unit Root –Levels

Variable-in level	Method				
	LLC	IPS	Fisher	Breitung	Hadri
GDP_{jt}	1.10 (0.83)	0.15 (0.56)	-3.11 (0.99)	2.70 (1.00)	36.94 (0.00)
GDP_{it}	1.20 (0.88)	4.49 (1.00)	-3.14 (0.99)	3.93 (1.00)	40.19 (0.00)
VOL_{ijt}	0.11 (0.54)	-1.36 (0.08)	2.81 (0.02)	-0.97 (0.16)	36.70 (0.00)
$NVOL_{ijt}$	0.59 (0.72)	-1.19 (0.11)	2.94 (0.00)	-0.88 (0.18)	36.31 (0.00)
SIM_{ijt}	-0.96 (0.16)	0.43 (0.66)	-0.09 (0.53)	2.61 (0.99)	22.29 (0.00)

Table B.2: Existence of Panel Unit Root –Growth Rates

Variable-in level	Method				
	LLC	IPS	Fisher	Breitung	Hadri
GDP_{jt}	-5.42 (0.00)	-4.70 (0.00)	8.28 (0.00)	-4.13 (0.00)	8.58 (0.00)
GDP_{it}	-6.57 (0.00)	-8.55 (0.00)	35.16 (0.00)	-9.06 (0.00)	-2.27 (0.98)
VOL_{ijt}	-1.28 (0.09)	-9.07 (0.08)	49.83 (0.00)	-2.86 (0.00)	-0.24 (0.59)
$NVOL_{ijt}$	-1.79 (0.02)	-8.85 (0.00)	46.83 (0.00)	-2.60 (0.00)	-0.19 (0.57)
SIM_{ijt}	-4.58 (0.00)	-7.62 (0.00)	29.09 (0.00)	-5.67 (0.00)	3.24 (0.00)

Notes: Values in parentheses are probabilities.