International Journal of Food and Agricultural Economics
ISSN 2147-8988, E-ISSN: 2149-3766
Vol. 9, No. 4, 2021, pp. 245-261

ASSESSING TRADE BENEFITS OF A TTIP AND THE ROLE OF REGIONAL TRADE FREE BLOCKS ON SOUTH CAROLINA AGRICULTURAL EXPORTS: A STATIC AND DYNAMIC GRAVITY MODEL APPROACH

David Karemera
School of Business, South Carolina State University, USA
Email : karemera @scsu.edu, ORCID ID: 0000-0002-0671-5424

Cynthia N'Dede
School of Business, South Carolina State University, USA

Gerald Hubbard Smalls
Johnson College of Business & Economics, University of South Carolina Upstate, USA, ORCID ID: orcid.org/0000-0003-3479-2555

Louis Whitesides
SC State 1890 Research and Extension, South Carolina State University, USA
ORCID ID: 0000-0003-1498-869X

Abstract

This study provides an analysis of the effects of a potential transatlantic free trade agreement (TTIP) on the US state of South Carolina agricultural exports and trade. Trade benefits are evaluated within the framework of static and dynamic gravity models. The panel gravity models and probit equations that account for zero trades are estimated by methods that deal with various effects. The results show that dynamic system GMM is the preferred estimator. World country panel trade data from 1989 to 2018 were used. The findings reveal that the TTIP would increase South Carolina agricultural among member countries. The other major regional blocks including the EU, ASEAN, and MERCOSUR are shown to be significant destination markets for South Carolina agricultural and exports and trade.
JEL Codes: *F13, F14, F15*
Key Words: *Agricultural production, Exports, ASEAN, Dynamic gravity models, EU, MERCOSUR, South Carolina, Trade expansion*

1. Introduction

International trade has grown substantially under bilateral and multilateral trade agreements. The proliferation of free trade agreements (FTAs), particularly the regional and bilateral free trade agreements (RTAs) has been one of the most prominent aspects of the global economy over the past 30 years (Urata & Okabe, 2007). While there is strong evidence that the proliferation of FTAs has contributed to increase trade between countries, there have been several debates on the extent of trade creation given the reported possibilities of trade diversion. Early studies on trade, including agricultural commodities and food trade have used

the popular gravity model to explain trade patterns between exporting and importing countries.

The studies by Greenaway & Milner, (2002); Cheng & Tsai, (2005); Carrere, (2006); Koo et al., (2006) and Dennis, (2006) focused the impact of regional trade agreements on bilateral trade. Urata & Okabe (2014) analyzed trade creation and trade diversion effects of regional free trade agreements and found that, owing to higher tariff rates for non-members countries, the RTAs caused more trade diversion in developing countries than in developed countries. Sun & Reed, (2010) focused on ASEAN – China preferential trade agreements and the EU Southern African Development Community and found that the agreements increased trade among members. Recent studies including Ghazalian, (2016); Mujahid & Kalkuhl, (2015); and Kazunobu Hayakawa, Tadashi Ito, & Fukunari Kimura, (2016) addressed the impacts of regional free trade agreement on agricultural products. In February 2013, the US and EU started negotiations to create the US-EU Transatlantic Trade and Investment Partnership, (TTIP). The Agreement connects the world's most developed economies; represents half the world's GDP, and one-third of its population (Suominen, 2013).

A successful TTIP negotiation will fundamentally alter trade flows on both sides of the Atlantic. The agreement will remove tariffs and nontariff barriers, harmonize costly food safety regulations, and sanitary and phytosanitary restrictions. It will create a transatlantic market with significant impacts on global agricultural trade, food safety and other sectors. Economic benefits and challenges are enormous.

The advent of a US-EU free trade agreement has spurred research to evaluate the potential impacts of TTIP. Several authors have already addressed some potential impacts of TTIP. Ikenson, 2013 wrote, "The Transatlantic Trade and Investment Partnership: A Roadmap for Success," and outlined steps for TTIP's success. The International Trade Commission (ITC, 2014) details s potential benefits of TTIP on US smalls businesses. This proposal will expand the ITC report on include small farmers, medium and large farmers and all agricultural exports with focus on South Carolina and address potential impacts of TTIP on farm exports.

Most past studies have analyzed the effects of free trade agreements on a national level in participating countries and as such, ignored an important possible effect of the agreement on specific states or regions. This is important because the TTIP effects cannot be the same across states or regions within a state. It is this lacking evaluation that we propose to address in this study.

Another fundamental shortcoming of previous trade study is that the majority of them used static models and ignored the dynamic nature of trade behaviors. They ignore that current trade behavior is affected by previous period trade flows. The studies failed to account for missing trade observations. Our research methods are an innovation in that we focus on TTIP impacts on South Carolina local farmers and farm exports. Missing trade observations are accounted for in panel probit gravity models in this study. This paper follows the methodology and estimates both static and dynamic gravity panel data models of agricultural trade and provide the potential impacts of TTP and extent of trade creation, diversion of NAFTA.

Furthermore, in this study, we identify the multilateral resistance terms and included dummy variables capturing bilateral flow pairs and time specific effects on trade volumes. Helpman et al. (2008) gravity equation accounts for firm heterogeneity and fixed trade costs and asymmetries between the volume of exports from country i to country j and the volume of exports from i to j is used in the econometric estimations of results. Hence, this section, we implement the Helpman et al (2008) econometric specifications and estimate both static and dynamic gravity panel models to analyse the effects of world regional free trade agreements and TTIP on South Carolina agricultural exports.

2. Methodology

2.1 Static Panel Gravity Models of State Agricultural Exports

The prototype static gravity model with empirical characteristics of agricultural trade is specified below

$$X_{ijt} = BY_{it}^{\beta 1} Y_{jt}^{\beta 2} y_{it}^{\beta 3} y_{jt}^{\beta 4} D_{ij}^{\beta 5} \times exp[\beta_6 TTIP_{ij} + л_1 EU_{ij} + л_2 NAFTA_{ij} + л_3 ASEAN_{ij} + л_4 MERCOSUR_{ij} \quad (1)$$

where X_{ij} is the amount of state i's agricultural exports to country *j*; Y_i (Y_j), i's agricultural GDP (j's GDP)'; y_i (y_j), i's per capita agricultural GDP (j's per capita GDP). The subscript i is fixed to 1 and represents to South Carolina (Sheldon, et al 2010). The variable TTIP is not yet a signed agreement. Thus, TTIP represents a trade flows from SC to a EU country and is equal to 1.0; otherwise is equal to zero. It is used to identify potential trade expansion arising from TTIP without regard to whether it is trade creating or trade diverting. The variable $NAFTA_{ij}$ is a dummy variable identifying flows between SC and the Canada or Mexico and is equal to 1.0, zero otherwise. Since the study does not deal with trade benefits of membership in the EU, ASEAN, and MERCOSUR. The blocks are included to identify the extent of the South Carolina agricultural exports competitiveness and penetration in these markets. The coefficients β and *л* are parameters and U_{ijt} is an error term. Complete list of free trade agreements and membership blocks are shown in Appendix A.

2.2 Dynamic Panel Gravity Models of State Agricultural Exports

A dynamic panel gravity model with a lagged dependent variable and a probit equation is specified to account for persistence in international agricultural trade. current period trades may be affected by previous period realizations. The models in log forms are:

$$lnX_{ijt} = b_{1ij} + \mu_{1ij} + \lambda_{1t} + \alpha_1 lnx_{ij,t-1} + \alpha_2 lnY_{it} + \alpha_3 lnY_{jt} + \alpha_4 lny_{it} + \alpha_5 lny_{jt} + \alpha_6 lnD_{ij} + {}_t + \alpha_7 TTIP_{ij} + + \varphi_{21} NAFTA_{TC} + \varphi_{22} NAFTA_{TD} + \varphi_1 EU_{ij} + \varphi_2 ASEAN_{ij} + \varphi_3 MERCOSUR_{ij} + e_{ijt} \quad (2)$$

and

$$F_{ijt} = b_{2ij} + \mu_{2ij} + \lambda_{2t} + \theta_1 lnx_{ij,t-1} + \theta_2 lnY_{it} + \theta_3 lnY_{jt} + \theta_4 lny_{it} + \theta_5 lny_{jt} + \theta_6 lnD_{ij} + \theta_7 TTIP_{ij} + \delta_{21} NAFTA_{TC} + \delta_{22} NAFTA_{TD} + \mu_1 EU_{ij} + \mu_2 ASEAN_{ij} + \mu_{13} MERCOSUR_{ij} + v_{ijt} \quad (3)$$

where μ_{ij} is a trade flow effect associated with i and j; λ_t is a time effect; γ is the adjustment coefficient. The coefficients α , θ, φ, δ, and μ are parameters, and v_{ijt} an error term. Equation (3) is a probit model that accounts for possible zero trade flows. F_{ijt} is a binary variable = 1.0 for positive flows from i to j; 0 otherwise.

To account for the possible zero or missing trade flows, a panel-equation (3) which is a probit model, where F_{ijt} is a binary variable that takes a value of 1 for positive flows from i to j; 0 otherwise. The export equation X_{ijt} and probit equation F_{ijt} are estimated by a Generalized Method of Moment–System (GMM) estimator proposed by Helpman et al. (2008). The estimated elasticities are used to compute trade effects of various RFTAs.

3 Econometric Results

3.1 Data Sources:

A summary of SC agricultural exports to EU and the rest of the world is shown in table 1. The table 1 displays exports and export shares by destination for major five major destination

of SC agricultural exports. In the last 6 years, Netherlands, Indonesia, Colombia, Taiwan and Hong Kong have been major destination of SC agricultural exports. The five countries account for over 50 % of SC farms exports to the world. Netherlands is the top destination and the only EU member in the top five destination of SC agricultural products.

Table 1. Comparison of SC Agricultural Export Markets Shares for Major SC Farm Export Destinations

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Netherlands	4.25%	3.82%	4.82%	10.82%	26.93%	34.68%	29.70%	23.75%	19.69%	18.62%
Indonesia	3.69%	4.57%	3.26%	3.47%	0.89%	4.57%	11.37%	11.71%	16.78%	9.50%
Colombia	4.46%	1.76%	7.03%	3.74%	1.63%	2.12%	1.70%	3.06%	4.41%	8.70%
Taiwan	5.29%	4.63%	5.63%	6.26%	9.52%	8.90%	5.87%	8.40%	6.68%	7.95%
Hong Kong	2.34%	0.94%	7.27%	21.38%	19.59%	7.85%	2.56%	5.88%	6.26%	7.76%
Top 5 subtotal	20.04%	15.73%	28.01%	45.68%	58.55%	58.12%	51.21%	52.80%	53.83%	52.53%
Rest of the World	79.96%	84.27%	71.99%	54.32%	41.45%	41.88%	48.79%	47.20%	46.17%	47.47%
World Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100.00%

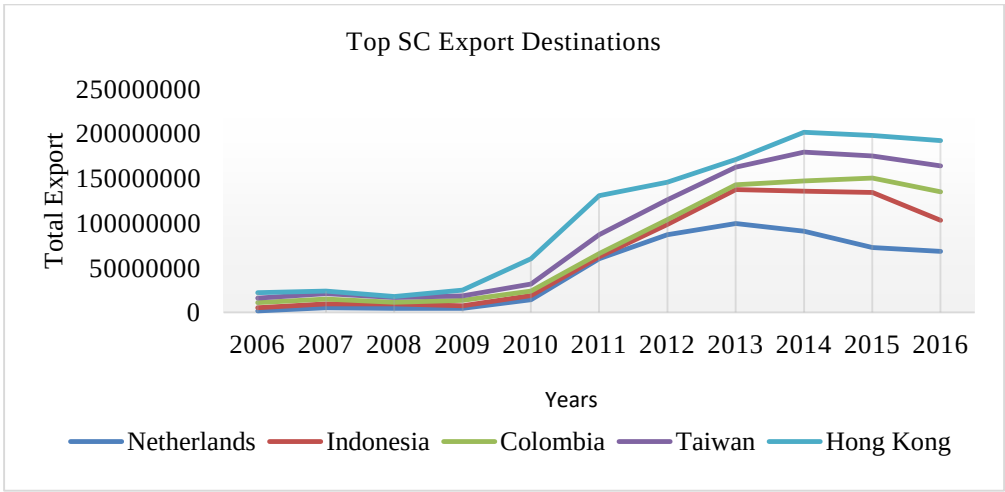

Figure 1. Top five Destinations of South Carolina Agricultural Exports

South Carolina agricultural exports increased substantially since 2010. While the Great Recession of 2008 may impair SC farm exports, the exports substantially increased since 2010 and reached highest levels in 2016. However, while SC farm export shares to the Netherlands declines continuously since 2011, it does not clear why the Netherlands has continued to remain the top destination of SC agricultural products. The country is not in the top four largest EU economies (Germany, United Kingdom, France, Italy are the top four richest EU countries- pending BREXIT). More efforts and export promotions programs could result in more market penetration in the European Union richest markets. The Appendix B shows list of countries that are major destinations of SC farm products. Moreover, figure 1 shown significant increases of SC farms exports following the end of the great recession in 2010.

Taiwan and Hong Kong while they have much economic sizes, they are in the top five destination of SC farm products. China the second largest world economy is not in the top five.

The agricultural Trade flow data are obtained from the HIS/Global Trade Atlas under one year subscription and from USDA websites. Exports data and other state financial characteristics were compiled into a trade matrix database. Data include state agricultural exports to EU and world countries, SC GDP and SC farm income, countries' GDP, distance between state export ports and country's importing ports, population, and GDP per capita, and variables representing major regional free trade agreements such TTIP, NAFTA, EU, ASEAN AND MERCOSUR. Country membership is shown in Appendix A by country and trade bloc.

3.2 An Empirical Specification of a Panel Gravity Model and Probit Equations

In the empirical specification of our model, traditional gravity variables and variable pertinent to agricultural trade flows are included to analyze the effects of factors affecting SC agricultural trade flows. The variables representing regional free trade agreements are included in this study. Gravity models typically use GDP to represent income (Linneman (1966); Bergstrand (1985, 1989); Summary (1989); Koo & Karemera (1993); Anderson, J.E., & van Wincoop, E. (2003); Hilbun, B.M. (2006) & Ghazalian (2016)). However, we include countries' per capita GDP to represent export agricultural export capacity and GDP to represent the purchasing power and absorption capacity and disposable income in importing countries. Pagoulatos & Sorensen (1975); Bergstrand (1989); Baier & Bergstrand (2009) and Markusen (2010) showed that there is more trade among countries with high per capita incomes.

Per capita production variable was included in model specification to reflect the unique characteristics associated with the agriculture in exporting and importing countries. An exporting country's per capita production was included to reflect the country's production and export capacity. A rise in the exporting country's per capita production leads to increased exports, and a positive coefficient sign is hypothesized. A rise in the production per capita in the importing country would be associated with reduced imports and a negative coefficient sign is expected. The agricultural production per capita is used to represent the production capacity in the exporting country and self-sufficiency in consumption for the importing country. Increases in the population of trading countries will likely increase the volume of trade.

The distance between countries (D_{ij}) is used a proxy for transportation costs and was included under the hypothesis that countries close to each other are more likely to have similar cultures or cultural heritages, similar patterns of production and consumption. Relative short distances between countries result in lower transportation costs and the countries have high incentives for trade with each other.

Table 2 through 5 present the regression results. Gravity models are estimated in static and dynamic specifications. For the static models, the ordinary least squares (OLS), the fixed effects, and two stage fixed effect estimation models are estimated. The dynamic panel models include the country-and-time fixed effect specifications and are implemented by use of the System Generalized Method of Moment estimator (GMM) developed and used by Blundell and Bond (1998, 1999). Table 2 and 3 highlight TTIP results while 3 and 4 present NAFTA results. Most of the parameters have the expected signs and are statistically significant, and consistent with previous studies. The factors affecting South Carolina agricultural exports are succinctly discussed below.

3.2.1 Static Regression Estimation of Trade Creation and Trade Diversion

Tables 2 and 3 present the estimated results for static panel equations. The first column in table 2 presents the results for the pooled OLS estimation. Most parameters estimates have expected signs and are statistically significant highlighting the importance of factors affecting South Carolina agricultural exports. All the estimated coefficients of income, production, and population, distance, have the expected signs and are statistically significant.

Table 2. The Impacts of a TTIP on SC Agricultural Exports: A Static Panel Gravity Model Estimation Results: 1989- 2016

	OLS with TTIP	**Fixed Effects/TTIP**	**2-Step Helpman/TTIP**	
Variables	Output Equation	Output Equation	Output Equation	Prediction Equation
Constant	-11.757*** (-6.89)	-13.977*** (7.97)	-18.664*** (-8.06)	0.76 (0.07)
Exporter's per capita GDP	12.182*** (2.64)	9.457** (2.07)	37.119* (1.74)	-13.906 (-0.65)
Importer's per capita GDP	25.594*** (10.30)	21.961*** (8.72)	50.619* (1.67)	-20.308 (-0.98)
Exporter's GDP	0.149 (0.46)	0.269 (0.82)	-2.522 (-1.02)	1.633 (1.00)
Importer's GDP	-24.957*** (-10.10)	-21.375*** (-8.53)	-49.580* (-1.66)	19.968 (0.99)
Distance	-0.578*** (-8.05)			
Exporter's Population	0.930*** (2.89)	0.771** (2.39)	3.366 (1.56)	-1.427 (-0.81)
Importer's Population	25.444*** (10.27)	21.771*** (8.67)	49.520* (1.69)	-19.615 (-0.98)
Exporter's per capita Production	-3.691*** (-12.01)	-3.657*** (-11.86)	-4.727*** (-2.92)	1.083 (0.93)
Importer's per capita Production	0.205*** (4.24)	0.207*** (4.23)	0.091 (0.54)	0.106 (0.39)
TTIP	0.969*** (11.84)	1.077*** (13.70)	-3.338 (-0.65)	3.449** (2.39)
ASEAN	1.555*** (13.46)	1.100*** (9.96)	-2.98 (-0.61)	3.278** (1.91)
MERCOSUR	1.065*** (10.09)	1.21*** (11.64)	-2.001 (-0.53)	2.524** (2.17)
Zhat			1.176 (0.79)	
Inverse Mills Ratio			-0.954*** (-4.888)	
Statistics				
N	2344	2344	2344	2671
RMSE	1.359	1.381	1.375	
Log Likelihood Value				-535.14***
R^2	0.479	0.462	0.468	

Notes: T-stats are in parentheses - *, **, and *** indicate significance at 10%, 5% and 1% respectively

Table 3. The Impacts of NAFTA and other FTAs on SC agricultural Exports: Static panel gravity model estimation results: 1989- 2016

	OLS With NAFTA	**FIXED EFFECT/NAFTA**	**Helpman /NAFTA**	
Variables	Output Equation	Output Equation	Output Equation	Prediction Equation
Constant	-12.965*** (-10.13)	-13.781*** (-7.80)	6.250 (0.29)	-9.09 (-1.28)
Exporter's per capita GDP	21.696*** (11.87)	.224 (0.65)	13.625 (1.45)	3.891 (0.44)
Importer's per capita GDP	0.380*** (13.41)	-21.142*** (-8.40)	0.614*** (2.96)	-0.087 (-0.43)
Distance	-0.488*** (-5.45)			
Exporter's Population	1.342*** (23.93)	0.816** (2.45)	0.745 (1.31)	0.241 (0.67)
Importer's Population	0.367*** (6.29)	21.516*** (8.53)	-0.676 (-0.75)	0.388 (0.84)
Exporter's per capita Production	-4.582*** (-15.54)	-3.402*** (-10.04)	-9.04** (-2.10)	1.83 (1.61)
Importer's per capita Production	0.158*** (3.19)	0.218*** (4.39)	-0.124 (-0.39)	0.131 (0.56)
NAFTA_TC	-0.253 (-0.85)	0.89*** (4.44)	4.404 (1.32)	-1.461 (-0.88)
NAFTA_TD	0.192 (1.63)	-0.142 (-1.20)	0.243 (1.45)	-0.045 (-0.36)
EU	1.498***	1.119***	-5.465**	2.775***
	(3.06)	(2.89)	(-3.68)	(3.22)
ASEAN	0.836*** (5.55)	1.152*** (10.21)	-5.241 (-0.86)	2.6*** (2.27)
MERCOSUR	1.023*** (8.73)	1.255*** (11.81)	-3.838 (-0.78)	2.1 (2.36)
Zhat			2.456 (1.04)	
Inverse Mills Ratio			-0.197 (-0.89)	
Statistics				
N	2344	2344	2344	2671
RMSE	1.747	1.379	1.4088	
Log Likelihood Value				-538.29
R^2	0.459	0.4644	0.4408	

Notes: T-stats are in parentheses - *, **, and *** indicate significance at 10%, 5% and 1% respectively

Although most estimated coefficients seem correct in terms of signs and significance, the results are biased due to the omission of the multilateral resistance terms in the gravity equation (Anderson & van Winn coop, 2003). Adding time fixed effects in the gravity equation improves slightly the significance of the parameters and increasing each coefficient. The parameters for fixed effects model are estimated in a two-stage estimation approach to account

for selection bias and firm heterogeneity[1] (Helpmann et al., 2008). Relative to the OLS and the fixed effects model, the GMM system estimators improve results in terms of the magnitude and significance of the estimates. The linear prediction p1 is negative and statistically significant while the inverse mills ratio is positive and statistically significant. This finding indicates evidence of selection bias and firm heterogeneity, thus slightly biased OLS estimates.

Table 4. The Impacts of a TTIP on SC agricultural Exports: A dynamic Panel Gravity Model Estimation Results: 1989- 2016

	FE With TTIP	**SYSTEM GMM/TTIP**
Variables	Output Equation	Output Equation
Constant	-3.378*** (-2.74)	-8.360** (-2.25)
Lagged Exports	0.712*** (35.46)	0.238*** (4.34)
Exporter's per capita GDP	1.923 (0.63)	10.775 (1.12)
Importer's per capita GDP	6.661*** (3.93)	-23.088*** (3.94)
Exporter's GDP	0.211 (0.92)	-0.158 (-0.25)
Importer's GDP	-6.483*** (-3.86)	-22.620*** (-3.89)
Distance	-0.143*** (-2.72)	-0.423** (-2.50)
Exporter's Population	0.133 (0.58)	0.904 (1.42)
Importer's Population	6.617*** (3.92)	22.944*** (3.94)
Exporter's per capita Production	-1.191*** (-5.27)	-2.295*** (-3.31)
Importer's per capita Production	0.069* (1.74)	0.201* (1.82)
TTIP	0.267*** (4.52)	0.682*** (291.00)
ASEAN	0.403*** (4.80)	1.082*** (2.75)
MERCOSUR	0.315*** (3.84)	0.739** (2.47)
Statistics		
N	2294	2185
RMSE	1.747	
Log Likelihood Value	-4525.685	
R^2	0.197	
AR1		-4.94***
AR2		-0.48
Sargan test		5.64
Hansen test		2.57
Hansen Diff test		0.6

Notes: T-stats are in parentheses - *, **, and *** indicate significance at 10%, 5% and 1% respectively

Table 5.The Impacts of NAFTA and other FTAs on SC Agricultural Exports: A Dynamic Panel Gravity Model Estimation Results: 1989- 2016

	FE With NAFTA	**System-GMM /NAFTA**
	Output Equation	Output Equation
Variables		
Constant	-4.905*** (-5.49)	2.53 (0.35)
Lagged exports	0.731** (37.70)	0.661*** (7.17)
Exporter's per capita GDP	6.392*** (5.11)	31.891** (2.02)
Importer's per capita GDP	0.103*** (5.30)	0.225 (1.56)
Distance		-0.673 (-1.37)
Exporter's Population	0.386*** (9.07)	0.499 (1.43)
Importer's Population	0.807* (1.88)	-0.304 (-1.05)
Exporter's per capita Production	-1.28*** (-6.31)	-2.432** (-2.40)
Importer's per capita Production	0.581 (1.46)	0.541** (2.10)
NAFTA_TC	0.203 (1.12)	-5.678 (0.62)
NAFTA_TD	0.060 (0.76)	0.329 (1.01)
EU	0.363*** (6.35)	-0.119 (-0.40)
ASEAN	0.277*** (3.47)	1.465** (2.26)
MERCOSUR	0.368*** (4.49)	0.536 (1.65)
Statistics		
N	2245	2245
RMSE	0.9109	
R^2	0.7461	

Notes: T-stats are in parentheses - *, **, and *** indicate significance at 10%, 5% and 1% respectively

3.2.2. Dynamic Regression Estimation of TTIP Effects and NAFTA Trade Creation and Trade Diversion

Results for the dynamic gravity panel model are presented in table 4 and 5. Traditional gravity panel models are often statics and assume contemporaneous trade effects of regressors and ignore the persistence of exports and trade (Bun & Klaasen, 2002; Benedictis et al., 2005). Hence, the lagged dependent variable is included to capture the export dynamics. The lagged export's coefficient has a positive and statistically significant at 1% level, indicating significant trade dynamics, a result that is consistent Martinez-Zarszoso et al., (2009). Bun & Klaasen (2002) report that the significant estimate for lagged trade represents also the effect

of unobserved country-pair specific time invariant factors present in both current and lagged trade, and the number of significant estimates in the dynamic is lower also compared to the static form. This confirms previous study by Martinez-Zarszoso et al., (2009), which suggest that the reduction in significance may be due to the integration dummies picking up part of the persistence effect. The GMM estimates of the dynamic specifications offer unbiased and consistent and are used for inferences.

In table 4 and 5, the estimation results of the system GMM are reported. The coefficient for the lagged exports is positive and statistically significant at 1%. Most coefficients have expected signs and are significant in most cases. The system GMM is robust to heterosckedascity and autocorrelation. The magnitudes of the coefficients are remarkably low, suggested that the estimated dynamic models are stable.

The results from the system GMM are presented in the second column of table 4 under a TTIP and table 5 under NAFTA. They provide results from the GMM estimation in which the lagged dependent variable and the lagged values of the integration dummies are used as instruments. The system GMM presents better results in terms of standard errors, significance and magnitude. The Hansen test p-value (0.108) fails to reject that the null hypothesis that the overidentification restrictions are valid, thus the model is valid here. In addition, the system GMM estimates are robust to heteroskedasticity and autocorrelation.

4. The Effects of Income, Production and Population on SC Farm Exports

The estimated coefficients of income, population and production have the expected signs and are significant at the 1% level. With respect to estimated coefficients of income, the results suggest that an increase in per capita income in trading countries leads to increased South Carolina agricultural trade flows. The coefficients are significant and positive in most models. The magnitudes of the exporter coefficients are greater than 1.0, suggesting that these farm exports are more sensitive to change in per capita incomes in the exporting country. The estimated per capita income elasticities in importing countries are also greater than 1.0, suggesting that agricultural product imports are sensitive to changes in income or purchasing power in importing countries.

The results show that the population of trading countries is a significant factor enhancing trade flows. A rise in the importing country's population lead to increased consumption needs while increases in exporting country's population lead to increases production. The estimated elasticities were positive and significant at the 1% level almost uniformly. This result is consistent with Hilbun (2006). The magnitudes of the elasticities are less than 1.0 suggesting that quantities of commodities traded are not sensitive to changes in trading country populations.

Per capita production variables in exporting and importing countries have significant at the 1% level, in most cases. However, the signs indicate mixed impacts. The exporter's per capita production was included to represent production capacity. The results suggest that the increase in SC population leads to reduced agricultural exports. The estimated elasticities are greater than 1.00 the exporting countries, suggesting that trade flows are sensitive to changes in the production capacity. The insensitivity to domestic production changes by importing countries may be due to the fact that agricultural production and exports include staple products.

5. The Effects of Distance

The theory of spatial equilibrium suggests that the quantity of commodity trade varies inversely with distance. The estimated coefficients of distance are negative and significant at 1% level in most cases. However, the degree of significance varies by specification and estimation method. The findings suggest that distance is one of the major factors affecting South Carolina agricultural trade patterns.

5.1 Potential Impacts of Free Trade Agreements on SC Farm Exports

5.1.2 Impact of TTIP on SC Farm Exports: Simulation Results and Policy Implications

In order to project the impacts of TTIP on SC farm export to EU, a simulation exercise was conducted that is based on the econometric results. Specifically, we assume that the TTIP will remove all tariff barriers to SC exports to EU member countries. For comparative purposes, we also simulate trade benefits for states in the southeast region. Thus, following a complete removal of trade barriers under a TTIP, we simulate the changes in agricultural trade for South Carolina, Georgia, Florida and North Carolina by use of the following formula:

$$\Delta T_k = \beta_1 * \%\Delta t * T_k \quad (4)$$

where ΔT is the potential expansion in agricultural exports from the state k to the EU countries. The notation Δt is the percentage change in tariffs. The notation T_k is the current value of agricultural exports from the state k to the EU countries. Therefore, we expect SC agricultural exporters to expand their sales in the EU under the proposed TTIP reform. We display the simulated trade effects below in table 5a and 5b.

Table 5a. Potential TTIP Impact on State Agricultural Exports under Different Tariff Cut Scenarios in the US Southeast States.

State	2016 Agricultural	Scenario 1	Scenario 2	Scenario 3
	Export value ($1000.00)	Tariff cut =3%	Tariff cut =5%	Tariff cut=7%
		increases in agricultural exports		
South Carolina	$365,274.00	$13,149.88	$21,916.46	$30,683.04
Georgia	$1,066,739.00	$38,402.59	$64,004.31	$89,606.04

Table 5b. Potential TTIP Impact on State Agricultural Trade Flows (Exports +Imports) under Different Tariff Cut Scenarios in Southeast States.

State	2016 Agricultural	Scenario 1	Scenario 2	Scenario 3
	Trade Value ($1000.00)	Tariff Cut =3%	Tariff Cut =5%	Tariff Cut=7%
		Increases In Agricultural Trade Flows		
North Carolina	$1,777,906.00	$64,004.62	$106674.37	$149,344.12
Florida	$6,348,308.00	$228,539.09	$380898.48	$533,257.88
South Carolina	$833,066.00	$29,990.37	$49,983.94	$69,977.58
Georgia	$2,974,326.00	$107,075.73	$178,459.56	$249,843.58

Table 5a was constructed using the simulation model (4) and the level of exports under alternative tariff cut scenarios following a TTIP agreement. South Carolina would experience agricultural exports of up to $30.68 million as result of a TTIP tariff cuts alone. The State of Florida, a large agricultural producing state will benefit the most among South-eastern states. Since TTIP is not yet a free trade agreement, we are not able to separate trade creation and trade diversion. We estimate a total a TTIP agricultural trade expansion using trade flows

(exports + imports.). Since SC farms imports are than the exports, we evaluated total impacts of TTIP on trade flows regardless of whether it is trade creating or diverting. Table 5b shows that TTIP will boost South Carolina agricultural trade flows up to $69.97 million. Again, the State of Florida is the highest beneficiary of a TTIP among the southeast region.

The above tables show that SC is less competitive in foreign agricultural markets than the rest of the U.S. South East states. However, TTIP is expected to boost SC farm export products under a potential full implementation of a TTIP agreement. The State of Florida, a large coastal state benefits the most among the Southeast states.

5.2 Role of Other Major Regional Free Trade Blocks

Appendix A shows world regional free trade agreements and membership for the RFTAs included in the study. When countries enter into free trade agreements, two effects occur: trade creation and trade diversion effects. A trade creation occurs when a beneficiary country's imports displace higher cost domestic production. A member country 'exports diverted from non-beneficiary countries to beneficiary countries are a trade diversion. In the following variables, a subscript m identifies trade among member countries of a trading bloc, a trade creation; while subscript n indicates trade between member countries and non-member countries, a trade diversion.

For example, in equation 3, the dummy variable $NAFTA_{TC}$, represents a trade flow between two NAFTA countries, and was included to identify and estimate NAFTA's trade creation effects. Another dummy variable, $NAFTA_{-TD,}$ represents a trade flow between NAFTA member countries and non-NAFTA countries included in the study period. The variable, $NAFTA_{TD,}$ is used to identify the extent of trade diversion.

There is evidence of trade effects for NAFTA in both static and dynamic specification. However, the effects are not significant in most models. Table 3 shows a significant NAFTA trade creation and an insignificant trade diversion. The results show that NAFTA countries are major destinations of South Carolina farm products. In table 5, the NAFTA coefficients are not significant indicating little trade creation effects and diversion effects.

The GMM estimates are unbiased and robust to heteroskedasticity. Thus, we use GMM system estimates to further analyze the impact of NAFTA. From the second column of table 3, we find evidence of net trade creation ($\delta_{21}+\delta_{22}$) from NAFTA. Example, the NAFTA estimates show that NAFTA-increase agricultural trade flows by $17.13 million in trade creation and $21.28 million in trade diversion for a total trade flows expansion of $38.41 million. This finding suggests that both South Carolina agricultural exporters and consumers benefited from the NAFTA tariff reforms. Since the amount of trade diversion is greater than the amount of trade creation, this result also suggest that SC consumers benefited more from NAFTA than did the farm producers. However, the results vary by model. In table 5, the NAFTA coefficients in the dynamic models not significant indicating little trade creation and diversion effects. The lack of significance may be attributed to the fact that SC agricultural exports are a small portion of the United States agricultural exports to Canada and Mexico.

The results also reveal that EU countries are significant destination of SC agricultural export products. The findings suggest that South Carolina agricultural exports have successfully penetrated the economic blocks of APEC, ASEAN and MERCOSUR markets. The coefficients are mostly significant at 1% level for most of the associations. The evaluation of trade benefits of SC partners is beyond the scope of this study but it would be pursued in an additional research agenda.

An analysis of individual receiving countries show that the top three significant destinations are the Netherlands, Indonesia and Colombia as shown in table 1. The estimation

indicates that Netherlands is significantly the top destination of SC farm exports. The result suggests the need for SC to target and penetrate the major world economies such as China, Japan and German and increase the agricultural exports shares to these world major economies.

6. Conclusion

In this paper, a static and dynamic gravity models were specific and estimated to identify major determinants of South Carolina agricultural exports. The impacts regional free trade agreements on the exports were analyzed and evaluate with focus on the potential impact of TTIP and NAFTA. The use of panel data and the panel probit models allowed to account for missing observations. The GMM estimator proved to be slightly superior to the static estimators. While most results seemed sensitive to model specifications, the GMM results appeared to be unbiased and consistent and were used for inferences.

It is found that the Netherlands, Indonesia and Colombia are the top three destinations of SC agricultural exports. Taiwan and Hong end up in the top five destination of SC farm products. The five countries account for over 50 % of all SC agricultural exports to the world. However, the result suggests the need for SC to explore trade opportunities with major world economies such as China, Japan and German and increase the agricultural exports shares to the three world major economies.

There is evidence that the specification of the gravity model in dynamic form is important as including the lagged bilateral trade and the fixed effects in the gravity model obviously capture the dynamic trade among trade partners, control for heteroscedasticity, and the multilateral resistance terms. Future regional studies should include panel gravity models and probit specification models in trade research.

This study addressed the agricultural trade relationship between the State of South Carolina and the rest of the world. The potential trade impact of TTIP on SC agricultural exports are significant. The results suggest that TTIP would increase SC farm exports alone by an average of $67.99 million per year because of a complete tariff cut alone on SC agricultural exports to EU countries.

In general, there are significant trade expansion effects arising from a TTIP and moderate benefits from NAFTA in agricultural trade. Indeed, NAFTA estimates show that NAFTA increased agricultural trade flows by $17.13 million in trade creation and $21.28 million in trade diversion for a total trade flows expansion of $38.41 million. South Carolina agricultural exports have successfully penetrated domestic markets in the economic blocks of the of EU, ASEAN and MERCOSUR. The benefits of membership in the three associations are not the subject of this study. One limitation in this analysis is that the study was completed before NAFTA was replaced by USMCA (United States Mexico Canada trade) agreement. Thus, the estimated benefits of USMCA are not available. However, the topic is a useful agenda for future research.

Acknowledgement

David Karemera is a professor at the School of Business, South Carolina State University. Cynthia Ndede is adjunct Professor at University of South Carolina State University, Gerald Hubbard Smalls is a professor at the University of South Carolina Upstate while Louis Whitesides is the 1890 Research Administrator at South Carolina State University. The authors acknowledge the financial support from the US Department of Agriculture under a NIFA grant with the Evans-Allen project number SCX-101-08-1. The project was approved when the TTIP was still in active negotiations.

References

Anderson, J. E., & Van Wincoop E. (2003). "Gravity with Gravitas: A Solution to the Border Puzzle." American Economic Review, 93 (1): 170-192.

Baier, S. & Bergstrand, J., (2009). "Estimating the effects of free trade agreements on international trade flows using matching econometrics" Journal of International Economics, 77, (1), 63-76

Benedictis, L. D. & Vicarelli, C.(2005). "Trade Potentials in Gravity Panel Data Models" *The B.E. Journal of Economic Analysis & Policy*, vol. 5, no. 1, pp. 00001015153806531386. https://doi.org/10.1515/1538-0653.1386

Bergstrand, J. H. (1985). "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence." Review of Economics and Statistics. August. 481-8.

Bergstrand, J. H. (1989). "The Generalized Gravity Equation, Monopolistic Competition, and the Factor Proportions Theory in International Trade" Review of Economics and Statistics. February. 143-53.

Blundell, R., & Bond, S. (1999): GMM estimation with persistent panel data: an application to production functions, IFS Working Papers, No. W99/04, Institute for Fiscal Studies (IFS), London, http://dx.doi.org/10.1920/wp.ifs.1999.9904.

Blundell, R. & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. Journal of Econometrics, 87, 115–143.

Bun, M. J.G. & Klaassen, F., (2002), "Has the Euro increased Trade?", Tinbergen Institute Discussion Papers, Tinbergen Institute No 02-108/2

Carrere, C. (2006). "Revisiting the effects of regional trade agreements on trade flows with proper specification of the gravity model." European Economic Review, 50(2). 223-247.

De. Benedictis, L., & Vicarelli, C. (2005). "Trade potentials in gravity panel data models." Topics in Economic Analysis and Policy, 5(1), 1-31.

Dennis, A. (2006)" The Impact of Regional Trade Agreements and Trade Facilitation in the Middle East and North Africa Region." *World Bank Policy Research Working Paper, The World Bank, Washington.*

Egger, P. (2004). "Estimating regional trading bloc effects with panel data. Review of World Economics." 140(1), 151-166.

Ghazalian. P. L. (2016). "The Effects of NAFTA/CUSFTA on Agricultural Trade Flows: An Empirical Investigation." Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie. IHS Market/ Global Trade Atlas, Inc. (2017). World Trade Flows, Various issues, Colorado, USA.

Greenaway, D. & Milner, C. (2002). "Regionalism and Gravity. Scottish Journal of Political Economy". Scottish Economic Society.

Hayakawa, K., Ito, T., & Kimura, F. (2016). "Trade Creation Effects of Regional Trade Agreements: Tariff Reduction versus Non-tariff Barrier Removal." Review of Development Economics, 20(1), 317-326. https://doi.org/10.1111/rode.12208.

Helpman, E., Melitz, M., & Rubinstein, Y. (2008). "Estimating trade flows: Trading partners and trading volumes." The quarterly Journal of Economics, 123(2), 441-487.

Hilbun, B. M. "Analysis of Trade in the Western Hemisphere Utilizing a Gravity Model Framework." (2006). http://etd.lsu.edu/docs/available/etd-04192006102931/unrestricted/Hilbun_thesis.pdf

Ikenson, D. (2013). "The Transatlantic Trade and Investment Partnership: A Roadmap for Success." Free Trade Bulletin, Center for Trade Policy Study, Cato Institute, Washington DC.

Koo, W. W., & Kennedy, P. L. (2006). "The Impact of Agricultural Subsidies on Global

Welfare". *American Journal of Agricultural Economics*, 88(5), 1219–1226. http://www.jstor.org/stable/4123595

Koo, W. & Karemera, D. (1993) "Trade Creation, Diversion Effects and Exchange Rate Volatility in the Global Meat Trade". Journal of Economic Integration. Vol.30 No.2, June 2015, 240~268 http://dx.doi.org/10.11130/jei.2015.30.2.240

Linnemann, H. (1966) "An Econometric Study of International Trade Flows." *Holland Publishing, Amsterdam.*

Markusen, A. & Gadwa, A. (2010). "Arts and Culture in Urban or Regional Planning: A Review and Research Agenda". Journal of Planning Education and Research, 29(3), 379–391. https://doi.org/10.1177/0739456X09354380

Martinez-Zarzoso, I., Felicitas, & Horsewood, N. (2009). "Are regional Free Trade Agreement Beneficial? Static and dynamic Panel Gravity Models." The North American Journal of Economics and Finance, V. 20 ,1, March.

Mujahid, I. & Kalkuhl, M. (2015). "Do Trade Agreements Increase Food Trade?" The World Economy.

Pagoulatos, E. & Sorensen, R., (1975). "Two-way International trade: An econometric analysis," Review of World Economics vol. 111(3), pages 454-465.

Sapir, A. (1981)," Trade Benefits under the EEC Generalized System of Preferences", European Economic Review, 15 pp339-355.

Sheldon K. M., Abad N., Ferguson Y., Gunz A., Houser-Marko L., Nichols C. P., & Lyubomirsky S. (2010). "Persistent pursuit of need-satisfying goals leads to increased happiness: A 6-month experimental longitudinal study. Motivation and Emotion", 34(1), 39–48. https://doi.org/10.1007/s11031-009-9153-1

Summary, R.M. (1989). "A Political-Economic Model of U.S. Bilateral Trade". The Review of Economics and Statistics. 71 (1): 179–182. doi:10.2307/1928068. JSTOR 1928068

Sun, L., & Reed, M. R. (2010). "Impacts of Free Trade Agreements on Agricultural Trade Creation and Trade Diversion." American Journal of Agricultural Economics 92:5, 1351-1363. World Bank. World Development Indicators. Various Issues. Washington, DC: World Bank.

Suominen, K. (2013). "The case for TAFTA. Foreign Policy." Reviewed from: http://www.foreignpolicy.com/articles/2013/02/013/the_case_for_tafta_us_europe_free_trade?wpisrc=obnetwork, accessed November 2013.

South Carolina Agricultural Statistics. Various issues. SC Agricultural Statistics Service, Columbia, SC.

US International Trade Commission https://ustr.gov/about-us/policy-offices/press-office/press-releases/2014/March/USITC-Releases-Report-How-TTIP-Will-Benefit-Small-Business, retrieved May 12, 2015.

Tuan, H.L., Chin, C.C., Tsai, C.C. & Cheng, S.F. (2005) "Investigating the Effectiveness of Inquiry Instruction on the Motivation of Different Learning Styles Students". International Journal of Science and Mathematics Education, 3, Pages 541-566.

Urata, S. & Okabe, M. (2007). "The Impacts of Free Trade Agreements on Trade Flows: An Application of the Gravity Model Approach". Discussion papers, Research Institute of Economy, Trade, and Industry (RIETI)

Urata, S. & Okabe, M. (2014). "Trade Creation and Diversion Effects of Regional Trade Agreements: A Product-level Analysis," The World Economy, Wiley Blackwell, vol. 37(2), pages 267-289, February.

Appendix A
(Complete list of free trade agreements and membership blocks)

Major World Regional Free Trade Blocs and Membership

1. North American Free Trade Agreement, NAFTA:		
UnitedStates	Canada	Mexico
2. European Union Member, EU:		
Austria	Belgium	Bulgaria
Cyprus	CzechRepublic	Denmark
Estonia	Finland	France
Germany	Greece	Hungary
Ireland	Italy	Latvia
Lithuania	Luxembourg	Malta
Netherlands	Poland	Portugal
Romania	Slovakia	Slovenia
Spain	Sweden	United Kingdom
3. Association of South East Asian Nations: ASEAN		
Brunei	Burma	Cambodia
Indonesia	Laos	Malaysia
Myanmar	Philippines	Singapore
Thailan	Vietnam	
4. Common Market of the South America, MERCOSUR:		
Argentina	Brazil	Paraguay
Uruguay		
5. ASIAN –Pacific Economic Cooperation: APEC		
Australia	Republic of Korea	Vietnam
Russia	Brunei Darussalam	Malaysia
Singapore	Chinese Taipei	Canada
Mexico	Thailand	The United States
New Zealand	Peru	Indonesia
Peoples Republic of China	Hong Kong, China	Japan
Philippines	Papua New Guninew	
6. TTIP = Transatlantic Trade And Investment Partnership: U Countries + U.S.		

Appendix B

List of Countries Included in the Dataset

Reporter State	Destination Country
South Carolina	Argentina
South Carolina	Australia
South Carolina	Bangladesh
South Carolina	Belgium
South Carolina	Benin
South Carolina	Canada
South Carolina	Chile
South Carolina	China
South Carolina	Colombia
South Carolina	Costa Rica
South Carolina	Czech Republic
South Carolina	Denmark
South Carolina	Ecuador
South Carolina	Egypt
South Carolina	Italy
South Carolina	Japan
South Carolina	Republic of Korea
South Carolina	Malaysia
South Carolina	Mexico
South Carolina	Morocco
South Carolina	Mozambique
South Carolina	Netherlands
South Carolina	New Zealand
South Carolina	Nicaragua
South Carolina	Nigeria
South Carolina	Norway
South Carolina	Pakistan
South Carolina	Panama
South Carolina	Peru
South Carolina	Russia
South Carolina	Saudi Arabia
South Carolina	Senegal
South Carolina	Singapore
South Carolina	South Africa
South Carolina	Spain
South Carolina	Sri Lanka
South Carolina	Sweden
South Carolina	Tanzania
South Carolina	Thailand
South Carolina	Tunisia
South Carolina	United Kingdom
South Carolina	Venezuela

[1] The gravity equation is first estimated using a panel random-effect probit with time and country fixed effects. The linear predictions down weighted by their standard errors (p1), which is a proxy for firm heterogeneity, and the inverse mills ratio (IMR) are computed from this first stage estimation and then included in the second stage; in the second stage estimation, the gravity model is estimated with time fixed effect using pooled OLS (including p1 and IMR).