

Exploring foreign trade of Armenia from 2011 to 2015: Gravity model of trade

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Submitted to

American University of Armenia

Manoogian Simone College of Business and Economics

In partial fulfillment of the requirements for the degree of Master of Science in
Economics

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Yerevan 2016

ABSTRACT

The global financial crises of 2008-2009 severely damaged the world trade. It took Armenia about three years to reach its pre-crisis import and export levels. Various events took place over the next years in the international arenas that affected foreign trade of the country. With its membership to the Eurasian Economic Union in January 2015 Armenia gained access to a promising customs-free market of about 180 million people, which was believed to be greatly stimulating the country's economic and trade relations with the other participants of the union from the very beginning of the new economic year. The aim of this study is two-fold. First, augmented gravity models of international trade are estimated for Armenia for the period of 2011-2015 with the aim of determining the individual impacts of distinct factors on the country's total import, export and total trade. Second, the study is an attempt to measure the effect of the EAEU on trade volumes of the country. As a means to address the problem of missing trade values Heckman correction method and a procedure very similar to it are chosen. The results show that there exists statistically significant relationships between import, export (and total trade) and different country-specific, economic, geographical, cultural and diplomatic-political factors. Regression analyses also showed that the country's participation in the union did not bring about the expected change in trade volumes. Rather, for reasons not connected to the union's operation the trade volumes even declined, just as the real data suggests.

Keywords: Gravity Model of Trade, Armenia 2011-2015, the Impact of the EAEU on trade, Panel Data, Selection Bias Correction.

ACKNOWLEDGEMENTS

My deep gratitude goes to Dr. Vahram Ghushchyan, who expertly guided me through writing this thesis; also I would like to thank Dr. Vardan Baghdasaryan and Dr. Gayane Barseghyan for their valuable remarks throughout the program. Finally, I would like to thank my family and all my MSE friends for their support and encouragement during my Master's studies.

All errors in this paper are mine.

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Introduction

Sir Winston Churchill, one of the most famous political figures of 20th century is credited with the expression “Never be late for dinner, smoke Havana cigars and drink Armenia cognac”. The cigars and the cognac that the statesman had a special liking for were a result of a very favorable economic phenomenon known as international trade. In particular, Armenian cognacs popular with their fine flavor and originality became recognized worldwide because of the continued participation of the country in global trade.

As a small open economy Armenia has its own slice in the big pie of international relations and trade. After gaining independence from the Soviet Union in 1991 the country started its own path of establishing and strengthening relationships with the rest of the world nearly in all possible aspects of economic and non-economic cooperation. Year by year the country managed to deepen its trading ties both in terms of the number of traded products and services, and the quality and size of trade partners, which, in its turn, greatly contributed to its otherwise feeble economic conditions, caused partly by the newly-gained sovereignty and partly by the war in Nagorno Karabakh. The country’s membership in the Commonwealth of Independent States (CIS) at the end of 1991 was the main initial driving force in export-import realm, which was further stimulated by the country’s integration in World Trade Organization (WTO) in 2003 and by the over-time growing number of bilateral trade agreements with the members of European Union and major Asian economies. The most recent marked event in this “export-import” dynamics was the admission of the country in the Eurasian Economic Union ¹in early 2015

¹The Eurasian Economic Union (EAEU) is considered to be a deeper form of integration of the Customs Union of Belarus, Kazakhstan, and Russia. The original treaty establishing the Customs Union was annulled with the agreement to establish

instead of the other possible alternative, DCFTA within the framework of an Association Agreement with European Union². The decision to enter the union and the historical happening itself took a great deal of attention being subject to much debate and criticism by the general public.

The chronic trade balance deficit, the small-scale and easy-vulnerable but human-capital rich economy in conjunction with other socio-economic problems present in Armenia has consistently forced the country to look for new product-creation possibilities and geographical directions perspectives in its foreign trade. The country has always had stark statistics in export to import ratio (see Figure 1 in Appendix A for import-export dynamics). Just before the financial crises of 2008-2009 the trade as percentage of GDP was 58.34, and the trade balance as percentage of GDP was -19.97³. In the crises period most trade indicators including export and import both quantitatively and qualitatively deteriorated (the trade balance as % of GDP was -27.53 in 2009). Since then, the former statistic has well gone up (reaching as much as 76% of GDP in 2013), whereas the latter has remained in the negative range of 10 to 20 %. All in all, total imports have always exceeded total exports almost three times, with an exception of the last two years over which the former has substantially declined. Hopefully, according to some research by international institutions⁴ the problems mentioned are mainly soluble and are matter of time. The whole thing is that the country is utilizing only part of its economic powers and potential, which if fully exploited could boost the economy as a whole and thus curtail imports. While the permanent trade deficit and the fact that the trade as percentage to GDP averages about 74 percent (only considering the past five years' data) are alarming in the sense of the country's poor production and economy on the whole, they provide enough motives for rich

the Eurasian Economic Union. For more information on the EAEU see Eurasian Economic Integration: Facts and Figures, Eurasian Economic Commission.

²The Deep and Comprehensive Free Trade Area (DCFTA) between the EU and Armenia was a further step in developing Armenia's economic relations with the EU. The DCFTA, which would form part of an Association Agreement with the EU, aimed at strengthening the trade and investment performance of both economies, while facilitating Armenia's progressive integration with the EU economy of 500 million consumers.

³In this paper the data on trade indicators and exports, imports statistics are taken from <http://wits.worldbank.org>.

⁴See UN Development Program in Armenia, World Bank_ World Bank Urges 'Second Generation Reforms' In Armenia, Global Corruption Report 2008, Transparency International Corruption Perceptions Index, 2012.

research on this and adjacent fields. The large share of trade in the country's total economic output and the entry to the Eurasian Economic Union are few of them. The accession to the economic bloc is of great interest in particular, since trade volumes between Armenia and the other participants of the union were expected to be positively influenced since the first days of the cooperation.

The aim of this paper is to estimate gravity models of international trade for Armenia. There are plenty of studies on this topic. Similar study has also been done for Armenia for the pre-crisis period of 2003 to 2007 and this research will differ from it by including the years 2011 to 2015 and using special methods to solve the common problems in the model's estimation. Besides, the analysis covers 205 countries. The data I use is also panel data. The main data are taken from the World Bank's, World Trade Organization and CIA "The World Factbook"-s databases, and the website <http://www.tradingeconomics.com/>. Plus, as there are always downsides and advantages to joining any economic union (as well as uncertainty), it is quite sensible to think of tangible results even in the short run. In this study I also try to find answers to the question whether trade flows experienced shifts due to the country's participation in the EAEU. The results of this study reveal that trade flows are significantly correlated with many geographical, cultural, economic and political factors and that the country's trade volumes, though not significantly, changed after joining the Customs union, which was, in essence, not a direct consequence of that process.

More about foreign trade of Armenia

Productive integration of the Republic of Armenia into the world economy, rise of domestic goods export volumes, provision of appropriate legal framework and favorable environment for international economic cooperation, investment attraction, and foreign trade efficiency raising infrastructure development are the main principles of the international economic cooperation policy ⁵.

From early days of its independence in 1991 till now, the country has signed bilateral and multilateral international agreements in trade and economic fields in all possible geographical directions. A total of 42 Bilateral Investment Treaties (BIT's), 10 Free Trade Agreements (FTA) and 4 important trade association/integration agreements have been signed and concluded by far, some of which are in force today⁶. The 4 association agreements have been crucial for Armenian foreign trade and their particular roles deserve underlining. For about the first 6 years after the collapse of USSR the major trading partners of Armenia were chiefly from the CIS, which was quite natural, as the former soviet republics with their soviet-time-created economic links with Armenia represented good platform for bilateral trade. The trade within the CIS helped the country out in its worst days. The total value of Armenian foreign trade in 1997 was as little as 969 million USD of which a very large proportion (around 30%) fell to the CIS, the then only international bloc the country was member of. (Moreover, inspecting the FTA-s would make it clear that all of them have been signed with the CIS countries as well). The Partnership and Cooperation Agreement in 1999 became the cornerstone of EU-Armenia bilateral trade relations. This agreement did not include tariff preferences, but prohibited quantitative restrictions in

⁵For more on the investment policy and foreign economic cooperation go to <http://www.mineconomy.am>.

⁶For the complete list of the BIT partners of Armenia, their status, dates of signature go to <http://investmentpolicyhub.unctad.org/IIA/CountryBits/9>. For more on the FTA-s go to <https://www.wto.org/>.

bilateral trade thereby promoting it and enhancing its volumes. The EU has since gradually turned into Armenia's biggest export market (over 680 million USD in 2015), accounting for about 22 % of its total trade as of 2015. The access to the WTO was the next timely momentum. On December 10, 2002, the General Council of the WTO approved Armenia's application to join the WTO. Armenia officially became the 145th member of the WTO on February 5, 2003. The entry into the organization became a sort of propeller for the economy opening new and wider opportunities for trade. From 2001-2007 the country experienced its golden economic years with economic growth averaging about 12%, which was to some extent due to the WTO deal. The EAEU participation was the last and the most controversial event in the whole modern history of the country. For a long time before that the country had been conducting so-called complimentary way of foreign policy trying to keep balanced relations with both the West and Russia. In the end, Armenia made a decision in favor of the second party officially joining the EAEU on January 2, 2015, making the Association Agreement offered by the EU incompatible. The EAEU was expected to benefit Armenia and its trade between the other members of the union in many ways. According to the code of the union, no customs are levied on goods and services travelling within the Customs Union. This means cheaper imports from the member countries and more competitive Armenian exports (food, agricultural products etc) to a market of about 180 million consumers. Second, Armenia becomes eligible to take some percentage (now 1,11 %) of the union's yearly budget. In addition, the citizens of Armenia can work freely in the territory of the other member-states being treated in the same fashion as their domestic workers, without any limitations, something that was not possible within the framework of the Association Agreement with the EU. Finally, according to some military specialists and politicians, the decision was highly warranted by the political issues that the country faces⁷.

Armenia is the 141st largest export economy in the world and the 64th most complex economy according to the Economic Complexity Index (ECI). In 2011 Armenia exported

⁷For an interesting description of the main benefits for the EAEU member- states see Political and economic integration with the EAEU, Daria Bartsevich, Centre for Geopolitics & Security in Realism Studies 20-22 Wenlock Road, London N1 7GU, United Kingdom.

\$1.306B and imported \$3.979B, resulting in a negative trade balance of \$2.673B. In 2014 exports reached their all-time maximum, \$1.490B, while imports started declining sharply. In 2015, (and in general) the top five exported products by Armenia along with trade value were copper ores and concentrates (\$ 316million), cigarettes containing tobacco (\$ 170 million), gold in oth semi-manufactured forms (\$ 98 million), spirits from distilled grape wine or marc, (\$ 84million), foil, aluminium, not backed, rolled but not fur (\$ 82 million). The top five imported products by Armenia along with trade value were natural gas in gaseous state (\$429million), petroleum oils (\$ 217)million, medicaments of mixed or unmixed products (\$ 79million), spelt, common wheat and meslin (\$ 68 million), aluminium unwrought, not alloyed (\$ 58million). In 2015 (and in general) the top 5 export destinations were Russian Federation (\$ 226million, with a partner share of 15.23 percent), China (\$ 165million), Germany (\$ 145million), Iraq (\$ 131million), Georgia (\$ 114million). The top 5 import countries were Russian Federation (\$ 991million, with a partner share of 30.43 percent), China (\$ 315 million), Iran Islamic Rep. (\$ 198 million), Germany (\$ 182million), Italy (\$ 148 million).

Regarding the situation before and after the EAEU, there are a couple of things to pay attention to. In 2014 the total trade between Armenia and the other four members of the EAEU was 1.421billion USD (about 25% of the overall trade). A year later it contracted by 11.2 % reaching 1.261 billion USD. Both import and export served as sources of that contraction. Table 1 below summarizes the whole trade picture between the countries for the years 2014 and 2015.

Table 1.Export and import data for 2014 and 2015, Armenia and the EAEU, millions of current US dollars.

| Partners of the EAEU | 2014 | | 2015 | |
|----------------------|----------------|------------------|---------------|----------------|
| | export | import | export | import |
| Russian Fed. | 304,604 | 1,069,288 | 225,87 | 991,144 |
| Belarus | 9,023 | 31,022 | 5,461 | 33,783 |
| Kazakhstan | 6,868 | 0,55 | 4,857 | 0,292 |
| Kyrgyz Rep. | 0,313 | 0,095 | 0,349 | 0,083 |

Gravity model of trade

Gravity model of trade has long been one of the most successful empirical models in economics. The seminal work of Jan Tinbergen (1962) first brought to light the idea that the size of bilateral trade flows between any pair of countries can be approximated by a law called the “gravity equation” by analogy with the Newtonian theory of gravitation. Just as celestial bodies such as asteroids, moons, planets and the stars are mutually attracted in proportion to their sizes and proximity, countries trade in proportion to their respective GDPs and proximity. Countries having large “masses” are supposed to trade more (gravitate stronger) with other countries, while the distance between them negatively affects that trade (weakens the gravitational force). In its general formulation, the gravity equation is very similar in form to the universal gravitation equation:

$$TRADE_{ij} = \alpha \frac{GDP_i * GDP_j}{DISTANCE_{ij}} \quad (1)$$

where $TRADE_{ij}$ represents the value of the bilateral trade between country i and j , GDP_i and GDP_j are country i 's and j 's national incomes accordingly. $DISTANCE_{ij}$ is a measure of the

bilateral distance between the two countries and α is a constant of proportionality. Taking the logarithm of equation (1) produces the linear form of the gravity model of international trade and the corresponding estimable equation:

$$\log(\text{TRADE}_{ij}) = \alpha_1 + \alpha_2 \log(\text{GDP}_i * \text{GDP}_j) + \alpha_3 \log(\text{DISTANCE}_{ij}) + \varepsilon_{ij}(2)$$

where α_1 , α_2 and α_3 are parameters to be estimated, ε_{ij} stands for the error or residual term and captures all factors or shocks affecting bilateral trade between the two countries.

Several controversies have arisen with regard to the model since its first empirical applications. At first, the theoretical framework was put into doubt. For a long time some scholars believed that there was no theoretical justification for the gravity equation. However, over time, the theoretical foundations were established (Anderson 1979, Bergstrand 1989, Deardoff 1998 and many others) and different hypothesis emerged. After incorporating the deeper theoretical justifications of gravity into practice, the debates generally turned to performance of different estimation techniques because of common problems related to the model's estimation.

Traditionally, the gravity model has been linearized and estimated using OLS assuming that the variance of the error term is constant across observations or using panel data methods assuming that the error is constant across countries or country pairs. But the trade data used for the model are usually heteroskedastic, and this fact implies the expected value of the error term is a function of the regressors. In this situation, the conditional distribution of the dependent variable alters and linear estimation becomes inconsistent. For this reason, the linear methods are commonly found less effective in estimations of the gravity equations.

Another popular challenge about running of the regression which is extensively described in the literature and is usually faced by researchers, concerns zero bilateral trade values. Very often,

in data sets of bilateral trade, some of the trade flows are recorded as zero or missing. Since the logarithm of zero is not defined, the truncation and censoring methods have long been proposed in the literature to treat the problem of zero flows in data. The elimination of trade flows when zeros are not randomly distributed leads to sample selection bias (Santos Silva, Joao M.C., and Silvana Tenreyro, 2006, “The Log of Gravity”). Hence, the truncation and censoring procedures are presently deemed not that appropriate because they reduce efficiency and lead to biased estimates due to the omission of data.

The estimation problems concerning the validity of the log linearization process of the equation in the presence of heteroskedasticity and the loss of information due to the existence of zero trade flows together with the problem of choice of the right estimation procedure have, of course, been deeply explored and several conclusions have been drawn⁸. In this respect, the recent literature regarding estimation techniques (Gert-Jan M. Linders Henri L.F. de Groot_ Estimation of the Gravity Equation in the Presence of Zero Flow, Will Martin and Cong S. Pham_ Estimating the Gravity Model when zero trade flows are frequent, etc.) have opted to use nonlinear methods as well as two parts models for estimating the gravity equations. Among nonlinear estimation methods, the most frequently used are Nonlinear Least Squares (NLS), Feasible Generalised Least Squares (FGLS), the Heckman sample selection model and Gamma and Poisson Pseudo Maximum Likelihood (GPML and PPML). Overall, the nonlinear estimators show more accurate results and are robust to the presence of heteroskedasticity in data. The Heckman sample selection model, however, is revealed to be the estimator with the most desirable properties, since, as believed by many econometricians, it addresses the most urgent two questions_ the heteroskedasticity of the error term and the zero trade flows_ comparatively well. Specifically, in the first step, a probit equation is estimated to define whether two countries trade or not and in the next stage, the expected values of trade flows, conditional on that country trading , are estimated using OLS.

⁸The paper by Estrella Gomez Herrera, *Comparing alternative methods to estimate gravity models of bilateral trade*, provides a comprehensive summary of the models estimation issues. It makes a detailed comparison of different estimators using the same set of data. This paper is one of the papers used as reference in this study.

The model indeed found extensive usage in analyses of international trade since its introduction. In the last fifty years, it has been widely used for making predictions on trade flows and evaluating countries' trade policy. Various model specifications and hypotheses have been developed and tested to date. The paper by Matthieu Bussière and Bernd Schnatz (ECB, working paper series N 693) provides an assessment of China's "natural" place and integration in world trade with a gravity model based benchmark using a panel data with a lot of trade integration indicators. Their model proved to track international trade well and confirmed that China is already well integrated in world markets, particularly with North America, several Latin American and East Asian emerging markets and most euro area countries. In the paper by Amita Batra (India's global trade potential: the gravity model, December 2004), an augmented gravity model is run to first analyze world trade flows, and the coefficients obtained are then used to predict trade potential for India. The main findings were that countries like China, United Kingdom, Italy and France revealed maximum potential for expansion of trade with India. In their turn, Erkan Erdil Ibrahim and Hakan Yetkiner (The Determining Role of EU in Turkey's Trade Flows: A Gravity Model Approach, 2008) tried to determine whether the Customs Union of EU that Turkey entered in 1996 made a change in Turkey's trade flows. They found out that EU countries have always been important in Turkey's trade flows and that the Union has increased EU's importance marginally in determining Turkey's trade flows. Finally, the study (that is closer to the current research) by Konstantin Borodin and Anton Stokov (The Customs Union in the CIS, 2015 Journal of Economic Integration) was an attempt to evaluate the existing trends in trade before the formation of the Customs Union within the Eurasian Economic Community in January 2010 and the very first results of the Customs Union activities. Some of the conclusions the authors came to are that the removal of tariffs in mutual trade between Russia and Belarus, didn't led to the development of mutual trade, although it helped Belarus to improve some of its macroeconomic indicators, and that Kazakhstan's accession to the Preferential Trade Agreements (PTA-s) between Russia and Belarus might, probably, stimulate

the trade creation effect in some product groups.

Trade flows to and from Armenia has also been subject to gravity model analysis. Grigor Hayrapetyan and Viktoriya Hayrapetyan (Regional and International Trade of Armenia: Perspectives and Potentials, 2011, Kiev: EERC) used the gravity approach of trade to estimate trade potential for Armenia by product groups in international and regional directions. The study focused on the period 2003-2007 and included 139 countries. The data used were panel data. The results showed that trade relations of Armenia with most of the main trade partners have no potential to develop, that opening of Turkish- Armenian border could be economically beneficial for Armenian exporters. In addition, it came out that the most perspective product groups of Armenian export are “Food and beverages”, “Industrial supplies”, and “Consumer goods”.

The present paper differs from the above one in a number of ways. Firstly, the analysis includes the post crisis years 2011-2015 (keeping in mind the healing world economy) and spreads over 205 countries, with the aim of having a maximum possible geographical coverage of world trade. Secondly, the assortment and the content of variables in the gravity equations are different. By contrast, here I use aggregate data on import and export (and total trade) rather than data on distinct product groups. More importantly, the Heckman sample selection method and an equivalent procedure are applied to tackle the most central estimation issue, zero or missing trade flows⁹. Two papers – “*Comparing alternative methods to estimate gravity models of bilateral trade*” by Estrella Gomez Herrera and “*India’s global trade potential: the gravity model*” by Amita Batra_ are the main references used for this paper.

⁹In 2011 positive export was recorded with only 97 countries. At the same time Armenia imported goods from 152 countries. The numbers did not alter much from 2011-2015

Methodology and Data

Equation (2) above is the core gravity model equation and explains bilateral trade as a positive function of total output and negative function of distance. Allowing for other factors influencing trade levels, the basic equation is extended into the augmented gravity models, which are built by adding various variables (often dummy) that may have importance on international trade. In this study, the following specification is employed :

$$\begin{aligned} \log X_{Tij} = & \alpha_1 + \alpha_2 \log GDP_{Ti} + \alpha_3 \log GDP_{Tj} + \alpha_4 \log DISTANCE_{ij} + \alpha_5 BORDER_{ij} + \\ & \alpha_6 FTA_{Tij} + \alpha_7 LANGUAGE_j + \alpha_8 LANDLOCKED_j + \alpha_9 EMBSY_{Tj} + \alpha_{10} AFTER * \\ & MEMBERS_{Tj} + \epsilon_{ij} \end{aligned} \quad (3)$$

where i and j denote Armenia and the remaining countries respectively, X_{ij} is the dependent variable and represents total import in USD at time T from country j to Armenia, or total export from Armenia to country j, or the sum of both. The explanatory variables are as follows:

GDP_{Ti} : GDP_{Ti} is the gross domestic product (GDP) of Armenia at time T.

GDP_{Tj} : GDP_{Tj} is the gross domestic product of country j at time T.

$DISTANCE_{ij}$: $DISTANCE$ stands for the distance in km between the capital city of Armenia, Yerevan, and the capital city of country j. Here I use air distance as a measure of the distance.

$BORDER_{ij}$: $BORDER_{ij}$ is a dummy variable used for identifying a pair of countries that share common border. This dummy is in addition to the inclusion of the distance variable, and is expected to explain large volumes of border trade between neighboring countries. Armenia has common border with four countries, namely, Georgia, Azerbaijan, Iran and Turkey.

FTA_{Tj} : FTA_{Tj} is an indicator standing for Free Trade Agreements that Armenia has with country j

at time T . From 2011-2015, the country has had seven Free Trade Agreements, with Kazakhstan, Tajikistan, Moldova, Russia, Turkmenistan, Kyrgyzstan and Ukraine, which remained in effect throughout the period of interest. FTA-s are believed to have a positive impact on trade.

LANGUAGE_j: It is a dummy variable implying unity for countries of Former Soviet Union. Here by LANGUAGE I mean common language between Armenia and other countries. As such Russian language is selected. Common language is expected to reduce transaction costs as speaking the same language helps facilitate trade negotiations. Common language could also mean that countries have certain cultural similarities.

LANDLOCKED_j: LANDLOCKED_j is a dichotomous variable that gets value 1 for landlocked countries. A landlocked country is a sovereign state entirely enclosed by land, or whose only coastlines lie on closed seas. There are currently 48 such countries. Landlockedness of countries is supposed to have adverse influence on trade levels.

EMBSY_{Tj}: EMBSY_{Tj} is an indicator variable that is one for the states where Armenia has embassies. The country has had 86 embassies from 2011 to 2015 and that number has been invariant throughout the period. The embassies are mostly located in the countries with whom Armenia has strong economic and diplomatic relations as well as where there are relatively large Armenian communities. Trade with these 86 countries also makes up the big chunk of Armenian foreign trade.

*AFTER*MEMBERS_j*: AFTER*MEMBERS_j is an interaction variable (composed of two indicator variables) designed for estimating treatment effects. AFTER stands for the year 2015 when Armenia entered the Eurasian Economic Union, while MEMBERS includes the EAEU member countries, namely Belarus, Kazakhstan, Kyrgyzstan and Russia. AFTER takes value one only for the year 2015, whilst MEMBERS is 1 for the member countries for the whole panel-series. Usually by inserting such a variable one assumes countries' trade (and economy as a whole) largely profits from the privileges that economic unions give.

I estimate the gravity model specified above for each of the three types of trade flows

separately. For the first objective in this study_estimating gravity models _ I run the three equations without the variable AFTER*MEMBERS. For that purpose, the appropriate Hausman tests are carried out first to decide between fixed and random effects and thus to know which of the estimators better suits the panel-series. Second, the three regressions are estimated using GLS random effects and Fixed Effects estimators. Third, based on the Housman tests the Heckman two –step selection method is applied to reestimate the models to correct for possible selection bias in the data. Fourth and last, to take account of the presence of random or fixed effects and the possible selection bias in the data at the same time, a two-stage procedure very similar to the Heckman method is performed for each of the three equations__a probit model is run to generate the inverse of the Mills ratio, which is then used to reestimate the equations. logGDP_j, logDISTANCE_{ij}, LANGUAGE_j, EMBSY_j and WTO_j are used in the probit equations, with WTO chosen as identifying-variable¹⁰.Finally, to segregate and make the impact of entering the EAEU visible I estimate the three equations with AFTER*MEMBERS following the same steps¹¹.

The data on total import and export, GDP, WTO membership, air distance are collected for 205 countries. The data on GDP are downloaded from <http://data.worldbank.org/>, <https://www.cia.gov> and www.tradingeconomics.com/.The data on total import, export are obtained from <http://wits.worldbank.org/>. <http://www.distancefromto.net>is where the air distances were easily calculated. Information on WTO membership and FTA are taken from <https://www.wto.org/>. Because of the unavailability of data on GDP for some of the countries for specific years the panel data is not strongly balanced. Table 2 below contains the summary statistics of the data on export and import. Table 3in Appendix A at the end presents panel series for 3 countries.

¹⁰This set of variables is also used for the Heckman models. WTO is a binary variable that is one for countries that are member of World Trade Organization (WTO). Like FTA-s, WTO membership is expected to have positive influence on trade levels. Armenia has been member of WTO since 2003.

¹¹In this paper some problems common to panel data, such as potential endogeneity in random effects models, individual heterogeneity (heteroskedasticity of the individual error terms) are not considered in order not to complicate the analyses.

Table 2. Summary statistics of the data on total export and import, current US dollars.

| <i>year</i> | | <i>mean</i> | <i>observ.</i> | <i>min</i> | <i>max</i> |
|-------------|---------------|-----------------|----------------|------------|-----------------|
| | <i>export</i> | 6287212 | 205 | 0 | 2,21E+08 |
| 2011 | <i>import</i> | 19336407 | 205 | 0 | 8,85E+08 |
| | <i>total</i> | 25623619 | 205 | 0 | 1,11E+09 |
| | <i>export</i> | 6809628 | 205 | 0 | 2,78E+08 |
| 2012 | <i>import</i> | 19836507 | 205 | 0 | 1,05E+09 |
| | <i>total</i> | 26646135 | 205 | 0 | 1,33E+09 |
| | <i>export</i> | 6897817 | 205 | 0 | 3,32E+08 |
| 2013 | <i>import</i> | 20651128 | 205 | 0 | 1,10E+09 |
| | <i>total</i> | 27548946 | 205 | 0 | 1,44E+09 |
| | <i>export</i> | 7180293 | 205 | 0 | 3,05E+08 |
| 2014 | <i>import</i> | 20031385 | 205 | 0 | 1,07E+09 |
| | <i>total</i> | 27211678 | 205 | 0 | 1,37E+09 |
| | <i>export</i> | 7099520 | 205 | 0 | 2,26E+08 |
| 2015 | <i>import</i> | 15749451 | 205 | 0 | 9,91E+08 |
| | <i>total</i> | 22848972 | 205 | 0 | 1,22E+09 |

Results and Conclusions

The estimations were done via Stata 14 software. The results of the regression analyses appear in Appendix B. The outputs of the Hausman tests are found in Appendix C. The tests results support the presence of random effects for the import, export regressions and reject it for the total trade. The corresponding fixed effects and random effects estimates are also displayed in the regression tables for ease of comparison. The results of the estimated probit models needed for calculating the inverse of the Mills ratios are presented in Table 9 in Appendix B.

Looking at the outcomes generated by the different estimators in Table 4,5 and 6 one could see that the general theory is working for the most part. The idea on which the gravity equations are based is confirmed once again. The signs for most of the regressors go with the effects they are anticipated to have. For example, as the theory suggests GDP-s of the trading countries should be positively correlated with their trade flows, which is so for almost all of the three cases. The coefficients representing distance bear the expected negative coefficients meaning that increasing of the distance between countries diminishes the overall volume of the trade circulation (overall export, import or total trade) between them. Put another way, the shorter the distance the larger the volumes of trade, all other factors being equal. On the other hand, the variables for the common Russian language and the availability of embassies in trade partner countries warranted their inclusion in terms of their signs, magnitudes and statistical importance. The fact that the former Soviet Union countries and the countries with which Armenia maintains intimate diplomatic relations constitute the greatest proportion of its total trade (both total export and import) is evidenced by the high and positive elasticities.

In all, elasticities before the other variables have gotten the signs they would normally have. In some situations, however, the results are quite surprising, particularly with the variables LANDLOCKED and BORDER. Note that neither of them is statistically significant nor do they

have sufficient explanatory power. Ignoring the significance of the estimates, one can clearly see that the coefficient of the first even switches into positive sign across the estimations (see the regression for logEXPORT). Since most of the major export partners (Russia, China, Germany, Iraq, Georgia, Canada, Bulgaria, and Iran) are not landlocked, the positive coefficients of 0.493, 0.601 and 0.584 in the export's regressions are not intelligible. It is clear why FTA is often with incorrect signs. The correlation of about 0.69 with LANGUAGE is the answer to why it is not statistically significant¹². Meanwhile, the little or no trade recorded between Armenia and its eastern neighbor Azerbaijan, which is a direct effect of the prolonged Nagorno Karabagh conflict and the existing hostility between the two, is likely to be the reason why BORDER is not statistically significant¹³.

The estimator and hence the model that best explains the relationship between the variables varies across the three tables. In the table for logEXPORT, the 10 % and 5 % significant Mills ratios in the last two columns are indicative of the selection bias in the sample. Both the Heckman and the Random Effects with IMR report the corrected estimates but one should favor the second collection of those because Heckman does simple OLS, whereas here random effects estimation is a must. On the contrary, the statistical insignificance of the Mills ratios in the table representing logIMPORT speaks against the presence of the selectivity problem in spite of so many missing values for the variable import, and as a result the Random Effects model should be preferred. For the total trade, however, none of the estimators appears efficient, but going in line with econometric theory (the Housman tests results in particular), the Fixed Effects model should be chosen. In addition, comparing the models it should be mentioned that there come essential changes in magnitudes, reasonability and statistical significance of the estimates, with some estimators merely impairing the results.

Now let's move to the last two tables (Table 7 and Table 8) that show the results of the

¹²The countries (all were Soviet Union republics) that take value 1 for FTA also have value 1 for LANGUAGE. In many gravity equations of trade both variables occur together, usually have high explanatory power. Even after elimination of FTA from the equations very little changes in terms of the size and significance of the coefficients. The test for possible collinearity between the variables produces VIF value of 1.94, which implies tolerable collinearity and no need to exclude one of the variables. See appendix C at the end.

¹³In most gravity equations, variables representing common border are usually highly significant.

regressions with the interaction variable $AFTER*MEMBERS$ ¹⁴. Recall that the meaning of this variable is to capture the presumable positive or negative change in either of the trade directions that resulted from the participation in the EAEU. Before going on see that the Mills ratios are significant in the regressions for $\log EXPORT$ implying that there is a selection bias in the data. As to the variable of interest, one would say that none of the coefficients on $AFTER*MEMBERS$ is statistically meaningful, even, say, at 40% significance level. Ignoring the significance of the estimates there is one good thing that I would like to talk about. In the 5 of the 6 models in those tables the coefficients on $AFTER*MEMBERS$ take negative signs, which is what actually happened to Armenian export and import within the EAEU during 2015 (go back to Table 1 for the export and import data before and after the EAEU). Both export and import between Armenia and the remaining four countries of the union went down during 2015 and that fall is reflected by the negative coefficients. Anyway, in my opinion the EAEU was not the cause of the reduction in trade between the countries. Rather, there were other significant factors which impacted economic situation in the member-states. Among them the most important were the slowdown of Russian economy¹⁵, influenced by fall of oil prices, Western economic sanctions, geopolitical and economic challenges surrounding the members, ruble depreciation against USD and even AMD, and etc.

To sum everything up, I would say that the gravity model specification employed in this study was good at explaining the relationship between import, export and total trade and different geographical, economic, cultural and political factors. Using it I found that trade flows are significantly correlated with many of those factors. The tools used for solving the central problem in the gravity models of trade, the missing or 0 trade values, also proved to be effective. There was selection bias in the data that was solved. Finally, I could show that there was a small negative change, though not statistically meaningful, in trade flows of Armenia after its

¹⁴There are correlation of 0.52 between LANGUAGE and MEMBERS, and correlation of 0.56 between FTA and MEMBERS. That is why in this case FTA is left out from the regressions. Anyway, running the equations without FTA does not make any important difference.

¹⁵ For more details see "The economic and financial crisis in Russia: background, symptoms and prospects for the future", Ośrodek Studiów Wschodnich im. Marka Karpia Centre for Eastern Studies.

accession into the EAEU. Talking about the efficiency of the EAEU in general, I also think that it is very early to estimate the real impact of changes after joining the organization.

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Appendix A

Figure 1. Export-import dynamics from 2005-2015, billions of current USD.

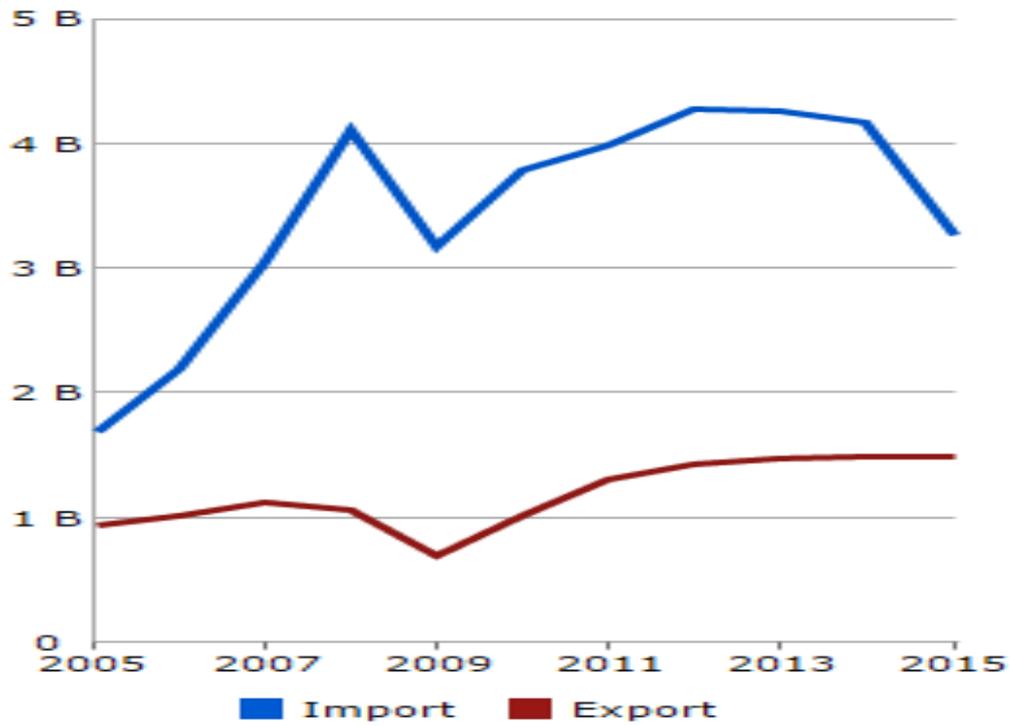


Table 3. The panel series for 3 random countries.

| year | country | export | import | Total | GDP | landlock | lang | border | WTO | distance | FTA | EMBSY | after | members |
|------|-----------------|-----------|-----------|-----------|-----------|----------|------|--------|-----|----------|-----|-------|-------|---------|
| 2011 | Russia | 2.209e+08 | 8.854e+08 | 1.106e+09 | 2.032e+12 | 0 | 1 | 0 | 0 | 1806.1 | 1 | 1 | 0 | 1 |
| 2012 | Russia | 2.779e+08 | 1.052e+09 | 1.330e+09 | 2.170e+12 | 0 | 1 | 0 | 1 | 1806.1 | 1 | 1 | 0 | 1 |
| 2013 | Russia | 3.319e+08 | 1.104e+09 | 1.436e+09 | 2.231e+12 | 0 | 1 | 0 | 1 | 1806.1 | 1 | 1 | 0 | 1 |
| 2014 | Russia | 3.046e+08 | 1.069e+09 | 1.374e+09 | 2.031e+12 | 0 | 1 | 0 | 1 | 1806.1 | 1 | 1 | 0 | 1 |
| 2015 | Russia | 2.259e+08 | 9.911e+08 | 1.217e+09 | 1.526e+12 | 0 | 1 | 0 | 1 | 1806.1 | 1 | 1 | 1 | 1 |
| 2011 | Moldova | 415476 | 1717124 | 2132600 | 7.015e+09 | 1 | 1 | 0 | 1 | 1468.18 | 1 | 1 | 0 | 0 |
| 2012 | Moldova | 710064 | 1411260 | 2121324 | 7.286e+09 | 1 | 1 | 0 | 1 | 1468.18 | 1 | 1 | 0 | 0 |
| 2013 | Moldova | 443275 | 1269359 | 1712634 | 7.985e+09 | 1 | 1 | 0 | 1 | 1468.18 | 1 | 1 | 0 | 0 |
| 2014 | Moldova | 514589 | 3572668 | 4087257 | 7.983e+09 | 1 | 1 | 0 | 1 | 1468.18 | 1 | 1 | 0 | 0 |
| 2015 | Moldova | 586773 | 1087778 | 1674551 | 6.551e+09 | 1 | 1 | 0 | 1 | 1468.18 | 1 | 1 | 1 | 0 |
| 2011 | ran islamic rep | 94301438 | 2.170e+08 | 3.113e+08 | 5.920e+11 | 0 | 0 | 1 | 0 | 784.26 | 0 | 1 | 0 | 0 |
| 2012 | ran islamic rep | 94211602 | 2.195e+08 | 3.137e+08 | 5.872e+11 | 0 | 0 | 1 | 0 | 784.26 | 0 | 1 | 0 | 0 |
| 2013 | ran islamic rep | 85869686 | 1.876e+08 | 2.734e+08 | 5.116e+11 | 0 | 0 | 1 | 0 | 784.26 | 0 | 1 | 0 | 0 |
| 2014 | ran islamic rep | 83738362 | 2.064e+08 | 2.901e+08 | 4.253e+11 | 0 | 0 | 1 | 0 | 784.26 | 0 | 1 | 0 | 0 |
| 2015 | ran islamic rep | 77949338 | 1.983e+08 | 2.763e+08 | | 0 | 0 | 1 | 0 | 784.26 | 0 | 1 | 1 | 0 |

Appendix B

Table 4.Regression results for total imports.

| logIMPORT | RANDOM EFFECTS | FIXED EFFECTS | HECKMAN | RANDOM EFFECTS with IMR |
|--|----------------------------|---------------------------|-----------------------------|--------------------------------|
| <i>logDISTANCE</i> | -0.579* (-1.89) | 0 (.) | -0.721*** (-4.57) | -0.605* (-1.84) |
| <i>logGDP</i> | 1.239*** (13.40) | -0.0881 (-0.15) | 1.258*** (16.66) | 1.293*** (8.86) |
| <i>logGDPARM</i> | 1.491 (1.42) | 2.548** (2.21) | 1.519 (0.81) | 1.504 (1.45) |
| <i>BORDER</i> | 0.578 (0.42) | 0 (.) | 0.553 (0.81) | 0.536 (0.37) |
| <i>FTA</i> | -0.139 (-0.11) | 0 (.) | -0.269 (-0.44) | -0.175 (-0.13) |
| <i>LANGUAGE</i> | 1.299 (1.35) | 0 (.) | 1.321*** (2.72) | 1.385 (1.35) |
| <i>LANDLOCKED</i> | -0.144 (-0.32) | 0 (.) | -0.229 (-0.98) | -0.0956 (-0.20) |
| <i>EMBSY</i> | 2.046*** (4.20) | 0 (.) | 1.158*** (4.23) | 2.153*** (4.05) |
| <i>IMR</i> | | | -0.837 (-1.59) | 0.460 (0.55) |
| <i>_cons</i> | -48.82** (-2.00) | -43.60* (-1.79) | -47.76 (-1.10) | -50.45** (-2.08) |
| N | 728 | 728 | 984 | 727 |
| * significant at 10%; ** significant at 5%; *** significant at 1% t values are in parentheses | | | | |

Table 5. Regression results for total exports.

| logEXPORT | RANDOM EFFECTS | FIXED EFFECTS | HECKMAN | RANDOM EFFECTS with IMR |
|--|-----------------------------|--------------------------|-----------------------------|--------------------------------|
| <i>logDISTANCE</i> | -1.280*** (-2.70) | 0 (.) | -2.399*** (-5.72) | -2.200*** (-3.70) |
| <i>logGDP</i> | 0.971*** (5.81) | 0.695 (0.65) | 1.729*** (7.48) | 1.560*** (5.35) |
| <i>logGDPPARM</i> | 0.487 (0.26) | 0.999 (0.48) | -0.612 (-0.16) | 0.294 (0.16) |
| <i>BORDER</i> | 0.535 (0.29) | 0 (.) | 0.0116 (0.01) | -0.0820 (-0.05) |
| <i>FTA</i> | 0.382 (0.23) | 0 (.) | -0.192 (-0.17) | 0.0245 (0.02) |
| <i>LANGUAGE</i> | 2.950** (2.32) | 0 (.) | 4.467*** (4.41) | 4.136*** (3.16) |
| <i>LANDLOCKED</i> | 0.493 (0.64) | 0 (.) | 0.601 (1.14) | 0.584 (0.79) |
| <i>EMBSY</i> | 0.384 (0.52) | 0 (.) | 2.608*** (3.46) | 1.808** (1.98) |
| <i>IMR</i> | | | 4.872*** (4.65) | 3.313** (2.38) |
| <i>_cons</i> | -14.42 (-0.33) | -28.34 (-0.63) | -3.157 (-0.04) | -20.35 (-0.46) |
| N | 439 | 439 | 977 | 438 |
| * significant at 10%; ** significant at 5%; *** significant at 1% t values are in parentheses | | | | |

Table 6. Regression results for total trade.

| logTOTAL | RANDOM EFFECTS | HECKMAN | FIXED EFFECTS | FIXED EFFECTS with IMR |
|--|-----------------------|------------------|----------------------|-----------------------------------|
| <i>logDISTANCE</i> | -0.666** | -0.720*** | 0 | 0 |
| | (-2.16) | (-4.53) | (.) | (.) |
| <i>logGDP</i> | 1.201*** | 1.210*** | -0.295 | -0.249 |
| | (12.96) | (16.71) | (-0.50) | (-0.41) |
| <i>logGDPARM</i> | 0.308 | -0.448 | 1.614 | 1.444 |
| | (0.30) | (-0.24) | (1.42) | (1.28) |
| <i>BORDER</i> | 0.533 | 0.736 | 0 | 0 |
| | (0.39) | (1.06) | (.) | (.) |
| <i>FTA</i> | 0.665 | 0.509 | 0 | 0 |
| | (0.53) | (0.82) | (.) | (.) |
| <i>LANGUAGE</i> | 1.418 | 1.524*** | 0 | 0 |
| | (1.46) | (3.15) | (.) | (.) |
| <i>LANDLOCKED</i> | -0.145 | -0.199 | 0 | 0 |
| | (-0.32) | (-0.85) | (.) | (.) |
| <i>EMBSY</i> | 2.056*** | 1.407*** | 0 | 0 |
| | (4.23) | (5.26) | (.) | (.) |
| <i>IMR</i> | | -0.623 | | 1.212 |
| | | (-1.20) | | (0.58) |
| <i>_cons</i> | -19.52 | -1.110 | -16.65 | -14.17 |
| | (-0.81) | (-0.03) | (-0.70) | (-0.58) |
| <i>N</i> | 752 | 750 | 752 | 750 |
| * significant at 10%; ** significant at 5%; *** significant at 1% t values are in parentheses | | | | |

Table 7. Regression results with the variable AFTER*MEMBERS

| logIMPORT | RANDOM EFFECTS | HECKMAN | RANDOM EFFECTS with IMR |
|--|-----------------------|----------------------|--------------------------------|
| <i>logDISTANCE</i> | -0.572* (-1.88) | -0.715*** (-4.54) | -0.599* (-1.85) |
| <i>logGDP</i> | 1.246*** (13.57) | 1.272*** (16.69) | 1.306*** (8.99) |
| <i>logGDPPARM</i> | 1.417 (1.30) | 1.050 (0.54) | 1.445 (1.34) |
| <i>BORDER</i> | 0.521 (0.39) | 0.528 (0.78) | 0.471 (0.34) |
| <i>LANGUAGE</i> | 1.434* (1.76) | 1.427*** (3.40) | 1.535* (1.76) |
| <i>LANDLOCKED</i> | -0.124 (-0.28) | -0.203 (-0.87) | -0.0697 (-0.15) |
| <i>EMBSY</i> | 2.035*** (4.24) | 1.166*** (4.27) | 2.146*** (4.11) |
| <i>AFTER*MEMBERS</i> | -0.394 (-0.27) | -0.531 (-0.42) | -0.467 (-0.31) |
| <i>IMR</i> | | -0.768 (-1.45) | 0.499 (0.60) |
| <i>_cons</i> | -47.33* (-1.87) | -37.32 (-0.83) | -49.46** (-1.96) |
| <i>N</i> | 728 | 984 | 727 |
| * significant at 10%; ** significant at 5%; *** significant at 1% t values are in parentheses | | | |

Table 8.Regression results with the variable AFTER*MEMBERS.

| logEXPORT | RANDOM EFFECTS | HECKMAN | RANDOM EFFECTS with IMR |
|--|-----------------------------|-----------------------------|-----------------------------|
| <i>logDISTANCE</i> | -1.288*** (-2.71) | -2.412*** (-5.63) | -2.230*** (-3.73) |
| <i>logGDP</i> | 0.975*** (5.77) | 1.756*** (7.32) | 1.592*** (5.33) |
| <i>logGDPPARM</i> | 1.121 (0.58) | -0.00852 (-0.00) | 1.012 (0.52) |
| <i>BORDER</i> | 0.430 (0.23) | -0.0226 (-0.02) | -0.209 (-0.12) |
| <i>LANGUAGE</i> | 3.047*** (3.67) | 4.610*** (4.84) | 4.301*** (2.77) |
| <i>LANDLOCKED</i> | 0.507 (0.65) | 0.644 (1.20) | 0.624 (0.84) |
| <i>EMBSY</i> | 0.366 (0.49) | 2.646*** (3.43) | 1.831** (1.99) |
| <i>AFTER*MEMBE</i> | | | |
| <i>RS</i> | 0.434 (0.22) | -0.352 (-0.15) | -0.107 (-0.06) |
| <i>IMR</i> | | 4.972*** (4.61) | 3.426** (2.43) |
| <i>_cons</i> | -29.13 (-0.65) | -17.85 (-0.19) | -37.68 (-0.83) |
| <i>N</i> | 439 | 977 | 438 |
| *significant at 10%; ** significant at 5%; *** significant at 1% t values are in parentheses. | | | |

Table 9. Results of the probit models for import, export and total trade.

| PROBIT | IMPORT | EXPORT | TOTAL |
|---|------------------|------------------|------------------|
| | | | |
| <i>logGDP</i> | 0.272*** | 0.335*** | 0.284*** |
| | (8.05) | (9.98) | (8.05) |
| <i>logDISTANCE</i> | -0.0718 | -0.654*** | -0.196* |
| | (-0.69) | (-7.21) | (-1.76) |
| <i>WTO</i> | 0.769*** | 0.775*** | 0.775*** |
| | (6.15) | (5.03) | (6.04) |
| <i>LANGUAGE</i> | 0.871** | 0.922*** | 0.491 |
| | (2.20) | (3.48) | (1.24) |
| <i>EMBSY</i> | 0.959*** | 0.754*** | 0.987*** |
| | (5.49) | (5.90) | (5.10) |
| <i>_cons</i> | -5.942*** | -3.734*** | -5.000*** |
| | (-4.57) | (-3.58) | (-3.64) |
| N | 989 | 987 | 989 |
| * significant at 10%; ** significant at 5%; *** significant at 1% t values are in parentheses. | | | |

Appendix C

Note. Below are the Stata outputs of Houseman tests for the presence of fixed and random effects for import, export and total trade. The null hypothesis is that the unique errors are not correlated with the regressors. If the null hypothesis is not true, random effects model should be used. The tests results show that there are random effects present in the two of the three cases (If Prob>chi2 is > 0.05 (i.e. insignificant) use random effects).

| IMPORT | Fixed | Random | Difference | S.E. |
|--|--------------|---------------|-------------------|-------------|
| logGDP | -.0880522 | 1.232479 | -1.320531 | .5868999 |
| logGDPARM | 2.548021 | 1.491857 | 1.056164 | .4994255 |
| Test: Ho: difference in coefficients not systematic | | | | |
| chi2(2) = 5.23 | | | | |
| Prob>chi2 = 0.0731 | | | | |

| EXPORT | Fixed | Random | Difference | S.E. |
|--|--------------|---------------|-------------------|-------------|
| logGDP | .695415 | .9712031 | -.2757882 | 1.061722 |
| logGDPARM | .9989612 | .4826001 | .5163611 | .8243423 |
| Test: Ho: difference in coefficients not systematic | | | | |
| chi2(2) = 1.26 | | | | |
| Prob>chi2 = 0.5316 | | | | |

| TOTAL | Fixed | Random | Difference | S.E. |
|--|--------------|---------------|-------------------|-------------|
| logGDP | -.2947351 | 1.197952 | -1.492687 | .586861 |
| logGDPARM | 1.614025 | .3140191 | 1.300006 | .4959706 |
| Test: Ho: difference in coefficients not systematic | | | | |
| chi2(2) = 7.03 | | | | |
| Prob>chi2 = 0.0298 | | | | |

Note. Below are the results of the calculated correlations between MEMBERS, FTA and LANGUAGE. The correlations between the other variables are very low. Next, the results of the collinearity test between FTA and LANGUAGE are displayed. The VIF value of 1.94 indicates that there will be no collinearity issue in the regressions, since the critical value after which collinearity is a potential threat is 5.

| Correlation | MEMBERS | FTA | LANGUAGE |
|--------------------|----------------|---------------|-----------------|
| <i>MEMBERS</i> | <i>1.0000</i> | | |
| <i>FTA</i> | <i>0.5573</i> | <i>1.0000</i> | |
| <i>LANGUAGE</i> | <i>0.5226</i> | <i>0.6960</i> | <i>1.0000</i> |

| Variable | VIF | SQRT.VIF | Tolerance | R-Squared |
|-----------------|-------------|-----------------|------------------|------------------|
| <i>FTA</i> | <i>1.94</i> | <i>1.39</i> | <i>0.5156</i> | <i>0.4844</i> |
| <i>LANGUAGE</i> | <i>1.94</i> | <i>1.39</i> | <i>0.5156</i> | <i>0.4844</i> |
| <i>Mean VIF</i> | <i>1.94</i> | | | |