EFFECTIVENESS OF THE DEEP AND COMPREHENSIVE FREE TRADE AREA: A STRUCTURAL GRAVITY MODEL APPROACH

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ABSTRACT

Based on the gravity model of international trade, this article examines the ex-post impact of the Deep and Comprehensive Free Trade Area (DCFTA) on integration between Georgia, Moldova, and Ukraine with the European Union. We evaluate the welfare outcome of trade creation and trade diversion effects, compare the results of individual countries and identify differences between them. Additionally, the article evaluates the general effectiveness of the DCFTA as an instrument for trade integration. According to the structural gravity model estimations, as a result of the DCFTA, EU-Georgia trade increased by approximately 18%. In the case of EU-Moldova trade, the DCFTA impact is statistically less significant, around 9%. While DCFTA in Ukraine has a negligible effect on trade with European Union. The agreement brings welfare gains only in the case of Georgia. Generally, the average impact of the DCFTA on trade with the EU is positive but statistically insignificant for the region. The results are very different for each country.

Keywords: deep and Comprehensive Free Trade Area (DCFTA); gravity model; international trade; Eastern Partnership; European Union

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INTRODUCTION

The Association Agreements, including the Deep and Comprehensive Free Trade Areas (DCFTAs) with the EU, was one of the most significant trade policy advancements for Georgia, Moldova, and Ukraine. Considering the importance of the acquired access to the European Union Market for Eastern Partnership (EaP) Countries, this study aims to evaluate DCFTA's ex-post impact on trade and welfare gains regarding trade creation and diversion effects. The Paper explores the main differences between the outcome of the agreement in individual countries and the general effectiveness of DCFTA in the region.

Through the investigation of the existing literature, we can observe that several studies have been conducted to analyze associated countries' trade developments in the context of DCFTA. This research can be divided into two main groups. The first group of studies assessed the broader economic and social impact of DCFTA on all three or groups of two countries together. For example, Akhvlediani et al. (2021), Chkhikvadze, Groza, and Litra (2021), Eteria (2020), and Adarov and Havlik (2016&2017) evaluated association agreement and DCFTA implementation progress and its effectiveness in Georgia, Moldova, and Ukraine.

Another group consists of studies conducted separately for every country and focuses on the impact of DCFTA mainly on trade, using an

assessment of trade flows between the parties. This direction includes the works of Hellyer (2021), Matuszak (2019), Rabinovych (2022), Nekhay, Delgado, and Cardenete (2021), Eteria (2019&2020), Tomșa and Trofim (2021), Covaș and Crudu (2016). In addition, two studies used the gravity model to evaluate trade developments, the PMC research publication Economic Analysis of Georgia's Free Trade Agreements with EU and China (2020) and Hellyer's article on the trade development of Ukraine under the DCFTA (2019).

Although the existing studies provide significant results, which help to understand the main benefits and challenges of DCFTA, little research has been conducted on the general effectiveness in the regional context. To our knowledge, none of the empirical research has applied the theoretical gravity model on all associated countries to analyze the impact of DCFTA, nor compared results of individual countries and assessed the overall effectiveness of this agreement.

Furthermore, the studies that included the application of the gravity estimations mainly focus on the trade between the countries and the EU without inclusion of the trade diversion variable in the model. Therefore, little is known about trade creation and diversion effects of the agreement.

Considering the limitation identified in the literature, the lack of a unified assessment and comparative analysis of all associated countries with the theoretically developed methodology, the Paper applies a well-known structural gravity model for econometric evaluation of the dependence of EaP countries' trade flows on DCFTA.

To explore ex-post impact of DCFTA, we analyze data for 17 years, from 2004 to 2020, on trade flows between Georgia, Moldova, Ukraine, EU countries, and their main trade partners. The explanatory variables used in the model are economic size (GDP), the distance between trading partners, and historical, geographical, and cultural connections. To evaluate the welfare gains of the agreements, we include two variables that cover the assessment of trade creation and trade diversion effects. Based on the estimation of the gravity model, we will compare the results of the individual countries and identify main differences, as well as assess the overall effectiveness of DCFTA as a trade policy instrument.

The study contributes to the development of the literature by establishing a new estimation model and initial empirical results for the ex-post impact of DCFTA on trade between the EU and Associated countries. This research departs from the existing literature by introducing the structural gravity model in estimating the DCFTA effectiveness.

LITERATURE REVIEW

The rapid process of globalization and trade liberalization ignited the interest of economists to evaluate Free Trade Agreements (FTA) effectiveness and impact on trade. Despite the consensus in favor of free trade and its benefits, in his works, Dani Rodrik discusses the changing nature of Free Trade Agreements and the distributional impact that it has on different parties. Recent agreements aren't simply about eliminating restrictions on trade, such as import tariffs and quotas. They include domestic harmonization of the regulatory standards, patents, health and safety rules, investment policies, and many other directions. According to the author, such agreements may result in mutually beneficial trade or produce welfare-reducing and purely redistributive outcomes. New features of FTAs make it harder to assess their economic consequences with the traditional economic theories (Rodrik, 2018, p.74-76). Due to this transformation, much research has been dedicated to estimating the recent FTA's economic impact and effectiveness.

In their study, Caliendo and Parro defined the trade and welfare effects of the North American Free Trade Agreement (NAFTA). Following their results, for Mexico and Canada, welfare gains from trade creation are 1.80% and 0.08%, while the welfare losses from trade diversion with the rest of the world are 0.08% and 0.04% (Caliendo & Parro, 2015, p.3). The study demonstrates relatively modest results on NAFTA's effectiveness.

Another major study by Baier, Yotov, and Zylkin evaluates the empirical determinants of the ex-post impact of FTAs. Their database contains 908 estimates of FTA impact on trading pairs for 1986-2006. According to the results, not all the agreement-specific effects are positive and significant. Approximately 35% of the agreements are statistically insignificant, 8%

exhibit negative and significant impact, and the majority, 57%, have a positive and statistically significant impact on trade (Baier, Yotov, and Zylkin, 2019, pp.18-20). The evidence from the literature suggests that the FTAs have very heterogeneous effects on trade. They have a positive or modest impact in some cases; in others, countries gain nothing from them.

The following part of this article provides a literature review on theoretical development and methodology of the gravity model, as well as the assessments related to Georgia's, Moldova's, and Ukraine's trade with the EU.

For almost 50 years, international trade scholars and policy researchers have actively used the gravity model for trade policy analysis. In the beginning, it was based on intuitive empirical methods, but over the years, they have developed a theoretical foundation for the model. The Dutch Economist Tinbergen (1962) developed and empirically used an equation that is similar to Newton's law of universal gravitation to evaluate trade intensity between the countries. The gravity model's power in explaining bilateral trade flows prompted the search for a theoretical foundation, and in 1979, we see the first author to provide a theoretical basis for the model. Anderson (1979) incorporated the assumptions of product differentiation by place of origin (the so-called Armington Assumption) and Constant Elasticity of Substitution (CES) expenditures. Afterwards, Bergstrand (1990) added to the theoretical foundation by including the presence of both the demand and supply sides of an economy.

Moving into the 2000's, we see the growth of interest included into the theoretical gravity model. Many authors have used the model to quantify the effects of multiple variables on international trade. In this direction, there have been many important additions by many authors, such as, Anderson and Van Wincoop (2003), Silva and Tenreyro (2006), Baier and Bergstrand (2007), Head and Mayer (2015), Fally (2015), Olivero and Yotov (2012), Yotov, Piermartini, Monteiro and Larch (2016) and others. One particularly special work to note, is Anderson and Van Wincoop (2003), where they introduced a structural gravity model that considers multilateral resistance terms. This model separately incorporates bilateral trade costs, as well as exporters and importers trade costs towards other partners.

The development of the theory-based gravity model requires the inclusion of the Multilateral Trade Resistance Term (MRT). MRT's are not directly observable and therefore, many different authors have proposed various ways to specify and estimate the theoretical gravity equation. The selection of theory consistent estimators for the gravity model was the main focus of Head and Mayer's (2014) work. The authors summarized several model setups under the structural gravity equation and compared the performance of different estimation methods. For example, they used exporter and importer specific fixed effects and various trade cost variables. In the following year, Fally (2015) also evaluated theoretically consistent estimation methods of the gravity model by comparing the use of 'multilateral resistance' indexes, with the use of simple exporter and importer fixed effects. His study showed that estimating gravity equations using the Poisson Pseudo-Maximum-Likelihood Estimator (PPML) with fixed effects was consistent with the introduction of 'Multilateral Trade Resistance'. Earlier works by Silva and Tenreyro (2006) focused on the theoretical gravity model and found that log linearized models, estimated by OLS, lead to biased estimates of elasticity, related to heteroscedasticity. The authors go on to explain in detail the reasons for this problem and then propose an appropriate estimation method with PPML.

With the development of the theoretical gravity model, researchers expanded the scope of the model and covered the direction of the effectiveness for free trade agreements. For example, Baier and Bergstrand (2007), Caporale, Rault, Sova, R. and Sova, A.(2009), Dai, Yotov and Zylkin (2014), Yang and Martinez-Zarzoso (2014), Baier, Yotov and Zylkin (2019) as well as others studied the impacts of free trade agreements on trade, and some of them also included trade creation and trade diversion effects on economic integration into their research. Overall, the studies indicate the positive impact of FTA's on trade flows between the parties in the agreements, and the trade diversion impacts on the other partners. Baier and Bergstrand (2007) analyzed the influence of FTA's on bilateral trade for 96 countries spanning the years between 1960 and 2000. Authors concluded that on average, the two member countries bilateral trade will double in size after ten years. As mentioned above, despite the

positive results of the different studies, there is still no established consensus in literature about the positive impacts of FTA's on trade.

Considering the purpose of the study, the following part provides a literature review on the assessment of the effectiveness of the DCFTA in the Associated trio. In case of Georgia's DCFTA, the gravity model is used only in the PMC research paper 'Economic Analysis of Georgia's Free Trade Agreements with EU and China'. Research results indicated that after five years, the DCFTA's impact on trade wasn't economically significant (Mgebrishvili, 2020). In addition, Hellyer evaluated Ukraine's trade performance and used the gravity model to compare the ex-post impact of DCFTA with the expected indicators of ex-ante models. According to the study results, from 2015-2018, the actual performance of Ukraine's exports to the EU under the DCFTA is, on average, 15% lower than expected (Hellyer, 2019, p.28). Diavor's (2021) article is the only one to our knowledge that examined the foreign trade of Moldova, based on a gravity model. His analysis showed that free trade agreements have a positive and significant impact on Moldova's foreign trade.

Another noteworthy work in this direction come from the Paper, 'Free Trade Agreements, Institutions and the Exports of Eastern Partnership Countries'. The authors estimated the effects of free trade agreements on EaP countries. In comparison with other studies, the main findings showed that the countries gain significantly from FTA's with the EU, and improvements in the institutions play an important role in developing their exports (Gylfason, Martínez-Zarzoso, I., & Wijkman, 2015). As already stated, none of the studies present a comparative analysis of DCFTA's ex-post effectiveness in all three associated countries based on the theoretical gravity model. Additionally, neither study incorporates trade creation and the trade diversion effects of the agreement into the gravity model.

DATA AND METHODOLOGY

Theoretical Framework

In applying the well-known gravity model, as a theoretical framework, we can investigate the effects of the DCFTA on trade flows between the countries. This Paper shares an analytical approach that was developed by Anderson and Van Wincoop (2003) and considers relative trade costs. According to the model, the tendency of one country to trade with another is determined by the countries' trade costs between each other, relative to their overall import 'resistance' (weighted average trade costs) and the average 'resistance' facing exporters in another country, not only by the absolute trade costs between them. Multilateral resistance is measured with remoteness factors, such as physical distance from large markets, high tariff barriers, and other trade costs (Bacchetta et al., 2012, pp.104-105).

In its general formula, the structural gravity model is as follows:

$$X_{ij} = \frac{Y_i Y_j}{Y}\left[\frac{t_{ij}}{\Pi_i P_j}\right]^{1-\sigma} \quad (1)$$

In this equation, Y represents world GDP, Y_i and Y_j are the Country's GDP, t_{ij} denotes trade cost, $\sigma > 1$ is the elasticity of substitution, and Π_i and P_j represent exporters' and importers' outward and inward multilateral resistance terms.

Considering the numerous applications for the gravity model and the development of theoretical gravity literature, the estimate for the relevant equation in this study should be based on the reflection of several challenges and best practices related to them:

The main problem with the structural gravity model is that multilateral resistance indicators are not directly observable. There are several alternative ways to construct MRT's, with the most common and widely practiced methods being country fixed effects for importers and exporters. These country dummies are binary (0, 1) variables that will capture all the country-specific characteristics and control for a country's overall level of imports/exports (Bacchetta et a., 2012, pp. 105-107). We use country-specific (importer and exporter) and time-fixed effects, for proper control of the terms.

An important issue to consider is the welfare benefits of FTA's. Viner (1950) stated that the impact of FTA's can be divided into trade creation and trade diversion effects. Trade creation encourages the development of new trade and the replacement of unprofitable domestic production by imports from FTA partners, and thus is economically beneficial. Trade diversion leads to the increase of imports from FTA partners, through the replacement of cheap imports from other countries. To integrate both effects into the estimate, we must introduce two dummy DCFTA variables. A positive coefficient

on both represents the positive impact of an FTA on trade creation, and a positive coefficient on the first dummy variable, and a negative on the second indicates trade diversion (Bacchetta et al., 2012, p. 109).

Another noteworthy challenge is related to the traditional log-linear approach. When zero trade flows are dropped from the model, it causes a selection and estimation bias. Also, heteroscedasticity is typical for trade data, which in turn creates a trade costs estimation bias and is inconsistent with the log-linear form of the gravity model. The most convenient and recognized solution to this challenge is estimation with the multiplicative equation and the application of the Poisson Pseudo Maximum Likelihood (PPML) Estimator (Yotov et al., 2016, pp. 19-20). Considering the accuracy of the multiplicative methods compared to log-linear models, the estimations in the study are based on the PPML estimator.

Some authors criticize the use of trade data over consecutive years. The trade flow response to policy changes are not instantaneous, and adjustment needs some time. Therefore, it is better to use panel data with intervals. Recent studies use 3 to 5-year intervals to produce more accurate estimates of the trade costs (Olivero and Yotov, 2012; Yotov et al., 2016, pp. 22-23). Despite this recommendation, we are still going to use data over consecutive years. The short period, only 7 years of DCFTA, is not enough to use intervals in estimation. However, for the sensitivity analyses, we will be using 2-year interval trade data.

One last point of consideration is the FTA-endogeneity bias. Trade agreements may be correlated with unobservable trade costs or with the previous partnership and the level of economic integration. Baier and Bergstrand (2007) propose applying the country-pair fixed effects to account for the unobservable links. Considering, that the set of country-pair fixed effects absorbs all bilateral time-invariant variables, we modeled separate estimations with and without them.

Estimation Model

Our study aims to address these challenges in the gravity model. Considering the previously mentioned recommendations, we will use the structural gravity model, consecutive panel data, importer and exporters, time, and pair fixed effects, and the PPML estimator. At the same time, as a robustness check, the gravity model will be estimated by applying the intuitive gravity model and the 2-year interval panel data.

As a result, we have developed the following gravity equation to quantify the effects of the DCFTA on Georgia's and Moldova's trade:

$$X_{ijt} = exp[a_1 t_{ijt} + a_2 DCFTA_{ijt} + a_3 OneinDCFTA_{ijt} + a_4 Y_i + a_5 Y_j + \pi_i + \chi_j + \mu_{ij} + \gamma_t] + \varepsilon_{ijt} \quad (2)$$

X_{ijt} denotes bilateral trade flow from country i to j at year t. t_{ijt} are trade costs. The DCFTA is a dummy variable for the 'trade creation' that takes a value of 1 if i and j are both members of the DCFTA at time t and 0 Otherwise, another dummy variable OneinDCFTA for the 'trade diversion' takes a value of 1 if only one country belongs to the DCFTA, and 0 in the other cases. Y_i and Y_j are exporter's and importer's GDP (GDP_E and GDP_I). The variables π_i and χ_j denote the set of country-specific dummies, which control for the outward and inward multilateral resistances, as well as the other factors that may influence bilateral trade. Lastly, μ_{ij} denotes the set of country-pair fixed effects and γ_t time effects.

t_{ijt} are trade costs and consists of several variables:

$$t_{ijt} = distw_{ij}^{\delta} * \exp[\delta_2 contig_{ij} + \delta_4 colony_{ij} + \delta_5 smctry_{ij} + \delta_6 Form\_USSR_{ij}] \quad (3)$$

$distw^{\delta I}$ is distance between the biggest cities of the countries being weighted by the share of the city in the overall country's population (Mayer & Zignago, 2011, p.11). *Contig, colony, smctry, and the form_USSR,* all make up the dummy variables, respectively denoting whether or not the two countries have a common border, a colonial relationship (have had a common colonizer after 1945 or have ever had a colonial link), or were part of the same country or the Soviet Union.

Additionally, the introduction of the dummy variable on the former members of the Soviet Union is the result of the geographical orientation of the markets and the historical economic connection between post-soviet countries, which probably significantly determines trade flows of the respective countries.

Data

The model is estimated based on a dataset that includes 41 countries over the period spanning from 2004 to 2020. Among the countries used in the study are Georgia, Moldova, Ukraine, European Union, EFTA countries, other EaP countries and the main trading partners of associated countries (China, Russia, Turkey, UK, US,). The data on the bilateral trade values (in million USD) is obtained from the Direction of Trade Statistics IMF Database. In 2020, the sample of the countries selected for the study accounted for the main portions of Georgia's, Moldova's, and Ukraine's international trade. The total shares for the selected countries are:

- Georgia – 87% of exports, 86% of imports;
- Moldova - 86% of exports, 91% of imports.
- Ukraine - 71% of exports, 86% of imports (IMF, 2021).

The data on distance, common borders, and colonial ties are obtained from the CEPII geographical dataset, Geodist. Information for the GDP (current, USD) of the countries is derived from the World Bank's World Development Indicators.

DCFTA in Georgia and Moldova has been provisionally applied since 2014, While DCFTA in Ukraine entered provisionally into force in 2016. Accordingly, the impact of DCFTA in Georgia and Moldova is analyzed from 2014, while in the case of Ukraine from 2016. We created a panel dataset using countries' bilateral trade flows (exports and imports) from 2004 to 2020. The final dataset contains 4080 observations.

EMPIRICAL RESULTS AND DISCUSSION

Effects of DCFTA on Georgia's Trade Flows

The results of the gravity equation on Georgia are reported in Table 1. We examine several additional specifications for checking the robustness of our results. Column 1 is for the structural gravity model with the sets of exporter, importer, time, and country-pair fixed effects estimated using the PPML method. For comparison, column 2 is a fixed-effects estimate of the dataset with 2-year intervals. To demonstrate the consequences of disregarding the MRT indicator, in column 3, we used the traditional intuitive gravity model without fixed-effects estimates.

Table 1. Estimated impacts of the DCFTA on Georgia's trade

Variables	PPML FE	PPML (2-year intervals)	PPML (baseline)
Distance	-0.556	-1.532***	-1.359***
DCFTA	0.166**	0.172*	-0.000938
OneinDCFTA	0.220**	0.225*	0.247**
Contig	1.473	-0.629	0.987***
Smctry	0.952	0.392	-1.005***
form_USSR	1.235***	-3.051***	1.485***
GDP_E	0.498***	0.467***	0.932***
GDP_I	0.714*	0.745*	0.629***
Observation	1,360	710	1,360
R-squared	0.95	0.95	0.85
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Source: Author's calculations, STATA.

According to the results of the structural gravity model presented in Table 1, as expected, the coefficient on distance is negative, but statistically not significant. Also, the Countries' GDP plays an important positive role in trade development. The GDP of exporters is statistically more significant at the 1% level.

The Impact of Common borders and historical ties are positive but statistically insignificant, while the common past with the Soviet Union has a significantly positive impact on trade between the countries. The variable colony was dropped from regression to ensure that estimates exist. PPML estimator automatically identifies the existence of data that do not

convey relevant information for the estimation process and can be discarded. In the case of Georgia, the estimator dropped colonial past shared only with Russia .

The main interest of the study, is the impact of the DCFTA. The coefficients of dummy variables show that it has a positive and statistically significant (at a 5% level) impact on trade. At the same time, the positive sign of the OneinDCFTA variable is suggestive of the agreement's trade creation effect. The coefficients of the DCFTA dummy are estimated though to raise trade between the countries by 18% (exp (0.166)-1).

Finally, the results from the other two estimate methods are slightly different. DCFTA and its impact on trade creation are still positive, but statistically less significant in the model with the 2-year intervals. In the case of the intuitive model, the coefficient is small and non-important. Some variables though have different signs. For example, according to the estimates from the 2-year intervals model, having a common border and common past with the Soviet Union negatively impacts trade between the countries. Other estimations are very close to the first model estimates.

In summary, all coefficients in the structural gravity model have expected signs, but for the chosen country samples, distance is not a very critical determinant of trade between them, as well as the other dummy variables, such as historical ties, and common borders also have statistically not significant indicators.

Effects of DCFTA on Moldova's trade flows

Table 2. Estimated impacts of DCFTA on Moldova's trade

Variables	PPML FE	PPML (2-year intervals)	PPML (baseline)
Distance	-1.244***	-1.172***	-1.436***
DCFTA	0.0889*	0.0720	-0.240***
OneinDCFTA	-0.317***	-0.326***	-0.203
Contig	0.841***	0.920***	0.306
Colony	-3.981***	-1.430***	-0.415
form_USSR	1.805***	-0.756	1.685***
GDP_E	0.633***	0.614***	0.959***
GDP_I	0.500***	0.524***	0.776***
Observations	1,341	710	1,360
R-squared	0.96	0.96	0.79
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Source: author's calculations, STATA

According to the results of the gravity model presented in the table 2, in the case of Moldova, as expected, distance with a negative sign, and GDP with a positive sign, have a statistically significant impact on trade relations. Dummies for common borders and former members of the Soviet Union are also positively correlated with trade. At the same time, former colonial ties, though having a negative sign, have no significant impact on the determination of trade relations between the parties.

Considering that the PPML estimator identifies the existence of data that do not convey relevant information for the estimation process and can be discarded, the dummy variable *smctry* is automatically dropped from the estimation model. In the dataset, no countries were or are the same state or administrative entity as Moldova for a long enough period (Mayer & Zignago, 2011, p.12).

According to the structural gravity model, the coefficients for the dummies on trade creation and diversion impacts on the DCFTA have different signs and are suggestive of the agreement's trade diversion effect. Overall, the DCFTA has a positive and at a 10% level significant impact on the development of trade with the European Union, but at the same time, also has a statistically significant (at a 1% level) negative effect on trade with other countries. According to the results of the theoretical gravity

model, the DCFTA has raised trade between the countries by 9.2% (exp (0.0889)-1).

Compared with other estimations, the results from the model with 2-year intervals have a very similar outcome. The signs of all coefficients are corresponding, and the value of the DCFTA dummies are almost the same, which indicates the accuracy of the model. At the same time though, the different results of the intuitive gravity demonstrate the necessity to use a theoretical approach.

Effects of DCFTA on Ukraine's Trade Flows

The results of the gravity model estimation for DCFTA's impact on Ukraine's trade are presented in Table 3. According to the structural gravity estimations, the distance between the countries has a statistically significant and negative impact on trade. In comparison, the importer's and exporter's GDP has a positive and significant effect on trade development.

The only negative coefficient from historical and cultural variables is recorded for the former colonial relationship dummy. Other variables have positively affected trade between the countries, with the former USSR membership being the statistically most significant determinant.

Table 3. Estimated impacts of the DCFTA on Ukraine's trade

Variables	PPML FE	PPML (2-year intervals)	PPML (baseline)
Distance	-1.369**	-1.518**	-0.804**
DCFTA	-0.478	-0.407	-0.0204
OneinDCFTA	-1.018*	-0.944*	-0.261
Contig	0.139	-0.00597	0.967***
Colony	-0.584***	-0.544***	-0.606***
Smctry	0.301**	0.310**	-0.213
form_USSR	2.723***	2.795***	1.739***
GDP_E	0.729***	0.746***	0.857***
GDP_I	0.888***	0.958***	0.677***
Observation	1,360	720	1,360
R-squared	0.94	0.93	0.83
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Source: Author's calculations, STATA.

It is noteworthy that in the case of Ukraine DCFTA effect is different from other countries. As shown in the results, DCFTA didn't significantly impact trade between the parties. The negative sign of the dummy variable indicates the negative contribution to trade flows across the parties of the agreement (38% decrease (exp (-0.478)-1)). But due to the high indicator of robust standard errors, in the case of Ukraine, DCFTA doesn't qualify to be a determinant of trade between the parties. At the same time, the negative coefficient of the trade diversion dummy suggests a decrease in Ukraine's trade flows with other trade partners.

The results from the other two estimate methods are very similar to the structural model. Thus, the most irregular result of the negative coefficient of DCFTA impact on trade creation and trade diversion dummies have corresponding negative coefficients.

Comparison of the Results

The evidence of gravity estimation for the three countries shows that the DCFTA positively impacts trade with the European Union in the case of Georgia and Moldova. Still, at the same time, it hasn't determined Ukraine's trade flows. Additionally, DCFTA has a heterogeneous impact on trade diversion in selected countries. Table 4 compares the empirical results for the models of Georgia, Moldova, Ukraine, and these countries together.

As expected, all estimates reveal that distance has a negative impact on bilateral trade and that the level of GDP for importer and exporter countries has a statistically significant positive

effect. The coefficients for other variables also have similar values.

Table 4. Comparison of the results

Variable	Georgia (ppml FE)	Moldova (ppml FE)	Ukraine (ppml FE)	Associated trio (ppml FE)
Distance	-0.556	-1.244***	-1.369**	-1.471***
DCFTA	0.166**	0.0889*	-0.478	0.288
OneinDCFTA	0.220**	-0.317***	-1.018*	-0.213**
Contig	1.473	0.841***	0.139	0.732**
Smctry	0.952	-	0.301**	-0.291
Colony	-	-3.981***	-0.584***	-0.731***
form_USSR	1.235***	1.805***	2.723***	2.276
GDP_E	0.498***	0.633***	0.729***	0.721***
GDP_I	0.714*	0.500***	0.888***	0.879***
R-squared	0.95	0.96	0.94	0.94
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Source: author's calculations, STATA

Seeing the primary interest of this study, we mainly focused on assessing the DCFTA's impact on trade diversion and creation. It is noteworthy that Georgia's and Moldova's DCFTA have a positive but small impact on the development of trade with the European Union, while in the case of the Ukraine agreement has no statistically significant impact on trade flows with the EU.

Compared with Moldova, Georgia's DCFTA is more beneficial for the country. If we look at the years following 2014, due to the agreements, Georgia's trade with the EU increased approximately by 18%, which is two times more than Moldova's trade with the EU (9% increase.) Therefore, as mentioned previously, Georgia's DCFTA positively impacts trade creation, while in Moldova, the agreement negatively affected trade with other countries and, therefore, has a trade diversion effect. The negative and statistically less significant coefficients of variables for the trade creation and trade diversion in Ukraine indicate that in terms of welfare gains, DCFTA is an unproductive instrument.

Overall, all coefficients except for the DCFTA dummy have expected signs, but for the chosen country samples, distance is not a very critical determinant of trade. The other dummy variables, such as historical ties and common borders, have positive but statistically less significant coefficients.

Unlike other FTA's the Deep and Comprehensive Free Trade Area covers elimination of both tariff and non-tariff barriers and regulates a wide range of trade-related issues. Additionally, the agreement purports to approximate trade regulatory legislation and institutions with relevant European Union standards. Therefore, DCFTA gives the countries' economies an incentive to grow and develop (Silagadze & Zubiashvili, 2015, p.443). At the same time, considering that DCFTA covers the gradual introduction of the expected standards of the EU, it will take a long time to build a competitive market at the European level and in associated countries, it cannot happen in the medium term (Silagadze & Zubiashvili, 2016, p.539). That is why the effect of DCFTA after the 7 years is still limited and small-scale. In addition, the different impacts on Moldova and Ukraine can partly be explained by the redirection of trade flows from CIS countries and the development of trade relations with the European Union before the DCFTA.

At the regional level, by reviewing the estimates of all countries together, despite the positive coefficient, DCFTA has a favorable (33% increase) but insignificant impact on trade between the European Union and the three eastern partner countries. On an aggregate level, DCFTA tends to bring welfare loss to trade with non-member countries.

To sum up, our findings align with the challenges identified in the literature on FTA effectiveness. The study once again confirms the necessity to consider the changing nature of the Free trade agreements and their disparate impact on the trade development between the parties.

DISCUSSIONS

Contributions

This article has two main directions of contribution. Empirically, we investigate DCFTA effectiveness in associated trio with the theoretical approach that wasn't used in this direction before. The literature so far examined the general effects of DCFTA in the region or focused on individual countries. We develop the gravity model for the associated countries to assess general effectiveness of the agreement and identify the differences between the countries to enrich the literature on the topic.

In addition, we argue that for the proper estimation of the DCFTA's impact on trade, it is necessary to include trade diversion and creation variables into the model. Consideration of Georgia's, Moldova's, and Ukraine's trade with other countries provides more precise results on the impact of DCFTA. Therefore, we contribute to the development of the literature through an investigation of the issues with the methodology that wasn't used in this case before.

Second, we enrich the theoretical gravity model by providing a comparison of the results of the structural and intuitive estimation methods. We use recently developed model with consideration of the main challenges identified in the literature. Theoretically, we argue that for sound results, the model should be based on PPML estimator instead of log-linear methods, importer and exporter fixed and time effects, as well as trade creation and trade diversion dummy variables. Finally, we also make one small methodological contribution. We introduce new variable that considers membership of the countries in the Soviet Union and its impact on trade. Based on the comparison of the results, we demonstrate the importance of structural gravity estimation and the challenges associated with the intuitive model.

In conclusion, main contribution of the Paper is the provision of the new theoretical and methodological approach to studying the effectiveness of DCFTA on a regional level.

Limitations of the Research

The short period after the enactment of DCFTA is the main limitation of the study. According to the existing literature on FTAs, on average, it takes ten years for an agreement to have its impact on trade. Therefore, estimation of the DCFTA impact only after seven years is less precise. Additional studies should be conducted in the medium and long term for more accurate results.

Another Limitation of the research is related to the use of aggregate data for assessing FTAs' effectiveness. A sectoral analysis should be integrated into the model for more advanced modeling.

Future Research

Our study leaves several questions for future research, which include: The need for medium- and long-term assessments (10-15 years); Investigation of the causes of the differences between the effectiveness of DCFTA in individual countries, Discussion of the overall effectiveness of DCFTA in comparison with other FTA's; Evaluation of the DCFTA's impact on the sectoral level; and Identification of the most successful and prospective directions.

CONCLUSION AND RECOMMENDATION

This Paper empirically examines the ex-post impact of free trade agreements, focusing on trade creation and diversion effects, by applying the structural gravity model of international trade with current methodological improvements. The research objectives were to provide a quantitative assessment of the effectiveness of the DCFTA in the region while comparing the results of the evaluated countries and identifying their differences.

In conclusion, our study has demonstrated that Georgia's trade with the European Union is positively affected by the DCFTA. In the case of Moldova, the DCFTA has a positive, but not very significant, impact on trade among its members. We observed an 18% increase in EU-Georgian trade caused by the DCFTA and an approximately 9% increase in EU-Moldovan trade. It is also important to note that the relatively low impact on both countries is caused by a long implementation period of trade liberalization procedures.

Compared with other countries, Ukraine's DCFTA has not had sufficient impact to be a determinant of trade with the European Union. Although the negative coefficients suggest a lower level of trade flows considering previous dynamics. Different results for Ukraine can be partly explained by the fact that the Paper evaluates only four years of DCFTA in Ukraine.

Other interesting findings were revealed concerning the DCFTA's impact on trade with countries outside of the EU. The effectiveness of agreements on extra-bloc trade is different between the countries. Only the DCFTA in Georgia showed evidence of trade creation. Whereas in contrast, trade diversion effects are shown in two other countries.

Overall, our findings suggest that, on average, trade performance between the three associated countries with the European Union has improved, but the effects are rather modest. Furthermore, our results indicate heterogeneous impacts of the DCFTA in Georgia, Moldova, and Ukraine. First, the level of DCFTA impacts on intra-agreement trade differs between the countries, and second, welfare gains from trade creation effect are detected only in the case of Georgia.

Further research is needed to study determinants of the considerable differences between the effectiveness of DCFTA in EaP countries. Moreover, the short period from when the DCFTA's entry went into force could impact the findings of our study, but it is too early for final conclusions about the benefits of this agreement, and additional studies in the medium and long-term periods should be conducted.

REFERENCES

Adarov , A. & Havlik , P. (2016), Benefits and Costs of DCFTA: Evaluation of the Impact on Georgia, Moldova and Ukraine, *The Vienna Institute for International Economic Studies*. Retrieved from https://wiiw.ac.at/benefits-and-costs-of-dcfta-evaluation-of-the-impact-on-georgia-moldova-and-ukraine-n-191.html

Adarov, A. & Havlik , P. (2017), Challenges and implications of the DCFTA agreements between the EU and Georgia, Republic of Moldova and Ukraine, *The Vienna Institute for International Economic Studies.* Retrieved from https://wiiw.ac.at/challenges-and-implications-of-the-dcfta-agreements-between-the-eu-and-georgia-republic-of-moldova-and-ukraine-pj-137.html

Akhvlediani, T. Blockmans, S., Bryhn, J., Gogoberidze, L. Ghiletchi, S. … Shamsfakhr, F. (2021), Ex-post evaluation of the implementation of the Deep and Comprehensive Free Trade Areas between the EU and its Member States and Georgia and Moldova, *CEPS inception report*. Retrieved from https://www.ceps.eu/personal-site/tinatin-akhvledianiceps-eu/ex-post-evaluation-of-the-implementation-of-the-deep-and-comprehensive-free-trade-areas-between-the-eu-and-its-member-states-and-georgia-and-moldova/

Anderson, J. E. (1979), A Theoretical Foundation for the Gravity Equation, *American Economic Review,* American Economic Association, vol. 69(1), 106-116. Retrieved from https://www.jstor.org/stable/1802501

Anderson, J. E. & van Wincoop, E. (2003), Gravity with Gravitas: A Solution to the Border Puzzle*, American Economic Review*, 93(1), 170-192. Retrieved from https://www.jstor.org/stable/3132167

Bacchetta, M., Beverelli, C., CadoT, O., Fugazza, M., Grether, J.M. …. Piermartini, R. (2012), A Practical Guide to Trade Policy Analysis, *World Trade Organization and the United Nations Conference on Trade and Development*, 101-131. https://doi.org/10.30875/131552a5-en

Baier, S. L., & Bergstrand, J. H. (2007), Do free trade agreements actually increase members' international trade? *Journal of International Economics*, 71(1), 72–95. https://doi.org/10.1016/j.jinteco.2006.02.005

Baier, S. L., & Yotov, Y.V., & Zylkin, T. (2019), On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration, *Journal of International Economics, Elsevier,* vol. 116(C), 206-226. https://doi.org/10.1016/j.jinteco.2018.11.002

Bergstrand, J. (1990), The Heckscher-Ohlin-Samuelson Model, the Linder Hypothesis and the Determinants of Bilateral Intra-industry Trade, *Economic Journal*, 100, issue 403, 1216-1229. https://doi.org/10.2307/2233969

Caliendo, L., & Parro, F. (2015). Estimates of the Trade and Welfare Effects of NAFTA. *The Review of Economic Studies,* 82(1 (290)), 1–44. http://www.jstor.org/stable/43551463

Caporale, G. M. C. Rault, R. Sova, & A.M. Sova (2009), On the Bilateral Trade Effects of Free Trade Agreements between EU-15 and the CEEC-4 Countries, *Review of World Economics,* 145(2), 189–206. https://doi.org/10.1007/s10290-009-0011-8

CEPII, Research and Expertise on the world Economy, GeoDist Database, http://www.cepii.fr/CEPII/en/bdd_modele/download.asp?id=6 (accessed: 08.04.2020)

Chkhikvadze, I. Groza, I. & Litra, L. (2021), Implementation of Association Agreements in Georgia, Moldova and Ukraine: a comparative overview 2021, *The international Renaissance Foundation*. Retrieved from https://rpr.org.ua/en/news/implementation-of-association-agreements-in-georgia-moldova-and-ukraine-a-comparative-overview-2021/

Covaș, S. & Crudu, R. (2016). The European Union and Republic of Moldova Association Agreement's impact on national economy. *CSIE Working Papers Series,* issue 3, 6-18. Retrieved from https://irek.ase.md/xmlui/handle/123456789.1/78

Dai, M., Yotov, Y. & Zylkin, T. (2014), On the trade-diversion effects of free trade agreements, *Economics Letters*, 122, issue 2, 321-325. https://doi.org/10.1016/j.econlet.2013.12.024

Diavor, M. (2021), Vulnerability of foreign trade of the Republic of Moldova analyzed on the basis of gravity model, *Relații internaționale*. Plus, vol. 2(20), 199-205. https://doi.org/10.52327/1857-4440.2021.2(20).22

Eteria, E. (2019), EU's Trade Policy Developments and Economic Dimension of EU-Georgia Association Agreement, Eastern European Journal for Regional Studies (EEJRS), vol. 5(2), 44-59. Retrieved from https://ideas.repec.org/a/aem/journl/v5y2019i2p44-59.html

Eteria, E. (2020), Impact of the EU Deep and Comprehensive Free Trade Area Agreements on Trade Performance of Georgia and Moldova, *CES Working Papers, Centre for European Studies, Alexandru Ioan Cuza University*, vol. 12(3), 198-212. Retrieved from https://ideas.repec.org/a/jes/wpaper/y2020v12i3p198-212.html

Fally, T. (2015), Structural Gravity and Fixed Effects, *Journal of International Economics*, 97(1), 76-85.: https://doi.org/10.1016/j.jinteco.2015.05.005

Gylfason, T., Martínez-Zarzoso, I., & Wijkman, P. M. (2015), Free trade agreements, institutions and the exports of eastern partnership countries*, JCMS: Journal of Common Market Studies*, 53(6), 1214–1229. https://doi.org/10.1111/jcms.12275

Head, K., & Mayer, T. (2014), Gravity Equations: Workhorse, Toolkit, and Cookbook, Elsevier, ch. Chapter 3, 131-195. https://doi.org/10.1016/B978-0-444-54314-1.00003-3

Hellyer, M. (2019), Ukraine's Trade under the DCFTA: A Gravity Model, *Global Economic Relations, nr.6, 20-32*. http://doi.org/10.31617/visnik.knute.2019(128)02

Hellyer, M. (2021), Identifying Residual Barriers to Trade under the EU Ukraine DCFTA, *The Ukrainian Yearly book of European Integration Studies*, Vol.5, 171-179. Retrieved from http://yearlybook-aprei.com.ua/wp-content/uploads/2020/11/Ukrayinskyj-SHHorichnyk-z-YEvropejskyh-Integraczijnyh-Studij-Vypusk-V.-2020-r..pdf#page=138

International Monetary Fund, Direction of Trade Statistics (DOTS) https://data.imf.org/?sk=9d6028d4-f14a-464c-a2f2-59b2cd424b85&sId=1390030341854 (accessed: 08.04.2020)

Matuszak, S. (2019), Real integration – impact of the DCFTA on trade between Ukraine and the European Union, *International Issues & Slovak Foreign Policy Affairs*, 28(1/2), 84–93. Retrieved from https://www.jstor.org/stable/26898332

Mayer, T. & Zignago, S. (2011) Notes on CEPII's distances measures: the GeoDist Database, *CEPII Working Paper*, 2011-25. http://dx.doi.org/10.2139/ssrn.1994531

Mgebrishvili, M. (2020) Economic Analysis of Georgia's Free Trade Agreements with EU and China, *PMC Research Centre*, Retrieved from https://pmcresearch.org/policypapers_show/65/Economic-Analysis-of-Georgia%E2%80%99s-Free-Trade-Agreements-with-EU-and-China

Nekhay, O., Delgado M. C. & Cardenete M. A. (2021), Does Abolishing Tariffs in Bilateral Trade Matter for a Country's Economic Growth? The Impact of the EU–Ukraine DCFTA, *Europe-Asia Studies,* 73:7, 1257-1278. https://doi.org/10.1080/09668136.2020.1807468

Olivero, M. P. and Yotov, Y. V. (2012), Dynamic Gravity: Endogenous Country Size and Asset Accumulation, *Canadian Journal of Economics* 45[1], 64-92. https://doi.org/10.1111/j.1540-5982.2011.01687.x

Rabinovych, M. (2022), EU-Ukraine "deep" trade agenda: the effectiveness and impact perspectives. *International Politics*. https://doi.org/10.1057/s41311-022-00384-x

Rodrik, D. (2018) What Do Trade Agreements Really Do?, *Journal of Economic Perspectives*, vol 32(2), pages 73-90. https://doi.org/10.1257/jep.32.2.73

Silagadze, A. and Zubiashvili, T. (2015), Parameters of the European Union and the post-soviet Georgia's economy, *International Journal of Multidisciplinary Thought*, 5 (3). 441-448. Retrieved from http://eprints.tsu.ge/1091/

Silagadze, A. and Zubiashvili, T. (2016), Georgia's economy against the background of the association agreement with the European Union, *International Journal of Business and Management Studies*, 5 (2). 533-540. Retrieved from http://eprints.tsu.ge/1093/

Silva, J. M., & Tenreyro, S. (2006), The Log of Gravity, *The Review of Economics and Statistics*, 88(4), 641–658. https://doi.org/10.1162/rest.88.4.641

Tomșa, C. & Trofim, D. (2021). The trade policy of the Republic of Moldova in the context of DCFTA. *Simpozion Științific Internațional al Tinerilor Cercetători*, vol. 3, 219-222. Retrieved from https://irek.ase.md:443/xmlui/handle/1234567 89/1552

Viner, J., & Olsington, P. (2014), The Customs Union Issues, New York: Oxford University Press, 53-56.

Yang, S., & Martinez-Zarzoso, I. (2014), A panel data analysis of trade creation and trade diversion effects: The case of ASEAN–China Free Trade Area, *China Economic Review,* Elsevier, vol. 29(C), 138-151. https://doi.org/10.1016/j.chieco.2014.04.002

Yotov, V. Y., Piermartini, R., Monteiro J.A. & Larch, M. (2016), An Advanced Guide to Trade Policy Analysis, *the World Trade Organization and the United Nations Conference on Trade and Development*, 9-63. Retrieved from https://www.wto.org/english/res_e/publications_e/advancedguide2016_e.htm

World Bank, World Development Indicators. https://databank.worldbank.org/source/world-development-indicators (accessed 08.04.20)

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