Trade Creation and Diversion Effects of Selected Bilateral and Regional Free Trade Agreements and Exchange Rate Volatility in the Global Meat Trade

DAVID KAREMERA
SOUTH CAROLINA STATE UNIVERSITY

WON KOO
NORTH DAKOTA STATE UNIVERSITY

and
LOUIS WHITESIDES
1890 RESEARCH
SOUTH CAROLINA STATE UNIVERSITY

I. Introduction

- **A shortcoming of most gravity models is the use of aggregate commodity trade flows.**
- **In this study, we derive a specific gravity model for meat trade**
- **We use the international trade flow data for major meat categories: Bovine and swine meat products.**

II. Background: EMPIRICAL CHARACTERISTICS OF GRAVITY MODELS

- **The typical gravity model has three components:**

1) Economic factors affecting trade flows in origin country;

2) Economic factors affecting trade flows in destination countries;

3) Natural or artificial factors enhancing or restricting trade flows.

Table 1: Comparison of bovine export markets shares for major Bovine meat exporting Countries

	Years									
Country	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Australia	15.05%	19.02%	16.34%	14.57%	19.21%	17.69%	16.24%	15.17%	14.66%	13.20%
Brazil	5.39%	7.74%	7.77%	8.78%	12.23%	13.46%	14.96%	14.99%	12.69%	11.18%
Netherlands	7.84%	6.05%	7.73%	9.26%	9.54%	9.72%	9.70%	9.98%	10.18%	10.79%
United States of America	23.32%	21.87%	19.13%	19.43%	3.00%	4.31%	6.41%	7.77%	9.08%	9.16%
Germany	6.06%	7.14%	7.28%	7.16%	7.83%	6.81%	7.40%	7.32%	7.98%	8.25%
France	5.64%	3.31%	4.72%	5.65%	5.40%	5.01%	5.09%	5.12%	5.09%	5.30%
Denmark	2.09%	1.75%	1.88%	1.67%	1.87%	1.75%	1.61%	1.63%	1.63%	1.82%
Total Exports Countries	65.39%	66.88%	64.85%	66.52%	59.08%	58.75%	61.41%	61.98%	61.32%	59.70%

Fig. 1. Major Meat Exporting countries and Fluctuating Behavior of US meat Exports

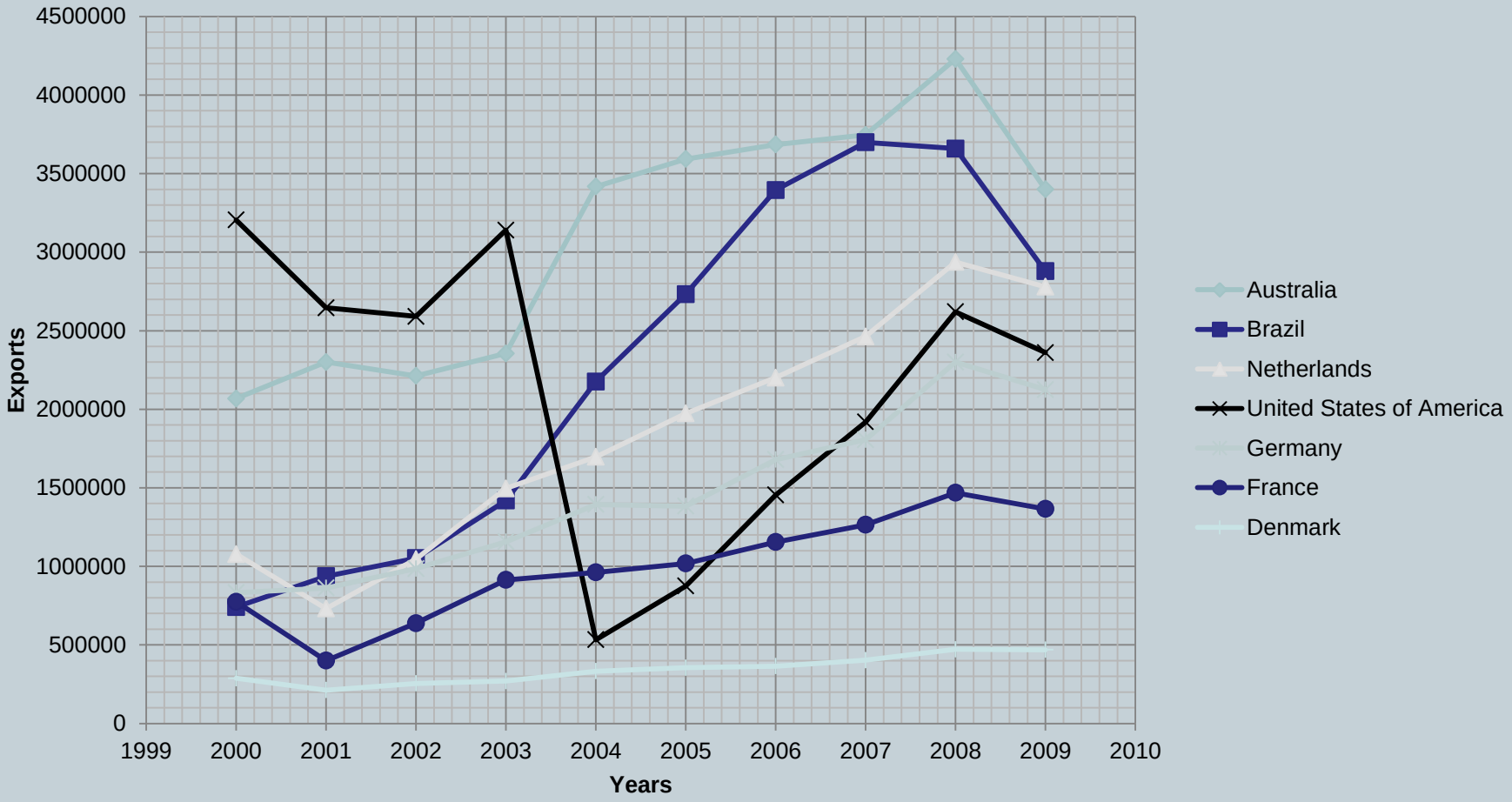
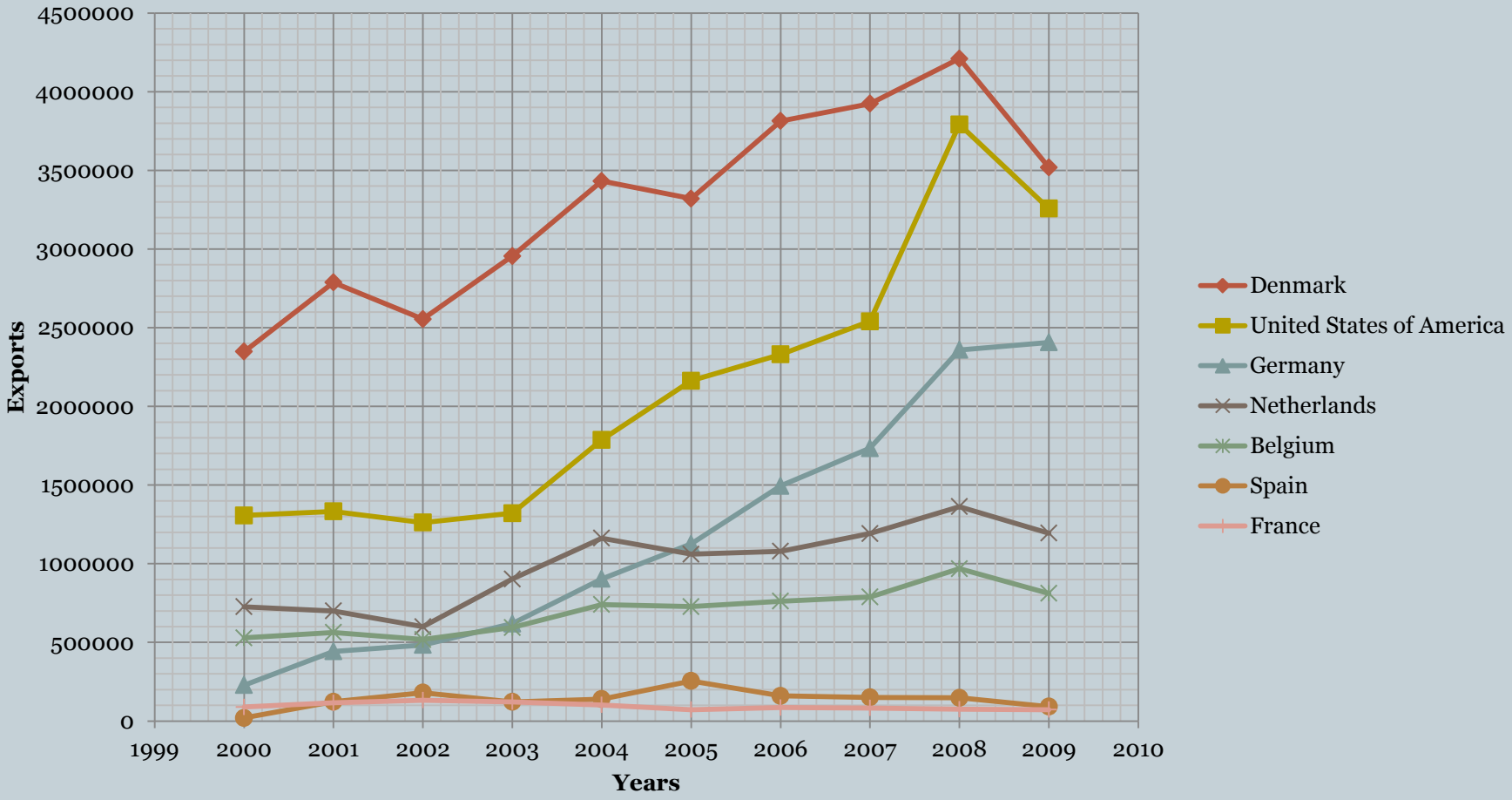


Table 2: Comparison of Swine Exporting Countries(export shares)

Country	Years 2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Denmark	31.92%	33.51%	32.23%	31.32%	28.63%	26.19%	27.17%	25.92%	22.28%	21.41%
United States of America	17.77%	16.02%	15.92%	14.00%	14.91%	17.06%	16.61%	16.78%	20.06%	19.82%
Germany	3.11%	5.32%	6.10%	6.56%	7.54%	8.88%	10.65%	11.45%	12.48%	14.64%
Netherlands	9.87%	8.41%	7.57%	9.56%	9.70%	8.37%	7.69%	7.87%	7.21%	7.27%
Belgium	7.69%	8.75%	8.14%	7.26%	7.41%	6.67%	6.57%	6.81%	6.85%	7.13%
Spain	4.80%	4.63%	4.83%	5.49%	6.01%	6.59%	6.64%	7.59%	7.98%	7.89%
France	7.18%	6.77%	6.54%	6.30%	6.18%	5.73%	5.43%	5.21%	5.13%	4.94%
Total Exports of Major Exporting Countries	82.33%	83.40%	81.33%	80.50%	80.39%	79.49%	80.77%	81.63%	81.99%	83.10%

Fig. 2. A COMPARISON OF MAJOR SWINE MEAT EXPORTING COUNTRIES



OBJECTIVES

- Identify and analyze factors affecting global meat trade by meat product category
- Evaluate Trade Creation and Trade diversion effects of bilateral and regional free trade blocs.
- Estimate impact of exchange rate volatility on meat trade flows.

III. METHODOLOGY.

- **A Generalized Gravity Model**
- **Gravity models often used to evaluate bilateral trade flows of aggregate commodities between pairs of countries.**
- **Formal theoretical foundation is provided in Anderson (1979), Bergstrand (1985, 1989,), and others**
- **The final form of a typical gravity equation is a reduced form equation from a partial equilibrium of demand and supply systems.**

III.METHODOLOGY.(cont.)

B. A Commodity –Specific Gravity Equation

- Unlike traditional models of aggregate trade, a commodity-specific model can incorporate unique characteristics associated with a specific commodity

- An Empirical Commodity-Specific Gravity Model is specific and applied to trade flows of meat by meat categories that include:
  - bovine meat
  - swine meat

C. MEASURES OF EXCHANGE RATE VOLATILITY

1. Short Term Measure of Exchange Rate Volatility

Following Koray and Lastrapes (1989) and Chowdhury (1993), short run volatility is measured V_t:

$$V_t = \left[(1/m) \sum_{i=1}^{m} (\log X_{t+i-1} - \log X_{t+i-2})^2 \right]^{1/2}$$

Where X_t is the real exchange rate at time t and m is the order of the moving average

2. Long Term Measure of Exchange Rate Volatility

Sethenbier and Cho, et al. (2002) used the long run exchange rate uncertainty as:

$$X_t = \frac{\max X_{t-4}^{t} - \min X_{t-4}^{t}}{\min X_{t-4}^{t}} + \left[1 + \frac{\left|X_t - X_t^{p}\right|}{X_t^{p}}\right]$$

Where max and min X identify the maximum and minimum values of the exchange rate within a time interval t and k, and Xp is the equilibrium exchange rate.

D. An Empirical Commodity-Specific Gravity Model

- $$X_{ijt} = BY_{it}^{\beta 1} Y_{jt}^{\beta 2} D_{ijt}^{\beta 3} N_{it}^{\beta 4} N_{jt}^{\beta 5} \mathrm{Pr}_{it}^{\beta 6} \mathrm{Pr}_{jt}^{\beta 7} v_{ijt}^{\beta 8} \times$$
  $$\exp[\beta_9 A_{ijt} + \beta_{10} NAFTA_{mt} + \beta_{11} NAFTA_{nt} + \beta_{12} EU_{mt} + \beta_{13} EU_{nt} + \beta_{14} ASEAN_{mt} + \beta_{15} ASEAN_{nt} + \beta_{16} \mathrm{MERCOSUR}_{mt} + \beta_{17} \mathrm{HMD}_{it} + \beta_{18} D_{AUS} + \beta_{19} D_{BRA} + \beta_{20} D_{NET} + \beta_{21} D_{USA} + \beta_{22} D_{GER} + \beta_{23} D_{FRA}] + E_{ijt}$$

  $$i = 1,\ldots, N_1 \; and \; j = 1,\ldots N_2 \qquad (3)$$

  $$t = 1,\ldots\ldots T$$

Variable definition

- Traditional Gravity variables are defined as:
- X_{ij} = the quantity of country i's meat imported by country j;
- Y_i (Y_j)= per capita gross domestic product of country i (j)

- D_{ij} = the shortest distance between country i's commercial centers and country j's import port;
- N_i (N_j)= the population of exporting country i (importing country j);
- Pr_i (Pr_j)= per capita livestock production index in country i (j);

- Exchange rate volatility: V_{ij} = the exchange rate volatility is computed alternatively as short and long term volatility;

- A_{ij} = the border dummy = 1 if countries i and j share a common border and 0 otherwise;

Variable definition (cont.)

- Regional Free trade agreement dummy variables
  $NAFTA_m$= 1.0 for trade flows between NAFTA countries; and 0 otherwise
- $NAFTA_n$ =1.0 for a trade flow between a NAFTA country and a non-NAFTA country; and 0 otherwise

- EU_m = 1.0 for trade flows between EU countries; and 0 otherwise
- EU_n = 1.0 for trade flows between an EU country and a non-EU country; and 0 otherwise
- $ASEAN_m$ = 1.0 for trade flows between ASEAN countries; and 0 otherwise
- $ASEAN_n$ = 1.0 for a trade flow between an ASEAN member and a non- ASEAN member; and 0 otherwise

- $MERCOSUR_m$=1.0 for trade flows between MERCOSUR countries; and 0 otherwise
- $MERCOSUR_n$=1.0 for trade flows between a MERCOSUR country and a non-MERCOSUR countries; and 0 otherwise

Commodity specific dummy variable:

- HMD= hoof and mouth disease dummy variable; 1.0 for country recording cases of the disease; and 0 for country free from the disease.
- Country dummy variable, D= exporting country dummy variable; respectively=1 for Australia, Brazil, Netherlands, USA, Germany , and France; and 0 otherwise
- The countries are largest meat exporting countries

IV. Econometric Issues and Data Source

1. Remarks: Equation (3) is a time series and cross section form. However, the time series is so short (10 years) so that there are 0o enough degree of freedom to estimate time effects.

2. Estimation method: The model was estimated by use of the **Eicher-White heteroskedasticity consistent estimator** for .

- Bovine meat
- Swine meat

Data source

- Countries included in the analysis are shown in an appendix tables 1 and 2 for Bovine and swine meat products.
- Meat data are from FAO in various issues
- Financial data are from IFS in various issues
- Distance is used as a proxy for transportation instead of ocean freight rates. Distances were computed using map published by Time Atlas of Ocean, Time book limited.

v. Results

- Most of the estimated parameters have the expected signs and are statistically significant.
- The results are similar to those of previous studies on gravity models of trade flows.
- The impacts of specific determinants of meat trade flows are succinctly discussed below.
- Results are consistent for all meat categories: bovine and swine meats in most cases.

Table 3: The Eicker-White Heteroscedasticity-Consistent estimates of a gravity model of bovine meat by exchange rate volatility measures

Variables	Eicker-White Consistent Estimator		OLS	
	Short Term Volatility	Long Term Volatility	Short Term Volatility	Long Term Volatility
Constant	-0.157	-0.942	-0.157	-0.942
	(-0.15)	(-1.37)	(-0.15)	(-1.37)
HMD	-0.714***	-0.647***	-0.714***	-0.647***
	(-10.25)	(-11.55)	(-10.57)	(-11.55)
Exporters Per Capita GDP	0.099***	0.083***	0.099***	0.083***
	(3.55)	(4.46)	(3.71)	(4.46)
Importer's Per Capita GDP	0.111***	0.098***	0.111***	0.098***
	(5.16)	(7.67)	(5.63)	(7.67)
Exporter's Population	0.164***	0.138***	0.164***	0.138***
	(7.89)	(9.94)	(8.55)	(9.94)
Importers Population	0.194***	0.161***	0.194***	0.161***
	(12.22)	(13.75)	(13.75)	(13.75)
Distance	-0.232***	-0.25***	-0.232***	-0.25***
	(-11.29)	(-14.94)	(-10.4)	(-14.94)
Exporter's Livestock production	0.159	0.343***	0.159	0.343***
	(1.27)	(4.49)	(1.22)	(4.49)
Importer's Livestock production	-0.14	0.012	-0.14	0.012
	(-1.44)	(0.19)	(-1.28)	(0.19)
Both Countries EU	2.7***	3.07***	2.7***	3.07***
	(40.94)	(52.97)	(34.92)	(52.97)
One Country EU	-0.586***	-0.429***	-0.586***	-0.429***
	(-10.48)	(-10.32)	(-10.85)	(-10.32)
Both Countries MERCOSUR	1.633***	1.801***	1.633***	1.801***
	(9.75)	(11.43)	(7.32)	(11.43)
One Country MERCOSUR	1.883***	1.599***	1.883***	1.599***
	(25.72)	(28.39)	(24.58)	(28.39)
Both Countries ASEAN	-0.942***	-0.731***	-0.942***	-0.731***
	(-4.93)	(-5.27)	(-4.69)	(-5.27)
One Country ASEAN	-0.183**	-0.388***	-0.183**	-0.388***
	(-2.12)	(-6.44)	(-2.3)	(-6.44)
Both Countries NAFTA	2.482***	1.755***	2.482***	1.755***
	(6.49)	(5.18)	(6.24)	(5.18)
One Country NAFTA	-0.029	-0.377***	-0.029	-0.377***
	(-0.21)	(-3.6)	(-0.25)	(-3.6)
Share a common land border	1.229***	1.306***	1.229***	1.306***
	(14.12)	(17.02)	(11.71)	(17.02)
Exchange rate volatility	-0.456***	0	-0.456***	0
	(-3.6)	(0.86)	(-3.55)	(0.86)
AUSTRALIA	0.945***	0.914***	0.945***	0.914***
	(8.66)	(9.84)	(9.88)	(9.84)
BRAZIL	0.548***	0.535***	0.548***	0.535***
	(5.41)	(6.09)	(5.25)	(6.09)
NETHERLANDS	0.798***	0.904***	0.798***	0.904***
	(11.31)	(15.49)	(10.37)	(15.49)
UNITEDSTATESOFAM	0.301*	0.838***	0.301**	0.838***
	(1.74)	(6.55)	(1.97)	(6.55)
GERMANY	0.276***	0.576***	0.276***	0.576***
	(3.32)	(8.15)	(3.12)	(8.15)
FRANCE	0.442***	0.559***	0.442***	0.559***
	(6.35)	(9.25)	(5.57)	(9.25)
Statistics				
Number of cases	11048	20519	11048	20519
Centered R Square	0.341	0.303	0.341	0.303
SEE	2.229	2.37	2.229	2.37
Log Likelihood	-24518.648	-46804.886	237.252	370.501

T-ratios are in parenthesis under

Corresponding estimates: ***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

Table 4 The Eicker-White Heteroscedasticity-Consistent estimates of a gravity model of swine meat by exchange rate volatility measures

Variables	Eicker-White Consistent Estimator		OLS	
	Short Term Volatility	Long Term Volatility	Short Term Volatility	Long Term Volatility
Constant	-8.631***	-6.261***	-8.631***	-6.261***
	(-3.8)	(-4.84)	(-3.79)	(-4.75)
Exporters Per Capita GDP	0.319***	0.158***	0.319***	0.158***
	(5.79)	(4.77)	(5.97)	(4.87)
Importer's Per Capita GDP	0.382***	0.181***	0.382***	0.181***
	(9.72)	(8.33)	(9.95)	(8.4)
Exporter's Population	0.155***	0.13***	0.155***	0.13***
	(4.15)	(5.16)	(4.12)	(5.23)
Importers Population	0.245***	0.198***	0.245***	0.198***
	(8.46)	(9.94)	(8.33)	(9.74)
Distance	-0.376***	-0.427***	-0.376***	-0.427***
	(-10.75)	(-15.39)	(-10.13)	(-15.14)
Exporter's livestock production	0.472*	0.515***	0.472*	0.515***
	(1.67)	(3.36)	(1.77)	(3.49)
Importer's Livestock production	0.389	0.79***	0.389	0.79***
	(1.6)	(6.19)	(1.62)	(6.01)
Both Countries EU	0.942***	1.495***	0.942***	1.495***
	(8.67)	(16.55)	(8.19)	(16.04)
One Country EU	-1.505***	-1.282***	-1.505***	-1.282***
	(-13.69)	(-17.82)	(-14.13)	(-17.71)
Both Countries MERCOSUR	-1.411***	-1.842***	-1.411***	-1.842***
	(-3.54)	(-5.36)	(-2.86)	(-4.97)
One Country MERCOSUR	0.232	-0.22*	0.232	-0.22
	(1.1)	(-1.65)	(0.91)	(-1.53)
Both Countries ASEAN	-3.109***	-3.003***	-3.109***	-3.003***
	(-8.21)	(-11.19)	(-5.93)	(-8.93)
One Country ASEAN	-0.74***	-0.705***	-0.74***	-0.705***
	(-4.1)	(-6.41)	(-4.82)	(-6.75)
Both Countries NAFTA	3.178***	2.667***	3.178***	2.667***
	(9.59)	(5.11)	(5.22)	(5.77)
One Country NAFTA	0.466***	0.512***	0.466***	0.512***
	(3.3)	(4.99)	(3.11)	(4.83)
Share a common land border	1.087***	1.23***	1.087***	1.23***
	(7.44)	(9.58)	(6.55)	(8.92)
Exchange rate volatility	-0.061	0***	-0.061	0**
	(-0.16)	(2.66)	(-0.15)	(2.25)
JAPAN	0.224	0.787***	0.224	0.787***
	(0.9)	(4.05)	(1.13)	(5.18)
DENMARK	2.11***	2.131***	2.11***	2.131***
	(16.68)	(20.81)	(16.1)	(20.89)
GERMANY	1.104***	0.771***	1.104***	0.771***
	(7.59)	(6.47)	(7.35)	(6.65)
MEXICO	-0.922**	-0.513	-0.922*	-0.513
	(-2.2)	(-1.42)	(-1.96)	(-1.62)
UNITEDKINGDOM	-0.933**	-0.771**	-0.933	-0.771**
	(-2)	(-2.49)	(-1.55)	(-2.12)
UNITEDSTATESOFAM	-1.562***	-1.813***	-1.562**	-1.813***
	(-4.66)	(-7.53)	(-2.15)	(-3.5)
NETHERLANDS	0.815***	0.864***	0.815***	0.864***
	(6.02)	(8.2)	(6.31)	(8.54)
ITALY	0.329***	0.383***	0.329**	0.383***
	(2.81)	(3.9)	(2.57)	(3.62)
Statistics				
N	3377	6724	3377	6724
R^2	0.412	0.371	0.412	0.371
SEE	2.236	2.34	2.236	2.34
Log Likelihood	-7496.448	-15244.904	94.082	158.034

T-ratios are in parenthesis under
Corresponding estimates: ***denotes significance at 1% level **denotes significance at 5% level *denotes significance at 10% level

A. The Effects of Income, Population, and Production

- **The estimated coefficients have the expected signs and are significant at 5% in most cases.**
- Income in exporting country is an indication of the production capacity and ability to supply the product. Income in receiving country is indication of purchasing power and absorption capacity. The coefficients are positive and significant at1%.
- Populations in trading countries are a significant factor enhancing trade flows. Population is an indication of importer's market size and absorption capacity. A rise in importing countries' population leads to increased trade flows.
- A rise in the sending country's population is seen a factor resting meat export flows due the competing domestic consumption needs that would lead to reduced commodity outflows.
- The production capacity variable countries have expected signs and are significant at the 1% level in exporting country and insignificant in importing country

B. Impacts of Bilateral and Regional Free Trade Variables

- All coefficients on the free trade agreements are positive and significant at the 1% level in most cases.
- NAFTA and EC led to significant trade creation as shown by positive and significant coefficient signs.
- However, there is evidence that both NAFTA and EU also significantly enhanced meat trade diversion from non-member countries to NAFTA /EU countries.
- The magnitude and significance of elasticity coefficients suggested that the amount trade creation is much greater than that of trade diversion for both associations.

C. Impacts of Bilateral and Regional Free Trade Variables (cont.)

- Results for MERCOSUR association show significant trade creation however they also show incorrect sign on trade diversion.

- The ASEAN association shows more trade diversion than trade creation, which suggests that meat trade among the ASEAN members is not strong enough to elucidate trade creation effects among members.
- More work is needed to establish conclusive results here.

D. The Effects of Border, and distance variables

- The border dummy variable indicates that countries with common border traded more than countries geographically separated.
- The theory of spatial equilibrium suggests that quantity of commodity trade varies inversely with distance.
- The estimated coefficients on distance are negative and significant in all cases.
- The results shows consistency with gravity models for aggregate good trade.

E:Do Exchange Rate Volatility Enhance or Impair meat Trade Flows?

- Our findings show that the short run exchange rate volatility has a negative effect on global bovine meat trade while the long run exchange rate volatility has weak or no effect on trade flows.

- In bovine meat trade , the short -term volatility has much larger effects than the long-term volatility as suggested by the size and significance of the elasticity coefficients

- This finding is partially consistent with Cho, et al. (2002), who suggested that both short and long exchange rate volatility impairs aggregate trade flows in sectorial trade.

C:Do Exchange Rate Volatility Enhance or Impair meat Trade Flows? (cont.)

- In the global swine meat, the short term volatility has no effect on the trade flows while there is evidence of a positive impact of long term exchange rate volatility on the flows .
- This study suggests that the impacts of exchange rate uncertainty is commodity specific and may vary with computation methods.
- Additional computation methods are being considered by the authors to achieve conclusive results

F. Country effects:

- Dummy variables representing major exporting countries are all significant at 1% level. Findings suggest that Meat products are differentiated by country of origin.
- The results suggest that exporting countries produce and export different types of meat products.
- The quality of meat by country of origin was not researched issue in this study. It may be a fruitful agenda for continue the research on meat product trade.

VI. Conclusions

- This study demonstrates that the gravity models can be applied to single commodity trade flows such as meat trade flows.
- Per capita Income, per capita production, population are seen as significant factors influencing specific meat flows. Distances are an impairment to meat trade flows.
- Free trade variables significantly enhance trade flows among members:
- NAFTA and EU have enhanced trade creation among members but also lead significant trade diversion from nonmembers to members.
- The MERCOSUR has lead to trade creation with inconclusive results for trade diversion.
- The ASEAN association led to trade diversion with no clear indication of trade creation among members

Conclusions-cont.

- The exchange rate uncertainty significantly reduces trade in the majority of commodity flows.
- There is evidence that long term volatility have positive and significant effect on trade flows of swine meat products .
- The impact of exchange rate uncertainty remains commodity - specific and may vary with method of its computation

Appendix Table 1: Bovine meat trading countries

Exporting/Importing Countries

Argentina	Australia	Austria	
Belgium	Belgium-Luxembourg	Brazil	
Bulgaria	Canada	Chile	
China	China, Hong Kong SAR	China, Macao SAR	
Croatia	Cuba	Czech Republic	
Denmark	Estonia	Finland	
France	Germany	Greece	
Hungary	Indonesia	Ireland	
Italy	Japan	Lithuania	
Luxembourg	Malaysia	Namibia	
Netherlands	New Zealand	Papua New Guinea	
Paraguay	Philippines	Poland	
Portugal	Qatar	Romania	
Russian Federation	Saudi Arabia	Serbia and Montenegro	
Seychelles	Singapore	Slovakia	
Slovenia	South Africa	Spain	
Sweden	Switzerland	Trinidad and Tobago	
United Arab Emirates	United Kingdom	United States of America	
Vanuatu			

Importing only Countries

Guinea	Maldives

Appendix Table 2: Swine meat trading countries

Exporting/ Importing Countries		
Argentina	Australia	Austria
Belgium	Belgium-Luxembourg	Brazil
Bulgaria	Canada	Chile
China	China, Hong Kong SAR	China, Macao SAR
Croatia	Cuba	Czech Republic
Denmark	Estonia	Finland
France	Germany	Greece
Hungary	Indonesia	Ireland
Italy	Japan	Lithuania
Luxembourg	Malaysia	Namibia
Netherlands	New Zealand	Papua New Guinea
Paraguay	Philippines	Poland
Portugal	Qatar	Romania
Russian Federation	Serbia and Montenegro	Seychelles
Singapore	Slovakia	Slovenia
South Africa	Spain	Sweden
Switzerland	Trinidad and Tobago	United Arab Emirates
United Kingdom	United States of America	
Importing only Countries		
Guinea	Maldives	Vanuatu

- THANK YOU