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A RE-EXAMINATION OF THE BENEFITS OF TRADE AGREEMENTS ON AGRICULTURAL EXPORTS AND THE IMPACT OF THE 2008 GREAT RECESSION

David Karemera
South Carolina State University, College of Business and Information, USA
E-mail: Karemera@scsu.edu ORCID:0000-0002-0671-5424

Mathew Guah
South Carolina State University, College of Business and Information, USA

Gerald Smalls
South Carolina State University, USA, ORCID: 0000-0003-3479-2555

Louis Whitesides
South Carolina State University, USA, ORCID: 0000-0003-1498-869X

Abstract

This study provides an analysis of trade benefits of regional trade agreements on global agricultural trade flows. The impact of the 2008 Great Recession is examined. Trade creation and diversion effects are evaluated within the framework of dynamic gravity models. The generalized gravity equations and probit models that account for missing export values are estimated by methods that deal with various specification effects. The findings show that the system-GMM is the efficient estimator. The results reveal that the ASEAN, EAC, and EU associations were more effective in generating agricultural trade benefits for members than the rest of the associations. The NAFTA, MERCOSUR, and SADC associations generated little or no benefits for members. The advent of the 2008 Great Recession impaired agricultural trade flows. While the ASEAN, EAC, and EU associations sustained net trade creation during the entire period and sub-periods, all benefits declined uniformly following the 2008 Great Recession.
Keywords: *2008 Great Recession, global agricultural trade, gravity equation, panel data, trade benefits.*
JEL Codes: *F13, F14, F15.*

1. Introduction

During the past three decades, the proliferation of regional free trade agreements (RTAs) has led to substantial growth in international trade (Urata & Okabe, 2010). There exists convincing evidence that increases in the number of RTAs continue to enhance global trade (Jayasinghe & Sarker, 2008; Lambert & McKoy, 2009; Pfaffermayr, 2020). Sun and Reed (2010) evaluated the effects of trade agreements on agricultural trade and found that the agreements increased trade flows. They indicated that the extent of trade creation and diversion varied over time and by agreement. More studies revealed that trade agreements increased trade among members (Jayasinghe & Sarker, 2008; Lambert & Mckoy, 2009). However, the

precise effects of the RTAs on agricultural trade creation and diversion remain subjects of debates due to the documented possibilities of trade diversion (Clausing, 2001).

Economists have continued to debate the effectiveness of regional trade agreements. Baier and Bergstrand (2007) report that the effectiveness of an RTA in creating trade between member countries varies by the economic characteristics of the trading pairs as well as the characteristics of all other members of the RTAs (Egger , 2004). Magee (2017) evaluated aggregate trade benefits of RTAs and showed that trade creation and diversion are endogenously influenced by member characteristics, including relative shares of imports from member countries. However, the above studies did not address the possible impact of external shocks or global economic crisis on trade creation and diversion effects. The advent of the 2008 Great Recession may have caused structural shifts in global trade and negatively affected the RTAs' trade benefits (Sundell & Shane, 2012).

The popular gravity models have been used to explain trade patterns between exporting and importing countries. The studies by Cheng and Tsai (2005), Carrere (2006), and Koo, et al. (2006) focused on the impact of regional trade agreements on bilateral trade and found that, while the agreement generated more trade among members, they may have negative effects for non-members. Urata and Okabe (2014) analyzed trade creation and trade diversion effects of free trade agreements and found that, owing to higher tariff rates on non-member countries' products, the RTAs caused more trade diversion in developing countries than in developed countries. Shelburne (2010) and Rajesh (2018) looked at other factors affecting trade behavior and found that the Great Recession caused a negative impact on trade. However, less attention was devoted to evaluating the impact of the crisis on the global agricultural trade. The 2008 Great Recession was a shock to global agricultural supply and may have negatively affected the agricultural trade expansion ability of free trade agreements.

This study analyzes and evaluates the impacts of bilateral and multilateral free trade agreements on global agricultural trade flows within the framework of static and dynamic panel gravity models of international trade. The focus is mostly on the trade creation, diversion, and openness of the regional trade agreements . The possible impact of the 2008 Great Recession on state agricultural trade flows is evaluated to identify potential structural shifts in exports and the impact on trade benefits of selected free trade agreements.

2. Literature Review

The gravity model has been used extensively to evaluate factors affecting trade flows and analyze the impacts of free trade agreements on trade flows (Anderson & van Wincoop, 2003; Helpman, Melitz, & Rubinstein, 2008; Martinez-Zarzoso, et al., 2009, Anderson et al., 2018). More studies continue to show the importance of RTAs on the trade flows (Baier & Bergstrand, 2007; Bergstrand, et al. 2015, Baier et al., 2019). Broll and Jauer (2014) applied gravity models of general trade and showed that the 2008 economic collapse negatively affected global trade.

While preferential trade agreements are considered beneficial among member countries, their effects on non-member countries may be negative. Karemera et al. (2015) apply a commodity-specific gravity model to investigate trade creation and trade diversion effects of RTAs on the global meat trade volume. The results show evidence of meat trade expansion through trade creation among members and trade diversion from non-members to members. Baier, et al. (2018) show that economic integration benefits of trade agreements vary by country.

Traditional gravity models have been static. Recent studies are using dynamic gravity models (Bun & Klaasen, 2002; Bergstrand et al., 2015). Soloaga and Winters (2001) introduced three sets of dummy variables capturing trade creation, export and import diversion effects. Chen and Tsai (2005), as well as Carrère (2006) used the methodology. Kim et al. (2003) applied dynamic gravity models to identify determinants of bilateral agricultural trade

patterns. Egger, et al. (2022) use dynamic gravity models and show aggregate trade benefits of free trade agreements.

Martinez-Zarsozo et al. (2009) also used dynamic gravity models to evaluate trade benefits of preferential trade agreements. They concluded that dynamic models generated more consistent and robust estimates, especially when using the Generalized Method Moment (GMM) estimator. Similarly, Bekele and Mersha (2019) used dynamic gravity models and applied the GMM estimators to evaluate factors affecting Ethiopian coffee exports.

The above methods have appealing properties. They identified multilateral resistance terms and included dummy variables capturing country-specific and bilateral country-pair and time-specific effects on trade volumes. The methods follow the Helpman et al. (2008) gravity equation specification that accounts for firm heterogeneity and fixed trade costs and asymmetries between the volume of exports from exporting countries to importing countries. Hence, this paper implements the Helpman et al. (2008) models and estimates both static and dynamic gravity panel models to analyze the effects of regional trade agreements and the 2008 Great Recession on global agricultural trade flows.

3. Major Agricultural Exporting Countries

Table 1 shows the top agricultural exporters' market share. As shown in the table, Canada is the largest exporter of agricultural products among the countries used in this study. About 85% of the Canadian processed agricultural and seafood is exported to the world. Following Canada are Chile and China. China has been the second largest exporter since 2009.

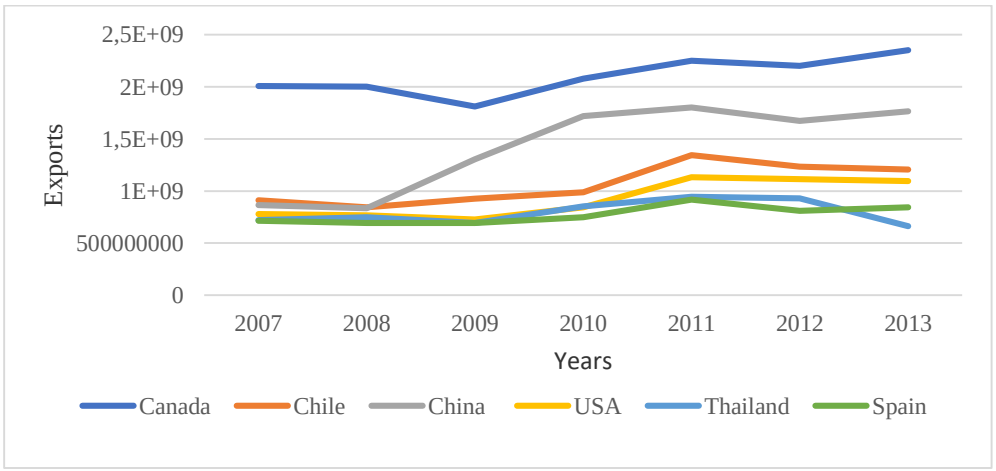

Figure 1. Top Sixth Leading Agricultural Exporting Countries

The U.S.A. takes the fourth place as one of the top agricultural exporting countries from 2009 to 2013. U.S. agricultural exports boosted by higher production volumes have increased by approximately 43% over the last 5 years. Thailand and Spain are in the top six world largest agricultural exporters. Figure 1 displays trade flow behavior of the top six agricultural exporters from 2007-2013. Other major agricultural exporters also include Indonesia and India.

Table 1. Comparison of Global Agricultural Export Markets Shares for Major Agricultural Exporting Countries

Countries	ISO	Years						
		2007	2008	2009	2010	2011	2012	2013
Canada	CAN	6.31%	6.09%	5.94%	6.04%	5.59%	5.48%	6.15%
Chile	CHIL	2.86%	2.57%	3.04%	2.88%	3.34%	3.06%	3.15%
China	CHN	2.71%	2.54%	4.28%	5.00%	4.48%	4.16%	4.61%
USA	USA	2.45%	2.33%	2.38%	2.45%	2.81%	2.77%	2.86%
Thailand	THA	2.26%	2.28%	2.27%	2.48%	2.35%	2.31%	1.73%
Spain	ESP	2.24%	2.11%	2.23%	2.18%	2.28%	2.01%	2.21%
Top 6 Subtotal		18.84%	17.93%	20.14%	21.03%	20.85%	19.79%	20.71%
Rest of the World		81.16%	82.07%	79.86%	78.97%	79.15%	80.21%	79.29%
World Total		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

4. Methodology: Gravity Models of Agricultural Trade

4.1. Static Panel Gravity Model of State Agricultural Trade

The specification of a generalized gravity model of global trade traditionally includes income, population, distance, price, and variables aiding or impairing trade. An augmented gravity model of agricultural trade is designed to reflect characteristics inherent to agricultural production, export, and trade. The variables representing the agricultural production capacity in trading countries are included. The standard gravity model (Bergstrand, 1989), modified to include empirical characteristics of global agricultural trade is specified as:

$$X_{ijt}=BY_{it}^{\sigma 1}Y_{jt}^{\sigma 2}PR_{it}^{\sigma 3}PR_{jt}^{\sigma 4}Pop_{it}^{\sigma 5}Pop_{jt}^{\sigma 6}D_{ij}^{\sigma 7}\times exp\{\sigma_8 Bor_{ij} + \sum_m \delta_m RFTA_{ijt}^{m} + U_{ijt}\}\ldots \quad (1)$$

where X_{ij} denotes the amount of agricultural exports from country *i* to country *j*, Y_i (Y_j) indicates per capita GDP of country *i* (j's per capita GDP); PR_{it} (PR_j) represents per capita agricultural production in country i (j); POP_{it} (POP_{it}) identifies i(j's) population, and D_{ij} is the vessel distance between *i*'s export and *j*'s import ports. The variables Bor_{ij} identify countries with a shared border. The RTAs are trade agreement variables described in detail below. The coefficients B, *σ, and δ* are parameters and U_{ijt} is an error term.

4.2. The Dynamic Panel Gravity Model of State Agricultural Trade

Most trade studies used static gravity equations similar to (1) and ignored the dynamic nature of trade flows. However, ignoring the persistence in exports and trade can lead to biased and misleading results. Moreover, previous studies used balanced trade data and ignored impacts of missing or zero trade flows. Tran et al. (2010) use several approaches and show that accounting for zero trade matters. Grant and Lambert (2008) overcome this issue by including time varying importer and exporter fixed effects to analyze the impact of RTAs on Agricultural and non-Agricultural trade. Santos and Tenreyro (2006) proposed a poison pseudo maximum likelihood (PPML) method to account for zero trade flows and found that the estimation method performed better than other estimators in the presence of heteroscedasticity, zero observations in trade flows. Though this method seems to behave well with a sizeable proportion of zero values in the dependent variable, providing consistent

estimates, it does not account for the dynamic nature of trade flows. Martinez-Zarsozo et al. (2009) used dynamic gravity models with application to global trade flows. Bekele and Mersha (2019) applied dynamic gravity models to identify determinants of Ethiopian coffee exports. In this study, dynamic gravity models are used to analyze and evaluate agricultural benefits of regional trade agreements.

Thus, a system of panel gravity equation for exports and a probit equation is specified to account for missing trade flows following Martinez-Zarsozo et al. (2009). The dynamic panel gravity model with a lagged dependent variable and a probit equation is written in log form as:

$$x_{ijt} = a_{1ij} + \mu_{1ij} + \lambda_{1t} + \beta_1 x_{ij,t-1} + \beta_2 y_{it} + \beta_3 y_{jt} + \beta_4 pr_{it} + \beta_5 pr_{jt} + \beta_6 pop_{it} + \beta_7 pop_{jt} + \beta_8 dis_{ijt} + \beta_9 bor_{it} + \sum_m \alpha_{1m} RFTA^m_{ijt} + \varepsilon_{1ijt} \quad (2)$$

and

$$F_{ijt} = a_{2ij} + \mu_{2ij} + \lambda_{2t} + \theta_1 x_{ij,t-1} + \theta_2 y_{it} + \theta_3 y_{jt} + \theta_4 pr_{it} + \theta_5 pr_{jt} + \theta_6 pop_{it} + \theta_7 pop_{jt} + \theta_8 dis_{ijt} + \theta_9 bor_{ijt} + \sum_m \alpha_{2m} RFTA^m_{ijt} + \varepsilon_{2ijt} \quad (3)$$

where μ_{ij} is a trade flow effect associated with the country pair *i* and *j*; λ_t is a time effect; β_1 is the dynamic adjustment coefficient; the coefficients β, *α, and θ* are new parameters, and ε_{ijt} is an error term. The dynamic panel gravity models (2) and (3) have received limited use in global agricultural trade research. The RTAs are discussed below. To account for the possible zero trade, a panel probit equation (3) is introduced, where F_{ijt} is a binary variable that takes a value of 1 for positive flows from *i* to *j*; 0, otherwise. The export model x_{ijt} and probit equation F_{ijt} are estimated by a GMM-System estimator used by Helpman et al. (2008). The estimated elasticities are used to analyze and evaluate trade effects of the selected agreements.

4.3. Trade Creation, Diversion, and Openness of Free Trade Agreements

Three new dummy variables representing free trade agreements are introduced into the gravity model based on the Vinerian specification of trade creation and trade diversion (Carrere, 2006; Mattoo, et al. (2017). Following Martinez-Zarsozo et al. (2009), the three dummy variables for each free trade agreement are coded as follows:

$$Xij = EVij + \sum_r \gamma_r RFTA^r_{mm} + \sum_r \Psi_r RFTA^r_{mn} + \sum_r \omega_r RFTA^r_{nm} + w_{ij} \quad (4)$$

where the term EV_{ij} includes variables previously defined. The symbol *r* denotes a trade bloc. The set of subscript mm identifies flows from members to members of a regional trade bloc; the second set of subscript mn identifies flows from members to non-members. The last set of subscripts nm represents trade flows from non-members to members. The RTAs are the EU_15, NAFTA, ASEAN, MERCOSUR, SADC, and the EAC. For example, a dummy variable EU_{mm} = 1.0 for trade flows among EU members; 0 otherwise and represents potential trade changes arising from EU membership. The variable EU_{mn} =1.0 for flows from EU members to non-members, 0 otherwise and suggests potential trade diversion. The dummy variable EU_{nm} =1.0 for trade flows from rest of the world to the EU countries and represents import diversions.

The coefficients γ_r identify the trade creation effects of an RTA among economic bloc members and are normally positively signed. The coefficients Ψr measure the extent of changes in members' exports to non-member countries and are expected to be negatively signed. The coefficients ω show members' increased propensity to import from non-members and should be positively signed. The relative magnitudes and signs of Ψr and ωr determine the extent of trade diversion and openness effects. Therefore, if $\gamma_r > 0$ and $\psi r + \omega_r > 0$, the agreement generated a net trade creation effect among members. If $\gamma_r > 0$ and $\gamma_r + \psi r < 0$,

or $\gamma_r + \omega r < 0$, the effect is said to be net export trade diversion or net import trade diversion, respectively. Martinez -Zarsozo et al. (2009) offers an excellent survey of integration effects.

5. Empirical Results

5.1. Data Source

The agricultural trade flow data were obtained from the HIS/Markit/Global Trade Atlas under a one year subscription and from the USDA websites. Table 1 provides a summary of major exporters represented in the study. Additional data include countries' agricultural exports, countries' GDP, distance between a country's export ports and a country's importing ports, population, and GDP per capita. Selected major regional trade agreements include the EU, NAFTA, ASEAN, AND MERCOSUR; minor regional agreements are the EAC and SADC. Countries included in the study and membership details are shown in Appendix A.

5.2. Estimation Results

Table 2 reports the estimated static and dynamic results for the full sample (2001-2013), while Tables 3 and 4 show the results for the sub periods 2001-2007 and 2008-2013, respectively for the static and dynamic specifications. The static results include the ordinary least squares (OLS), the fixed effects, and those from the two-stage fixed effect models. Results from dynamic panel models include country and time-fixed effects and were implemented using the GMM system estimator developed by Blundell and Bond (1998). Most parameters have the expected signs and are statistically significant and consistent with previous studies.

5.2.1. Static Estimation of Trade Creation and Trade Diversion

The results of the OLS estimates are presented in the first column of Table 2. Most estimated parameters are statistically significant, highlighting the determinants of global agricultural trade. The gravitational variables, income, population, distance, and border have expected signs and significant coefficients in most models. The exporter's agricultural production is a major determinant of agricultural trade. The estimated coefficients on the integration dummy variables have the correct signs and are significant in most cases.

Even though the OLS estimates have significant and correct signs, they are biased due the lack of treatment of multilateral trade resistance inherent to gravity models (Anderson & van Wincoop, 2003). Column 2 presents the estimated coefficients of the fixed effects model[1]. Accounting for time fixed effects in the gravity models improves the significance of the estimates and the size of most RTAs' coefficients. The estimates in the third column are obtained by a fixed effects model in a two-stage estimation approach that accounts for the selection bias and firm heterogeneity[2] (Helpmann et al., 2008). Comparing the OLS and fixed effects results, the two-stage estimates show improved magnitude and significance of the estimates. Positive and significant coefficients for the linear prediction p1 (1.96) and the inverse mills ratio (1.99) indicate existence of selection bias and firm heterogeneity. These findings suggest that accounting for zero trade matters. Thus, it is important to correct a selection bias in the global agricultural trade studies

5.2.2. Dynamic Estimation of Trade Creation and Diversion Effects

Results for the dynamic gravity panel models are presented in Table 2 in columns 4 and 5. The static specification of traditional gravity models assumes contemporaneous correlation of dependent variables and regressors and ignores the persistence nature of trade flows (Bun & Klaasen, 2002, Benedictis et al., 2005). Hence, the lagged dependent variable is included to capture the export flow dynamics. Column 4 reports the results for the fixed effects estimation results. The coefficient on the lagged exports is positive and significant at the 1% level, indicating significant persistence in trade flows. Bun and Klaasen (2002) reported that the significant estimates for lagged trade coefficients also represent the effect of unobserved country-pair specific time invariant factors that are present in both current and lagged trade flows. Relative to the static estimates, results presented in Table 2 show that the number of significant estimates in the dynamic specification is reduced. This finding is consistent with the study by Martinez-Zarszoso et al. (2009), which suggests that the reduction in number of significant coefficients may be due to the integration dummy variables accounting for part of the persistence effect.

Table 2. Static and Dynamic Model Estimation of Agricultural Trade: 2001-2013

	Static	**Estimates**		**Dynamic Estimates**	
	1	**2**	**3**	**4**	**5**
Variables	OLS	Fixed Effects	Two Stage	Fixed Effects	System GMM
Exporter's Income	0.239***	0.165***	0.134***	0.003	0.055
	(11.01)	(7.01)	(6.26)	(0.25)	(1.21)
Importer's Income	1.036***	0.931***	0.373***	0.122***	0.623***
	(47.65)	(39.82)	(12.7)	(7.72)	(8.7)
Exporter's Ag. Product.	0.468***	0.455***	0.124***	0.085***	0.333***
	(34.26)	(32.47)	(7.36)	(10.85)	(8.29)
Importer's Ag. Product.	0.007	0.016	0.019	0.002	0.014
	(0.60)	(1.25)	(1.59)	(0.24)	(0.56)
Exporter's Population	0.023	-0.030*	0.026	-0.019*	-0.028
	(1.23)	(-1.58)	-1.42	(-1.86)	(-0.71)
Importer's Population	0.842***	0.781***	0.467***	0.120***	0.553***
	(43.11)	(38.76)	(20.88)	(8.79)	(9.08)
Distance	-0.66				-0.41***
	(-34.9)				(-7.59)
Border Dummy	0.436*** (4.87)				0.192 (0.92)
EUmm	0.942***	1.930***	1.473***	0.308***	0.985***
	(9.86)***	(19.7)***	(10.99)***	(7.2)***	(4.02)***
EUmn	-1.06***	-1.04***	-1.488***	-0.19***	-0.59***
	(-14.1)	(-12.86)	(-19.37)	(-4.23)	(-3.34)
EUnm	0.599***	0.497***	-0.133**	0.040*	0.488***
	(9.35)	(7.47)	(-2.04)	(1.25)	(3.19)
NAFTAmm	0.103	0.347	-14.76***	0.032	0.275
	(0.36)	(1.33)	(-28.51)	(0.26)	(0.31)
NAFTAmn	0.0704	0.227**	-0.332***	0.017	0.247
	(0.78)	(2.39)	(-3.59)	(0.30)	(1.21)
NAFTAnm	-0.29***	-0.178*	-0.818***	-0.056	-0.111

	(-3.17)	(-1.92)	(-8.99)	(-1.21)	(-0.54)
MERCOSURmm	0.391**	0.121	1.195***	0.024	0.409
	(2.53)	(0.78)	(7.44)	(0.31)	(1.23)
MERCOSURmn	-0.33***	-0.56***	-0.0474	-0.113**	-0.236*
	(-4.40)	(-7.45)	(-0.62)	(-3.01)	(-1.38)
MERCOSURnm	-1.40***	-1.72***	-0.745***	-0.31***	-1.11***
	(-14.67)	(-18.00)	(-7.35)	(-4.49)	(-4.68)
ASEAmm	2.159***	2.876****	-1.341***	0.330***	1.342***
	(17.24)	(21.46)	-7.65)	(6.82)	(3.71)
	(0.27)	(-4.60)	(-20.48)	(-3.33)	(-0.62)
ASEANnm	0.725***	0.321***	-0.160**	0.041	0.367**
	(10.43)	(4.46)	(-2.23)	0.98	2.34
SADCmm	1.378***	0.860**	-0.963**	-0.046	0.493
	(3.38)	(2.49)	(-2.38)	(-0.20)	-0.54
SADCmn	0.042	-0.291**	-0.12	-0.106	0.11
	(0.36)	(-2.41)	(-1.02)	(-1.45)	-0.45
SADCnm	0.005	-0.328*	-0.206*	-0.081	-0.108
	(0.04)	(-2.74)	(-1.75)	(-1.01)	(-0.40)
EACmm	3.409***	3.861***	1.967***	0.629**	2.218**
	(6.22)	(6.99)	(3.56)	(2.39)	(2.08)
EACmn	1.370***	1.104***	0.688***	0.134	0.772**
	(9.17)	(7.22)	(4.56)	(1.47)	(2.18)
EACnm	-0.454**	-0.71***	-0.678***	-0.127	-0.397
	(-2.37)	(-3.84)	(-3.61)	(-1.01)	(-0.92)
Lagged Exports				0.841***	0.292***
				(100.9)	(4.95)
Linear Prediction			1.968***		
			(34.54)		
Inverse Mills Ratio			1.995***		
			(8.66)		
Constant	-12.6***	-14.68***	-4.476***	-1.54***	-5.79***
	(-23.08)	(-24.57)	(-6.69)	(-4.17)	(-4.64)
Observations	15441	15441	15441	13167	8928
R-squared	0.427	0.392	0.431	0.83	
AR(1)					-9.2***
AR(2)					1.35
Sargan Test					29.95
Hansen Test					17.17
Number of Instruments					31

Note: Above and below, t statistics are in parentheses. *, **, *** denotes the level of significance at the 10%, 5% and 1% level. White heteroskedasticty-consistent covariance matrix estimator is used.

The dynamic models were estimated by the system-GMM estimator suggested by Blundell and Bond (1998) and used by previous studies (Martinez-Zarzosso et al., 2009; Bekele & Mersha, 2019; among others). The results presented in column 5 of Table 2 show consistent estimates in terms of magnitude and significance. The Hansen test with a p-value (0.108) fails to reject the null hypothesis that the over-identification restrictions are valid. Thus, the models are valid here. Furthermore, the system-GMM estimates are robust to heteroskedasticity and

autocorrelation of first (p-value for AR1=0.000) and second order (P-value of AR2 =0.333). The findings suggest that dynamic gravity models are the most appropriate specifications for agricultural trade flows.

The income per capita in the importing country was included to represent level of development and absorption capacity. The results show a positive and significant coefficient at 1% level, indicating that the importer's per capita income is a factor affecting agricultural trade flows. The income elasticity in the origin country is positive but statistically insignificant, suggesting that the exporting country's per capita income is not a factor affecting the country's agricultural exports.

As expected, the exporting country's production is a major determinant of the country's fish exports. The production variable in the exporting country has the expected sign and is significant at 1% level. Increases in agricultural production in exporting countries lead to increases in agricultural exports. The production variable in importing countries is not a factor affecting agricultural trade flows. The population variable in importing countries is significant and positively signed, indicating that increases in population are associated with the propensity to import agricultural products. This result is consistent in all models. However, as explained in Baier & Bergstrand, (2002), population in exporting countries may not be a factor affecting exports.

The distance variable is often included in gravity models as a proxy for transportation costs. The estimated coefficients on distance have correct signs and are significant in all cases. The border variable was included under assumption that countries with shared borders tend to have cultural commonalities and more propensity for trade than countries that are geographically separated. (A common language variable was dropped due to collinearity issues.)

Table 3 presents the static estimates for the two sub-periods (2001 to 2007 and 2008 to 2013) while the estimates from dynamic models are shown in Table 4 by sampling period. The results in both periods are mostly consistent in terms of signs and significance. The results suggest that agricultural production variables should be included in a dynamic model specification of agricultural trade flows. Since the dynamic GMM system estimates are robust and consistent, they are used to discuss specific benefits of the free trade agreements.

5.2.3. Empirical Benefits of Free Trade Agreements

The estimated results for the GMM model in Table 2 for the full sample show that the EU, ASEAN, and EAC associations increased agricultural trade flows among members. The pure trade creation for the EU (EU_{mm}+EU_{mn} + EU_{nm}) reached 186.78%[3] and the net trade creation for ASEAN ($ASEAN_{mm}$ + $ASEAN_{mn}$ + $ASEAN_{nm}$) amounted to 327.00%[4]. Similarly, the EAC led to increased agricultural trade among members by 935.30%. NAFTA and SADC associations had no significant trade creation effect during the entire sample period of the study. The NAFTA findings are not consistent with previous work by Martinez-Zarzosso et al. (2009), who used aggregated bilateral exports. The results are partly consistent with the study by Sun and Reed (2010), which determined that NAFTA had no trade creation but did lead to sporadic export creation and import diversion in agricultural trade. It is illustrated in this paper that the NAFTA agreement was not a factor affecting global agricultural trade flows and has had little or no agricultural benefits for members.

Table 3 Comparative Analysis of Static Results by Estimation Method and Sampling Period

Variables	1	2	3	4	5	6
	OLS		**Fixed Effects**		**Two Stage**	
	2001-2007	2008-2013	2001-2007	2008-2013	2001-2007	2008-2013
Exporter's Income	0.261***	0.263***	0.174***	0.156***	0.028	0.003
	(8.54)	(7.77)	(5.39)	(4.47)	(0.93)	(0.09)
Importer's Income	1.129***	0.974***	1.007***	0.845***	0.499***	0.310***
	(36.76)	(28.96)	(31.18)	(24.57)	(12.37)	(7.29)
Export's ag Production	0.459***	0.473***	0.448***	0.460***	0.225***	0.136***
	(23.89)	(24.12)	(22.67)	(22.82)	(10.65)	(5.63)
Import's ag Production	0.011	-0.005	0.021	0.012	-0.011	-0.027
	(0.65)	(-0.27)	(1.16)	(0.66)	(-0.62)	(-1.59)
Exporter's Population	0.018	0.049*	-0.045*	-0.011	-0.127***	0.045*
	(0.69)	(1.80)	(-1.68)	(-0.39)	(-5.06)	(1.65)
Importer's Population	0.883***	0.818***	0.812***	0.746***	0.550***	0.439***
	(32.55)	(28.66)	(29.22)	(25.33)	(18.58)	(13.32)
Distance	-0.675***	-0.664***				
	(-26.34)	(-23.58)				
Border Dummy	0.573***	0.257*				
	(4.92)	(1.88)				
EUmm	0.773***	0.954***	1.841***	2.002***	-0.622***	-1.900***
	(5.79)	(6.62)	(13.53)	(14.11)	(-4.02)	(-8.81)
EUmn	-0.930***	-1.295***	-0.873***	-1.221***	-0.985***	-1.518***
	(-8.93)	(-11.47)	(-7.92)	(-10.35)	(-9.49)	(-13.38)
EUnm	0.539***	0.590***	0.469***	0.503***	0.016	0.053
	(5.88)	(6.52)	(4.94)	(5.38)	(0.18)	(0.59)
NAFTAmm	0.134	-0.113	0.455	0.189	-10.02***	-15.03***
	(0.39)	(-0.24)	(1.47)	(0.43)	(-20.32)	(-19.41)
NAFTAmn	0.0905	-0.043	0.272**	0.170	0.391***	-1.054***
	(0.72)	(-0.33)	(2.05)	(1.24)	(3.13)	(-7.27)
NAFTAnm	-0.475***	-0.166	-0.322**	-0.0397	-0.941***	-0.331**
	(-3.81)	(-1.23)	(-2.55)	(-0.29)	(-7.61)	(-2.48)
MERCOSURmm	0.545**	0.288	0.222	0.0308	1.028***	-0.111
	(2.49)	(1.33)	(1.02)	(0.14)	(4.60)	(-0.51)
MERCOSURmn	-0.179	-0.474***	-0.445***	-0.690***	0.115	-0.417***
	(-1.62)	(-4.57)	(-3.97)	(-6.59)	(1.04)	(-4.01)
MERCOSURnm	-1.221***	-1.531***	-1.592***	-1.829***	-0.720***	-0.314**
	(-8.66)	(-11.75)	(-11.43)	(-13.95)	(-4.94)	(-1.99)
ASEANmm	2.439***	1.834***	3.144***	2.583***	0.359*	-15.78***
	(14.97)	(9.81)	(17.36)	(13.07)	(1.83)	(-20.41)
ASEANmn	0.231**	-0.207**	-0.124	-0.548***	-0.788***	-2.843***
	(2.40)	(-2.05)	(-1.28)	(-5.34)	(-8.17)	(-20.09)
ASEANnm	0.823***	0.644***	0.414***	0.223**	0.097	-0.096

	(8.41)	(6.54)	(4.09)	(2.18)	(0.96)	(-0.96)
SADCmm	2.021***	0.790	1.461***	0.223	0.668	-2.700***
	(4.12)	(1.24)	(3.63)	(0.41)	(1.42)	(-4.19)
SADCmn	-0.0776	0.256	-0.432**	-0.0849	-0.109	-0.140
	(-0.46)	(1.60)	(-2.53)	(-0.51)	(-0.65)	(-0.86)
SADCnm	-0.008	0.027	-0.354**	-0.334*	-0.176	-0.259
	(-0.05)	(0.15)	(-2.17)	(-1.92)	(-1.09)	(-1.51)
EACmm	3.718***	3.099***	4.131***	3.529***	-8.862***	1.430**
	(4.68)	(4.43)	(5.12)	(5.07)	(-9.53)	(2.01)
EACmn	1.549***	1.167***	1.263***	0.870***	0.517***	0.529**
	(8.10)	(4.96)	(6.46)	(3.58)	(2.68)	(2.18)
EACnm	-0.147	-0.695***	-0.457	0.963***	-0.696**	-1.302***
	(-0.51)	(-2.68)	(-1.64)	(-3.89)	(-2.44)	(-5.17)
Linear Prediction					1.596***	2.022***
					(27.47)	(24.45)
Inverse Mills Ratio					2.149***	2.396***
					(9.05)	(6.74)
Constant	-14.14***	-12.18***	-15.77***	-13.43***	-4.205***	-2.421**
	(-18.20)	(-14.34)	(-19.13)	(-15.43)	(-4.31)	(-2.33)
Observations	8223	7218	8223	7218	8223	7218
R-squared	0.437	0.415	0.401	0.379	0.444	0.419

Table 4. Comparative Analysis of Dynamic Results by Estimation Method and Sampling Period

	1	**2**	**3**	**4**
Fixed Effects	**Fixed Effects**		**System-GMM System-GMM**	
	2001-2007	**2008-2013**	**2001-2007**	**2008-2013**
Lagged Exports	0.819***	0.872***	0.304***	0.260***
	(73.64)	(69.91)	(2.83)	(4.51)
Exporter's Income	-0.005	0.010	0.078	0.160***
	(-0.24)	(0.53)	(1.61)	(3.40)
Importer's Income	0.138***	0.0985***	0.674***	0.711***
	(6.17)	(4.20)	(5.77)	(9.90)
Exporter's ag. Production	0.098***	0.072***	0.326***	0.357***
	(8.80)	(6.15)	(5.95)	(8.88)
Importer's ag. Production	0.010	-0.006	0.061*	-0.012
	(0.89)	(-0.60)	(1.90)	(-0.49)
Exporter's Population	-0.034**	0.006	-0.056	0.019
	(-2.19)	(0.36)	(-1.31)	(0.48)
Importer's Population	0.129***	0.0942***	0.510***	0.616***
	(6.52)	(4.61)	(5.09)	(10.38)
Distance			-0.401***	-0.465***
			(-5.16)	(-8.49)
Common Border			0.321	0.111

			(1.54)	(0.53)
EUmm	0.384***	0.244***	0.760***	0.695***
	(5.98)	(3.90)	(2.77)	(3.20)
EUmn	-0.175***	-0.173***	-0.714***	-1.008***
	(-2.61)	(-2.68)	(-3.57)	(-5.81)
EUnm	0.107**	-0.0277	0.431**	0.313**
	(2.28)	(-0.59)	(2.49)	(2.26)
NAFTAmm	0.034	0.082	0.159	-0.003
	(0.17)	(0.48)	(0.22)	(-0.00)
NAFTAmn	0.123	-0.119*	0.266	-0.107
	(1.35)	(-1.67)	(1.19)	(-0.54)
NAFTAnm	-0.058	0.025	-0.263	-0.187
	(-0.94)	(0.33)	(-1.23)	(-0.95)
MERCOSURmm	0.049	-0.025	0.337	0.057
	(0.38)	(-0.24)	(0.93)	(0.18)
MERCOSURmn	-0.085	-0.149***	-0.260	-0.452***
	(-1.49)	(-2.70)	(-1.37)	(-2.96)
MERCOSURnm	-0.429***	-0.163*	-0.968***	-1.038***
	(-3.98)	(-1.73)	(-3.39)	(-4.76)
ASEANmm	0.377***	0.268***	1.326***	1.184***
	(5.22)	(3.90)	(3.18)	(3.62)
ASEANmn	-0.036	-0.188***	-0.005	-0.429***
	(-0.65)	(-3.16)	(-0.03)	(-2.78)
ASEANnm	0.001	0.121**	0.261	0.437***
	(0.02)	(2.18)	(1.44)	(2.99)
SADCmm	0.101	-0.109	0.826	0.860
	(0.53)	(-0.23)	(1.02)	(0.97)
SADCmn	-0.116	-0.095	-0.187	0.206
	(-1.12)	(-0.96)	(-0.63)	(0.91)
SADCnm	0.004	-0.197	0.039	-0.106
	(0.03)	(-1.59)	(0.13)	(-0.38)
EACmm	0.852**	0.161	2.579**	2.327***
	(2.05)	(0.69)	(2.14)	(3.07)
EACmn	0.175	0.060	0.978***	0.848**
	(1.43)	(0.38)	(2.66)	(2.11)
EACnm	-0.067	-0.069	0.273	-0.636
	(-0.29)	(-0.44)	(0.54)	(-1.55)
Constant	-1.450**	-1.603***	-5.940***	-8.461***
	(-2.57)	(-3.01)	(-3.74)	(-6.54)
N	6451	5621	3309	4500
R-squared	0.819	0.843		
AR(1)		-5.27***		
AR(2)		1.23		
Sargan Test		78.89		
Hansen Test		33.46		
Number of Instruments			31	31

Table 5. Agricultural Trade Creation, Diversion Effects by Association and Sampling Period

RTA	Full Sample: 2001-2013			Subsample: 2001-2007			Subsample: 2008-2013		
	Effect	Equivalent Benefits	Effect	Equivalent	Benefits	Effect	Equivalent	Benefits	Effect
	Effect (%)			Effect(%)			Effect(%)		
EU	0.985	168%	Trade Creation	0.76	114%	Trade Creation	0.695	100%	Trade Creation
	-0.588	-44%	Export Diversion	-0.714	-51%	Export Diversion	-1.00	-64%	Export Diversion
	0.488	63%	Import Diversion	0.431	54%	Import Diversion	0.313	37%	Import Diversion
		186%	Total Effect		117%	Total Effect		74%	Total Effect
NAFTA	Insignificant			Insignificant			Insignificant		
MERCOSUR	-0.236	-21%	Export Diversion						
	-1.109	-67%	Import Diversion	-0.968	-62%	Import Diversion.	-1.105	-67%	Import Diversion
ASEAN	1.342	283%	Trade Creation	1.326	277%	Trade Creation	1.184	227%	Trade Creation
							-0.429	-35%	Export Diversion
	0.367	44%	Import Diversion						
		327%	Total Effect		277%	Total Effect		247%	Total Effect
EAC	2.218	819%	Trade Creation	2.579	1218%	Trade Creation	2.327	925%	Trade Creation
	0.772	116%	Export Diversion	0.978	166%	Export Diversion	0.848	133%	Export Diversion
		935%	Total Effect		1384%	Total Effect		1058%	Total Effect
SADC	No Significant Effect			No Significant Effect			No Significant Effect		

It should be noted that, while European food regulations are strict, the EU association led to an agricultural trade creation among members that is evaluated at 168.78%. The ASEAN association generated a trade creation valued at 282.67%. Similarly, trade creation is found for the EAC association that amounted to an 818.89% increase in intra-trade among members. There was no significant trade creation for the MERCOSUR and SADC associations. However, the EU did lead to export diversion to non-members that reached to 44.46%. There was significant trade diversion for the MERCOSUR association where the association diverted 21.02% of exports to non-member countries. Significant import diversion is also found for the MERCOSUR agreement that reduced its import from outside countries by 67.01%.

5.2.4. The Impact of the 2008 Great Recession on Benefits of Trade Agreements

Since the sampling period included the Great Recession of 2008, an assessment of the RTA effects before and after the crisis was necessary. Trade benefits were analyzed under two sampling scenarios. In the first scenario, the full sample results covered the entire data set from 2001 to 2013. The preceding discussion addressed results for the full sampling period. In the second scenario, the subsample results are reported for the periods from 2001 to 2007 and 2008 to 2013 in Table 3 and 4 for both static and dynamic versions, respectively.

There are striking similarities and notable differences between the full set and subsample results. Most integration variables have appropriate signs and are consistent with the full sample results. However, the magnitudes of most RTA coefficients are reduced across all associations after the Great Recession. Results in Table 4 are used to compare benefit changes during the periods. The system GMM estimates show significant pure trade creation for the EU and ASEAN agreements, which increased intra-trade among members by 113.83% and 276.59%, respectively during the subsample period 2001-2007. However, after the economic crisis, the effects are reduced to 100.37% for the EU and to 226.74% for the ASEAN association. Table 5 provides a summary of trade benefits by association and sampling period. The results show that the net trade creation effects declined by 43.06% for the EU following the economic downturn and by 29.93% for the ASEAN association. The EAC Trade creation effects reached 1218.39% before 2008 and then declined to 924.72% after the 2008 Great Recession. The findings show that net EAC trade effects decreased by 326.1% following the economic crisis.

Significant export diversion is found for the EU where exports from EU members to non-member countries were decreased by 51.08% before 2008 and by 63.51% following the Great Recession. There were no significant trade effects for the MERCOSUR and ASEAN associations during the period 2001-2007. However, after the Great Recession, agricultural trade from both associations was diverted, causing a reduction in export from member countries to the rest of the world by 36.06% and 34.88%, respectively. Significant export creation from EAC members to outside countries was found. The EAC increased exports to non-member countries by 165.91% before 2008, but the exports declined to 133.50% after the economic crisis.

The findings also show significant import creation for EU members. The EU imports from non-members increased by 53.88% before 2008 but were only 36.75% after the Great Recession. The results show no import creation or diversion for the ASEAN agreement before the Great Recession. However, significant trade diversion in terms of imports from non-members to members is suspected and found to increase by 54.81% after the economic crisis. Import diversion is found for the MERCOSUR association. This association led to a reduction in imports from non-member countries by 62.02% before the recession and 64.58% after 2008. No significant trade effect is found for NAFTA and SADC in both sub-periods. In general, the results reveal that the Great Recession decreased global agricultural trade and reduced the effectiveness of the free trade agreements. Trade benefits declined across all economic associations following the Recession.

6. Conclusion

In this paper, gravity models were respecified and estimated in static and dynamic to identify factors affecting global agricultural trade with focus on the impacts of regional free trade agreements and the role of the 2008 Great Recession. The evidence suggests that the dynamic gravity equation which accounts for persistence in trade flows is the most appropriate model. Moreover, the use of fixed effect models with controls for heteroscedasticity and the multilateral resistance yielded best results. The dynamic panel gravity and probit models

allowed to account for missing trade observations were estimated by a system-GMM estimator.

The results show that the EU, the ASEAN and EAC associations generated significant net agricultural trade creations. The EAC association resulted in a significant intra-bloc trade increase that is much larger that the inter bloc trade, leading to a significant net agricultural trade increase under the association. There was no significant trade effect for NAFTA and SADC. The MERCOSUR association led to trade diversion and insignificant intra- bloc trade effects. Among all RTAs included in this study, the EU, ASEAN, and EAC were more effective in increasing intra-bloc trade.

A comparative analysis of trade benefits before and after the Great Recession show notable differences. The EU, ASEAN, and EAC associations sustained a net agricultural trade creation before and after the Recession. However, the crisis impaired trade flows and reduced total effects of the economic blocs. The MERCOSUR trade diversion increased following the Recession. These findings demonstrate that the impacts of RTAs shifted and declined across all associations following the Recession. The EU and ASEAN associations were more effective in generating agricultural trade creation and openness than the other associations included in the study.

In general, the results are consistent with previous findings including Carrere (2006), Martinez-Zarzosso et al. (2009) and Sun and Reed (2010), among others. Gravity models can be respecified and applied to commodity groups while retraining gravitational variables. Characteristics inherent to the commodity groups such agricultural production should be included in modelling countries' agricultural trade flows.

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Appendix: List of Countries Included in the Study

Reporter/Partner Countries		Partner Countries Only
Algeria	Italy	Benín
Argentina	Japan	Cameroon
Australia	Kenya	Kuwait
Bahamas	Korea, Republic of	Norway
Bangladesh	Malaysia	Pakistan
Belgium	Mexico	Panama
Brazil	Morocco	Peru
Canada	Mozambique	Philippines
Chile	Netherlands	Poland
China	New Zealand	Portugal
China, Hong Kong SAR	Nicaragua	Uruguay
Colombia	Russia	
Costa Rica	Saudi Arabia	
Côte d'Ivoire	Senegal	
Denmark	Singapore	
Ecuador	South Africa	
El Salvador	Spain	
Finland	Sri Lanka	
France	Sweden	
Germany	Tanzania	
Greece	Thailand	
Guatemala	Tunisia	
Honduras	Turkey	
India	United Kingdom	
Indonesia	United States	
Ireland	Venezuela	

[1] The rejection of the null hypothesis for random effect using the Hausman test led to select fixed effects over the random effects models.

[2] In the first stage, the gravity equation is estimated using a panel random-effect probit with time and fixed effects. The linear predictions weighted by their standard errors (p1), as a proxy for firm heterogeneity, and the inverse mills ratio (IMR) are derived in the first stage. The gravity model is then estimated with time and fixed effects in the second stage using pooled OLS (including P1 and IMR).

[3] 186.23% = [exp (0.985)-1) *100] + [exp (-0.588)-1*100] + [exp (0.488)-1*100].

[4] 327.00% = [exp (1.342)-1) *100] + [exp (0.367)-1*100]. Insignificant ASEANmn coefficients are not included.