

The World's Largest Open Access Agricultural & Applied Economics Digital Library

# This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search http://ageconsearch.umn.edu aesearch@umn.edu

Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.



#### Introduction

Hazard Analysis and Critical Control Point (HACCP) is a preventive approach to food safety to control each stage of the food chain from prime production, processing, storage to marketing and consumption (FAO 2015)

The United States implemented HACCP December 18, 1997 (FDA 1995) for fishery. HACCP became a regulation for meat and poultry on January 25, 2000 (USDA 1996).

After the implementation of HACCP in the United States (U.S.) in 1997 for fish products, the European Union established HACCP with EC 852/2004 the European Food Hygiene Regulations in 2006 (European Commission, 2004).

### **Motivation**

#### **Researchers argue that HACCP may have two contradictory** effects on trade.

- HACCP increases the compliance cost for the producers and decrease trade or

- HACCP aids inspection by food control regulation and increase consumers' confidence in food safety and enhances trade.

#### **Impact of HACCP in trade flows**

RESEARCH POSTER PRESENTATION DESIGN © 201 www.PosterPresentations.co

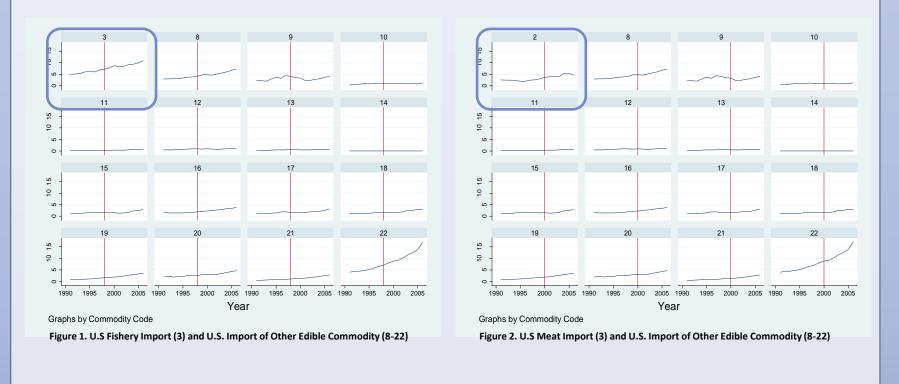
- HACCP acts as a catalyst among developed country in seafood exporters and a barrier among seafood developing country exporters (Anders and Caswell 2009).

- The implementation of HACCP results in an increase in consumer surplus, but a decrease in producer surplus with a net welfare increase (Liu and Yue 2012).

- HACCP implementation has a positive effect on the U.S. mollusks exports (Li Saghaian and Reed 2012).

- However, in all these studies, researchers use simply a dummy variable of HACCP implementation in the gravity model, which does not address the causal effect of HACCP.

- Figure 1 shows an increase in U.S. fishery imports (02) after the enforcement of HACCP (red vertical line), but little change is seen in the imports of other edible goods into the U.S. for the same period (such as fruit (08), coffee (09), cereals (10), milling products (11), oil seed (12), lac(13), vegetable plaiting materials (14), animal (15), meat food preparations(16), sugars (17), cocoa (18), cereal preparations (19), vegetable food preparations (20), and miscellaneous edible preparations (21), except for beverages (22)). Whilst Figure 2 shows that, after HACCP implementation, no obvious change in U.S. meat imports and other edible commodities (8-21), except 22.



#### The specific objectives of this paper are to determine:

- the effect HACCP implementation using a difference-indifference (DID) model based on gravity specifications and - the variation in the intensity of U.S. fishery and meat imports after the implementation of HACCP (intensive marginal effect);

In this paper, we assume U.S. fishery or meat imports (02 or 03) as the treatment group and other non-HACCP edible U.S. imports (8-22) as the control group with trade partners from 248 countries.

The fishery and meat import data from UN COMTRADE span 1988-2006, which include the pre-HACCP period 1988-1997 (1991-1999) and the post-HACCP period 1998-2006 (2000-2006) for fish products (meat products). The typical gravity variables are from CEPII, Eurostat and the Office of the U.S. Trade Representative, and World Bank Development Indicator.

## The Impact of HACCP Implementation on U.S. Imports

Rui Chen<sup>1</sup>, Nobert Wilson<sup>1</sup> and Valentina Hartarska<sup>1, 2</sup>

<sup>1</sup> Department of Ag. Economics and Rural Sociology, Auburn University, AL; <sup>2</sup> Department of Finance, Auburn University, AL

### **Objective**

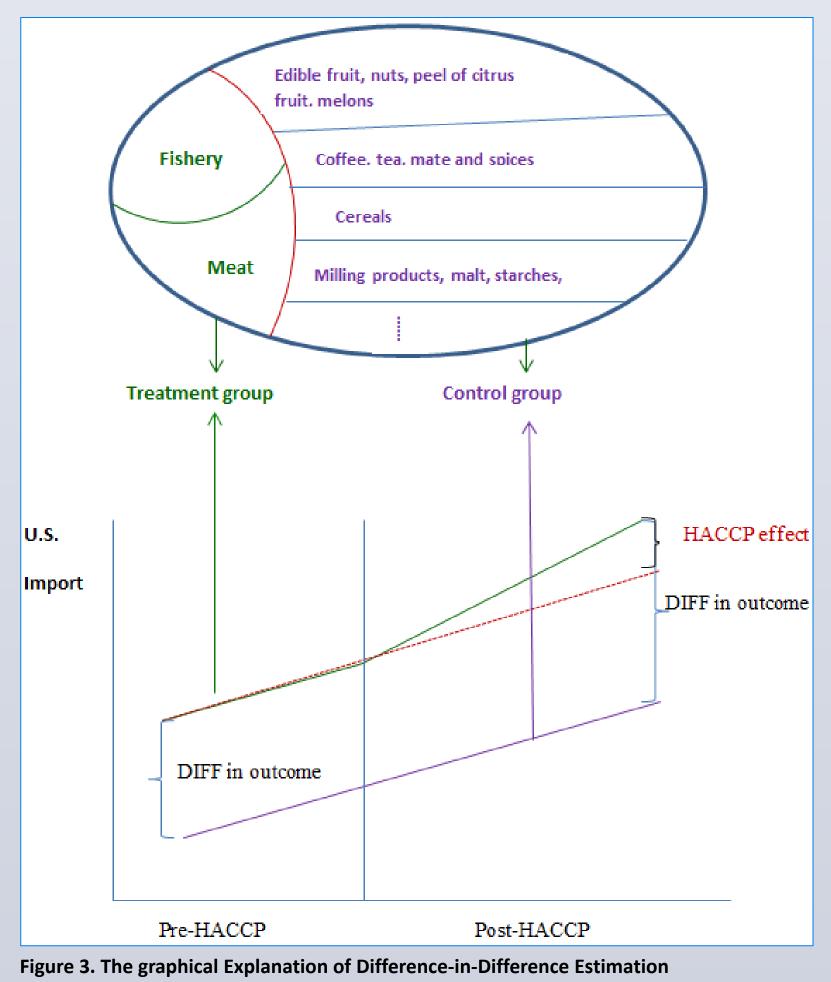
#### Data

#### Method

We assume that the treatment (U.S. fishery or meat imports) and control (other non-HACCP imports) have the same trend in the outcome in the pre- and post-HACCP periods to control for the changes caused by existing differences between the two groups. Thus, the DID model allows us to compare U.S fishery or meat imports (the treatment group) under pre- and post-HACCP implementation with other non-HACCP imports (the control group) during the same period. We apply the DID approach to a model influenced by the theoretical gravity model (Anderson and van Wincoop 2003; Disdier and Marette 2010; Tran, Wilson and Hite 2013). Fixed Effect Panel Model without Difference-in-Difference based on Gravity Specification  $\ln(\text{Import}_{\text{itc}}) = \alpha_0 + \alpha_i + \alpha_t + \alpha_c + \beta_1 \text{Enforcement Time of HACCP}_t + \sum_{i=4}^{9} \beta_i X_{\text{itc}} + \varepsilon_{\text{it}}$ 

Fixed Effect Panel Model with Difference-in-Difference based on Gravity Specification  $\ln(\text{Import}_{\text{itc}}) = \alpha_0 + \alpha_c + \alpha_i + \alpha_t + \beta_1 \text{HACCP Products}_c + \beta_2 \text{Enforcement Time of HACCP}_t + \beta_3 \text{HACCP}_c * \beta_2 \text{Enforcement Time of HACCP}_t + \beta_3 \text{HACCP}_c * \beta_2 \text{Enforcement Time of HACCP}_t + \beta_3 \text{HACCP}_c * \beta_3 \text{$ Time<sub>t</sub>+ $\sum_{i=4}^{9} \beta_i X_i + \varepsilon_{it}$ 

where  $X_{ii}$  are control variables (GDP<sub>i</sub>, Distance<sub>ii</sub>, Regional Trade Agreement<sub>ii</sub>, contiguity<sub>ii</sub>, Common Currency<sub>ii</sub>, Colony<sub>ii</sub>,);  $\alpha_i$ , and  $\alpha_t$  are fixed effects of exporter countries, year and commodity.  $Time_t$  is equal to 0 from 1988 to 1997 (pre-HACCP) and 1 if fishery imports is from 1998 to 2006 (post-HACCP);  $Time_t$  is equal to 0 from 1991 to 1999 (pre-HACCP) and 1 if meat import is from 2000 to 2006 (post-HACCP).  $HACCP_i$  is equal to 1 if fishery or meat imports to U.S., 0 if other U.S. import.  $HACCP_i * Time_t$  is the difference in fishery imports between U.S. fishery or meat import and U.S import of the other edible commodities during the period of pre-HACCP compared to those during the period of post-HACCP. The graphical explanation of DID specification shows, our treated group is the U.S. fishery (2) and meat imports (3), and our control group is U.S import of the other edible commodities (8-22).



## Results

able 1. Results of Fixed Effect Panel with and without Difference-in-Difference for U.S. Fish and Meat Imports

without DIDwith DIDwith DIDwith DIDUS. Fish=ry ImportU.S. Rist=ry ImportU.S. Meta ImportEnforcement Time of HACCP0.537***0.240***-0.0560.438***Enforcement Time of HACCP0.537***0.240***-0.0560.438***MACCP Products0.0240***0.060)(0.01)(0.071)HACCP Products0.0240***0.078)(-0.135)Distance-3.484***-1.513***-4.474***(-0.135)Distance0.0817)(0.240)(0.675)(-0.259)Exporter's GDP(0.217)(0.240)(0.675)(-0.259)(0.101)(0.050)(0.317)(-0.049)(-0.12)Contiguity-0.690**0.217*0.3320.214*(0.311)(0.161)(0.164)(-0.12)(-0.217)Contiguity-3.387***-1.572***(-0.217)(-0.217)Common Currency-3.387***-1.572***(-0.31)(-0.217)Constant35.901***(0.321)(0.910)(-0.32)Colony(6.872***4.179***-0.131-0.647*(1.395)(0.021)(0.910)(-0.32)(-0.295)Colony(6.779)(2.067)(6.201)(-2.297)Exporter fixed effectYesYesYesYesDiff(T-C): Baseline(-0.15)(-0.135)(-0.135)(-0.135)Diff(T-C): Baseline control(0.078)(0.078)(0.163).1.824***Diff(T-C): Baseline control(-0.332) <th></th> <th>Fixed Effect Panel</th> <th>Fixed Effect Panel I</th> <th>Fixed Effect</th> <th>Panel Fixed Effect Panel</th>		Fixed Effect Panel	Fixed Effect Panel I	Fixed Effect	Panel Fixed Effect Panel	
VariablesIn(import)In(import)In(import)SelectionEnforcement Time of HACCP0.537***00.240***0-0.0560.438***0ICO0.010(0.071)1.995**11.995**1HACCP Products0.078)0.0711.995**1Distance-3.484***1.095**00.0755(0.0259)Exporter's GDP1.225**00.222**01.127**00.579***Exporter's GDP1.225**10.222**11.127**00.579***GO0.6317)(0.044)(0.12)0.676**Go0.217*0.3320.214*Contiguity0.6313(0.161)(0.444)(0.12)Contiguity-3.387***5.049***(0.313)(0.101)Contiguity0.5317(0.201)(0.2217)(0.217)Common Currency-3.387***-1.572***(0.131)-2.163***Colony6.872***01.928***(0.217)(0.217)Contiguity(0.517)(0.201)(0.231)(0.101)Contact1.35520.388***3.570***(0.231)Contact(0.577)(0.217)(0.217)(0.2297)Contact1.9552.908***43.570***7.298***Contact1.9552.908***43.570***7.298***ContactYesYesYesYesVear fixed effectYesYesYesDiff(T-C): Follow-up2.944***(0.076)(0.163)Diff(T-C): Follow-up2.944***(0.078) <th></th> <th>without DID</th> <th>with DID</th> <th>without D</th> <th>ID with DID</th>		without DID	with DID	without D	ID with DID	
Enforcement Time of HACCP     0.53***     0.240***     -0.056     0.438***       IMACCP Products     2.944***     1.995***     1.995***       IMACCP Products     0.078)     (0.135)     (0.135)       Distance     -3.484***     -1.513***     -4.474***     1.474***       (0.817)     (0.240)     (0.675)     (-0.259)       Exporter's GDP     1.225***     0.222***     1.127***     0.579***       (0.011)     (0.050)     (0.317)     (-0.049)     0.579***       (0.311)     (0.16)     (0.444)     (-0.12)       Contiguity     5.049***     6.076***     (-0.295)       Contiguity     -3.387***     -1.572***     -0.131     (-0.295)       Contiguity     -6.872***     4.179***     -0.131     (-0.295)       Colony     6.872***     4.179***     -0.131     -0.6322       Constant     35.901***     21.098***     43.570***     -7.298***       (6.779)     (2.067)     (6.201)     (-2.297)       Exporter fixed effect     Yes     Yes		U.S. Fishe	ery Import	U	J.S. Meat Import	
Inclusion(0.124)(0.060)(0.401)(-0.071)HACCP Products2.944***1.995***1.995***Distance-3.484***(0.078)-4.474***1.474***(0.817)(0.240)(0.675)(-0.259)Exporter's GDP1.225***0.222***1.127***0.579***(0.601)(0.010)(0.010)(0.312)(-0.049)RTA-0.600**0.217*0.3320.214*(0.331)(0.116)(0.444)(-0.12)Contiguity(0.331)(0.116)(0.444)(-0.12)Contiguity-3.387***-1.572***-2.163***(0.517)(0.260)(-0.295)-2.163**Conmon Currency-3.387***41.79***-0.131-0.647*(0.517)(0.260)(-0.295)(-0.295)Colony6.872***41.79***-0.131-0.647*(0.517)(0.260)(-0.295)(-0.332)Constant5.901***21.098***43.570***-7.298***(6.779)(2.067)(6.201)(-2.297)Exporter fixed effectYesYesYesYear fixed effectYesYesYesDiff(T-C): Follow-up3.296***(0.078)(0.135)Diff(T-C): Follow-up(0.016)(0.183)-0.17No. Baseline control(0.026)(0.025)(0.183)No. Baseline control(0.026)(0.013)21008No. Follow-up treated(0.025)(0.183)21098No. Follow-	Variables	ln(import)	ln(import)	In(import)	Selection	
HACCP Products2.944***1.995***Distance-3.484***(0.078)(0.0135)Distance-3.484***-1.513***-4.474***1.474***(0.817)(0.240)(0.675)(0.259)Exporter's GDP1.225***0.222***1.127***0.579***(0.101)(0.050)(0.317)(0.049)RTA-0.690**0.217*0.3320.214*(0.331)(0.116)(0.444)(-0.12)Contiguity5.049***0.312(0.217)Contiguity-5.387***-1.572***C-2.163***(0.517)(0.260)(0.295)(0.295)Colony6.872***4.179***-0.131-0.647*(1.395)(0.321)(0.910)(-0.332)Constat35.90***21.098***43.57***-7.298***Exporter fixed effectYesYesYesYesYear fixed effectYesYesYesYesDiff(T-C): Baseline6.6769.329***1.995***Diff(T-C): Follow-up3.296***1.824***0.131Diff(T-C): Follow-up3.296***1.824***0.135No. Baseline controlControl0.335**-0.17No. Follow-up treated6.675404No. Follow-up treated6.675404No. Follow-up treated6.6752.9662No. Follow-up treated6.6750.890.54	Enforcement Time of HACCP	0.537***	0.240***	-0.056	0.438***	
Image: stance     (0.078)     (-0.135)       Distance     -3.484***     -1.513***     -4.474***     1.474***       Image: stand		(0.124)	(0.060)	(0.401)	(-0.071)	
Distance-3.484***-1.513***-4.474***1.474***(0.817)(0.240)(0.675)(-0.259)Exporter's GDP1.25***0.222***1.127***0.579***(0.101)(0.050)(0.317)(-0.049)RTA-0.690**0.217*0.3320.214*(0.331)(0.116)(0.444)(-0.12)Contiguity-5.049***6.076***(0.315)(0.315)(-0.295)(-0.295)Common Currency-3.387***1.572***-0.131-0.647*(0.517)(0.260)(-0.295)(-0.295)Colony6.872***4.179***-0.131-0.647*(1.395)(0.321)(0.910)(-0.332)Constant(6.779)(2.067)(5.201)(-2.297)Exporter fixed effectYesYesYesYear fixed effectYesYesYesVear fixed effectYesYesYesDiff(T-C): Baseline(0.78)(0.078)(0.135)Diff(T-C): Follow-up3.296***(0.076)(0.16)Diff(T-C): Follow-up3.296***(0.138)-0.17No. Baseline control(0.621536125190No. Baseline treated27754042062No. Follow-up treated6.8226623696320662No. Follow-up treated6.823696320662No. Follow-up treated0.520.890.54	HACCP Products		2.944***		1.995***	
Image: constant of the section of t			(0.078)		(-0.135)	
Exporter's GDP1.225***0.222***1.127***0.579***(0.101)(0.050)(0.317)(-0.049)RTA-0.690**0.217*0.3320.214*(0.331)(0.116)(0.444)(-0.12)Contiguity-5.049***(-0.217)Common Currency-3.387***-1.572***(-0.217)Colony-3.387***-1.572***(-0.131Colony-3.387***4.179***-0.131Colony(0.517)(0.260)(-0.295)Colony(1.395)(0.321)(0.910)Constant35.901***21.098***43.570***Gorstant35.901***21.098***43.570***Commodity fixed effectYesYesYesYear fixed effectYesYesYesDiff(T-C): Baseline2.944***(0.078)(0.135)Diff(T-C): Baseline-0.17(0.16)(0.16)Diff(T-C): Baseline control1536125190No. Baseline control3696320662No. Follow-up treated2775404No. Follow-up treated60.69250No. Follow-up treated6.820.520.89No. Follow-up treated0.820.520.89	Distance	-3.484***	-1.513***	-4.474***	1.474***	
Image: constant of the sector of the secto		(0.817)	(0.240)	(0.675)	(-0.259)	
RTA-0.690**0.217*0.3320.214*(0.331)(0.116)(0.44)(-0.12)Contiguity5.049***6.076***(0.315)(0.217)(-0.217)Common Currency-3.387***-1.572***-2.163***(0.517)(0.260)(-0.295)Colony6.872***4.179***-0.131-0.647*(1.395)(0.321)(0.910)(-0.332)Constant35.901***21.098***43.570***-7.298***(6.779)(2.067)(6.201)(-2.297)Exporter fixed effectYesYesYesYear fixed effectYesYesYesDiff(T-C): Baseline(0.79)(0.078)(0.135)Diff(T-C): Follow-up-0.140.353***-0.17Diff(T-C): Follow-up-0.15361-0.17No. Baseline control1536125190No. Baseline treated2775404No. Follow-up treated616920662No. Follow-up treated6169250No. Follow-up treated6169250No. Follow-up treated6169250No. Follow-up treated6169250No. Follow-up treated61622052No. Follow-up treated61820.52No. Follow-up treated61820.52No. Follow-up treated61820.52	Exporter's GDP	1.225***	0.222***	1.127***	0.579***	
Image: constraint of the section of		(0.101)	(0.050)	(0.317)	(-0.049)	
Contiguity5.049***6.076***Common Currency-3.387***(0.315)(-0.217)Common Currency-3.387***-1.572***-2.163***(0.517)(0.260)(-0.295)Colony6.872***4.179***-0.131(1.395)(0.321)(0.910)(-0.332)Constant35.901***21.098***43.570***(6.779)(2.067)(6.201)(-2.297)Exporter fixed effectYesYesYesYear fixed effectYesYesYesDiff(T-C): Baseline-YesYesYesDiff(T-C): Follow-up-3.296***1.824***Diff(T-C): Follow-up-0.353***-0.17No. Baseline control0.353***-0.17No. Baseline control3.775404No. Follow-up treated2.775404No. Follow-up treated2.775404No. Follow-up treated6.6792.9662No. Follow-up treated0.820.520.89	RTA	-0.690**	0.217*	0.332	0.214*	
Image: Common Currency     -3.387***     -1.572***     (-0.217)       Common Currency     -3.387***     -1.572***     -2.163***       (0.517)     (0.260)     (-0.295)       Colony     6.872***     4.179***     -0.131     -0.647*       (1.395)     (0.321)     (0.910)     (-0.332)       Constant     35.901***     21.098***     43.570***     -7.298***       (6.779)     (2.067)     (6.201)     (-2.297)       Exporter fixed effect     Yes     Yes     Yes       Year fixed effect     Yes     Yes     Yes       Ommodity fixed effect     Yes     Yes     Yes       Diff(T-C): Baseline     2.944***     1.995***     1.824***       0.078)     (0.135)     (0.135)     0.17       0.17     0.353***     -0.17     0.183)       Diff(T-C): Follow-up     3.296***     1.824***     0.17       0.0.76)     (0.183)     0.17     0.17       0.0.8aseline control     1.5361     25190     0.17       No. Baseline control		(0.331)	(0.116)	(0.444)	(-0.12)	
Common Currency-3.387***-1.572***-0.131-2.163***(0.517)(0.260)(-0.295)Colony6.872***4.179***-0.131-0.647*(1.395)(0.321)(0.910)(-0.332)Constant35.901***21.098***43.570***-7.298***(6.779)(2.067)(6.201)(-2.297)Exporter fixed effectYesYesYesYear fixed effectYesYesYesCommodity fixed effectYesYesYesDiff(T-C): Baseline-2.944***1.995***Diff(T-C): Follow-up6.873**0.076)(0.135)Diff(T-C): Follow-up0.053***-0.17Inff C-Diff0.055***0.017No. Baseline control1536125190No. Follow-up control3696320662No. Follow-up treated6169250Log pseudo likelihood6.820.520.89R-square0.820.520.89	Contiguity		5.049***		6.076***	
(0.517)     (0.260)     (-0.295)       Colony     6.872***     4.179***     -0.131     -0.647*       (1.395)     (0.321)     (0.910)     (-0.332)       Constant     35.901***     21.098***     43.570***     -7.298***       Main     (6.779)     (2.067)     (6.201)     (-2.297)       Exporter fixed effect     Yes     Yes     Yes       Year fixed effect     Yes     Yes     Yes       Ommodity fixed effect     Yes     Yes     Yes       Diff(T-C): Baseline     2.944***     1.995***       Diff(T-C): Follow-up     3.296***     1.824***       0.076)     (0.135)     0.131       Diff(n-Diff     0.353***     -0.17       0.059)     (0.183)     0.183)       No. Baseline control     15361     25190       NO. Baseline treated     2775     404       No. Follow-up treated     6169     250       No. Follow-up treated     6169     250       No. Follow-up treated     0.82     0.52     0.89     0.5			(0.315)		(-0.217)	
Colony     6.872***     4.179***     -0.131     -0.647*       (1.395)     (0.321)     (0.910)     (-0.332)       Constant     35.901***     21.098***     43.570***     -7.298***       (6.779)     (2.067)     (6.201)     (-2.297)       Exporter fixed effect     Yes     Yes     Yes       Year fixed effect     Yes     Yes     Yes       Ommodity fixed effect     Yes     Yes     Yes       Diff(T-C): Baseline     2.944***     1.995***       Diff(T-C): Follow-up     0.078)     0.135)       Diff(T-C): Follow-up     3.296***     0.13       0.076)     0.0135)     0.16)       Diff.in-Diff     0.533***     -0.17       No. Baseline control     0.5361     25190       NO. Baseline treated     2775     404       No. Follow-up control     36963     20662       No. Follow-up treated     6169     250       Log pseudo likelihood     6169     250       R-square     0.82     0.52     0.89     0.54 <th>Common Currency</th> <td>-3.387***</td> <td>-1.572***</td> <td></td> <td>-2.163***</td>	Common Currency	-3.387***	-1.572***		-2.163***	
Image: constant     (1.395)     (0.321)     (0.910)     (-0.332)       Constant     35.901***     21.098***     43.570***     -7.298***       Constant     (6.779)     (2.067)     (6.201)     (-2.297)       Exporter fixed effect     Yes     Yes     Yes     Yes       Year fixed effect     Yes     Yes     Yes     Yes       Ommodity fixed effect     Yes     Yes     Yes     Yes       Diff(T-C): Baseline     2.944***     1.995***     (0.135)       Diff(T-C): Follow-up     3.296***     1.824***     (0.135)       Diff(T-C): Follow-up     0.353***     -0.17       Diff.in-Diff     0.353***     -0.17       Mo. Baseline control     15361     25190       NO. Baseline treated     2775     404       No. Follow-up control     36963     20662       No. Follow-up treated     6169     250       Log pseudo likelihood     -0.82     0.52     0.89     0.54		(0.517)	(0.260)		(-0.295)	
Constant35.901***21.098***43.570***-7.298***(6.779)(2.067)(6.201)(-2.297)Exporter fixed effectYesYesYesYear fixed effectYesYesYesCommodity fixed effectYesYesYesDiff(T-C): Baseline02.944***1.995***Diff(T-C): Follow-up03.296***0.135)Diff(T-C): Follow-up00.076)00.135)Diff(T-C): Follow-up00.053***0.016)Diff.in-Diff00.353***0.0183)No. Baseline control02775404No. Follow-up treated03696320662No. Follow-up treated016169250No. Follow-up treated0.820.520.890.54	Colony	6.872***	4.179***	-0.131	-0.647*	
Image: constant state stat		(1.395)	(0.321)	(0.910)	(-0.332)	
Exporter fixed effectYesYesYesYesYear fixed effectYesYesYesYesCommodity fixed effectYesYesYesYesDiff(T-C): Baseline2.944***I.995***I.995***Diff(T-C): Follow-upI.00078)I.00135)I.824***Diff(T-C): Follow-upI.00076)I.0016)Diff-in-DiffI.0353***I.0016)I.016)Diff-in-DiffI.00059)I.00183)I.0183)No. Baseline controlI.011I.015361I.011No. Follow-up controlI.011I.0169I.0160No. Follow-up treatedI.011I.0169I.0160No. Follow-up treatedI.011I.0169I.0160No. Follow-up treatedI.011I.0169I.0160No. Follow-up treatedI.011I.0169I.0160R-square0.820.520.890.54	Constant	35.901***	21.098***	43.570***	-7.298***	
Year fixed effectYesYesYesCommodity fixed effectYesYesDiff(T-C): Baseline2.944***1.995***Diff(T-C): Baseline(0.078)(0.135)Diff(T-C): Follow-up3.296***1.824***Diff-in-Diff(0.076)(0.16)Diff-in-Diff0.353***0.17No. Baseline control15361 </th <th></th> <td>(6.779)</td> <td>(2.067)</td> <td>(6.201)</td> <td>(-2.297)</td>		(6.779)	(2.067)	(6.201)	(-2.297)	
Commodity fixed effectYesYesDiff(T-C): Baseline2.944***1.995***Diff(T-C): Baseline(0.078)(0.135)Diff(T-C): Follow-up3.296***1.824***Diff(T-C): Follow-up(0.076)(0.16)Diff-in-Diff0.353***-0.17Diff-in-Diff(0.059)(0.183)No. Baseline control1536125190No. Baseline treated2775404No. Follow-up treated6169250No. Follow-up treated0.820.520.89	Exporter fixed effect	Yes	Yes	Yes	Yes	
Diff(T-C): Baseline2.944***1.995***Diff(T-C): Follow-up(0.078)(0.135)Diff(T-C): Follow-up3.296***1.824***Diffor-Diff(0.076)(0.16)Diff-in-Diff(0.076)(0.16)Diff-in-Diff(0.059)(0.183)No. Baseline control(0.010)(0.183)No. Baseline treated2775404No. Follow-up control3696320662No. Follow-up treated6169250No. Follow-up treated0.820.82	Year fixed effect	Yes	Yes	Yes	Yes	
Image: Constraint of the second sec	Commodity fixed effect		Yes		Yes	
Diff(T-C): Follow-up3.296***1.824***0(0.076)(0.16)Diff-in-Diff0.353***0.0170.ff-in-Diff(0.059)(0.183)No. Baseline control1536125190NO. Baseline treated2775404No. Follow-up control6169250No. Follow-up treated6169250Log pseudo likelihood0.820.520.89No. Solo0.540.54	Diff(T-C): Baseline		2.944***		1.995***	
Image: Constraint of the			(0.078)		(0.135)	
Diff-in-Diff0.353***0.00000.017Image: Diff-in-Diff0.00000.00000.0183No. Baseline control0.100153610.25190No. Baseline treated27750.0000404No. Follow-up control0.61690.2066220062No. Follow-up treated0.820.520.890.54	Diff(T-C): Follow-up		3.296***		1.824***	
Image: No. Baseline controlImage: No. Baseline controlImage: No. Baseline treatedImage: No. Follow-up controlImage: No. Follow-up controlImage: No. Follow-up controlImage: No. Follow-up treatedImage: No. Follow-up treated <t< th=""><th></th><th></th><th>(0.076)</th><th></th><th>(0.16)</th></t<>			(0.076)		(0.16)	
No. Baseline control1536125190NO. Baseline treated2775404No. Follow-up control3696320662No. Follow-up treated6169250Log pseudo likelihoodR-square0.820.520.89	Diff-in-Diff		<mark>0.353***</mark>		-0.17	
NO. Baseline treated2775404No. Follow-up control3696320662No. Follow-up treated6169250Log pseudo likelihoodR-square0.820.520.89			<mark>(0.059)</mark>		(0.183)	
No. Follow-up control3696320662No. Follow-up treated6169250Log pseudo likelihoodR-square0.820.520.89	No. Baseline control		15361		25190	
No. Follow-up treated6169250Log pseudo likelihood0.820.520.890.54	NO. Baseline treated		2775		404	
Log pseudo likelihood0.820.520.890.54	No. Follow-up control		36963		20662	
R-square     0.82     0.52     0.89     0.54	No. Follow-up treated		6169		250	
	Log pseudo likelihood					
<b>Observations</b> 6007 43132 638 46526	R-square	0.82	0.52	0.89	0.54	
	Observations	6007	43132	638	46526	

\*\*\*, \*\*and \* significant at 1%, 5%, and 10%, respectively; numbers in parentheses are robust standard errors

#### **Alternative model-Heckman Results**

In this part, we assume U.S. fishery or meat imports (02 or 03) as the treatment group and the EU15 fishery imports or other edible U.S. imports as the control group with trade partners from 248 countries. To tackle the problem of the natural log of zero trade value, Heckman selection model will be employed as an alternative strategy.

 $Pro(Import_{ijt}) = \alpha_0 + \alpha_i + \alpha_j + \alpha_t + \beta_1 HACCP Product_i + \beta_2 \beta_1 Enforcement Time of HACCP_{tt} + \beta_3 HACCP_i$ 

\* Time<sub>t</sub> + 
$$\sum_{i=4}^{n} \beta_i X_i + \beta_{10}$$
Common language<sub>ij</sub> +  $\varepsilon_{ijt}$ 

 $\ln(\text{Import}_{iit}) = \alpha_0 + \alpha_i + \alpha_i + \alpha_t + \beta_1 \text{HACCP Product}_i + \beta_2 \text{Enforcement Time of HACCP}_t + \beta_3 \text{HACCP}_i$ 

\* Time<sub>t</sub> + 
$$\sum_{i=4}^{4} \beta_i X_i + \beta_{10} IMR_{ijt} + \varepsilon_{ijt}$$

The definition of variables are the same as the variables in the gravity model with DID specification, except HACCP.  $HACCP_i$  is 1 if fishery imports to U.S., 0 if fishery imports to EU15, which is a proxy of the validity of HACCP implementation. Our treatment group is the U.S. fishery imports, and our control group is the EU 15 countries- Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom.  $HACCP_i * Time_t$  is the difference in fishery imports between U.S. and EU during the period of pre-HACCP compared to those during the period of post-HACCP. Other factors have been defined the same as the gravity model with DID specification.



	Heckman selection model		Несктал	Heckman selection model	
	fish	ery import	me	eat import	
Variables	ln(import)	Selection	In(import)	Selection	
HACCP Products	4.004***	4.660***	1.533***	-1.445***	
	(0.199)	(0.558)	(0.124)	(-0.16)	
Enforcement Time of HACCP	0.746***	3.255***	0.277***	15.588***	
	(0.113)	(0.324)	(0.082)	(-0.469)	
HACCP*Time	0.138***	0.128**			
	(0.006)	(0.055)			
Importer's GDP	0.610***	-0.773***			
	(0.036)	(0.183)			
Exporter's GDP	0.216***	0.106***	0.532***	0.0003***	
	(0.007)	(0.022)	(0.059)	(0.00003)	
In Distance	-2.293***	-0.862***	-2.104***	0.0028521	
In_Distance	(0.031)	(0.034)	(0.245)	6.772472	
Contiguous Colony	0.167***	-0.646***	2.830***	28.00	
	(0.020)	(0.007) 0.383***	(0.304) 1.119***	(41511.7)	
	0.895***			14.575	
	(0.019)	(0.045)	(0.325)	(45700.76)	
EU15	0.607***	-0.070			
	(0.013)	(0.169)			
NAFTA	8.061***	3.246***			
	(0.040)	(0.250)			
Common language		0.300***		-3.883	
		(0.033)		(32901.75)	
Inverse Mills Ratio			0.661***		
			(0.102)		
Common Currency			-4.138***	24.195	
			(0.374)	(33124.29)	
RTA			0.214*	-1.157**	
			(0.124)	(-0.492)	
Constant	14.321	10.628	24.632***	-41.226	
	(0.403)	(0.630)	(2.175)	(58265.33)	
	<b>、</b> ,	· · · · · · · · · · · · · · · · · · ·	, , , , , , , , , , , , , , , , , , ,	, , , , , , , , , , , , , , , , , , ,	
Importer fixed effect	Yes	Yes			
exporter fixed effect	Yes	Yes	Yes	Yes	
Year fixed effect	Yes	Yes	Yes	Yes	
Diff(T-C): Baseline	103	105	1.533***	105	
			(0.124)		
			(0.124)		
Diff(T-C): Follow-up					
Diff-in-Diff			(0.149)		
			-0.126		
			(0.171)		
No. Baseline control			17264		
NO. Baseline treated			383		
No. Follow-up control			31865		
No. Follow-up treated			615		
Log pseudo likelihood	-55675.82			-3767.891	
rho	0.148				
lambda	0.267				
Wald test of (rho = 0): chi2(1)	16.99 ***				
R-square	0.65	0.80	0.54	0.79	
Observations	53,216		32480	32543	

of the selection and the outcome equations. Lambda is the product of rho and the standard deviation of the error from the outcome equation; inverse mills ratios is

## **Discussion and Conclusion**

The HACCP implementation on fishery imports has a statistically significant positive effect on the intensive margin and no effect on U.S. meat imports. In other words, the HACCP policy increases market access for U.S. fish import and no effect on the market access of U.S meat imports. From the outcome equation of the Heckman selection model, we find that the implementation of HACCP increased U.S.fishery imports by 35.3% and 13.8%, which are different from those predicted by Anders and Caswell (2009) with an overall 50.3% decrease, and Li, Saghaian and Reed (2013) with a 56% increase in U.S. mollusks exports. A much smaller effect with HACCP than the previous papers can be explained that the dummy variables of HACCP might overestimate the treatment effect, because of the failure to isolate the HAACP effect from other unobserved factors effect, which probably increase the trade flows. In sum, the enforcement of HACCP increases in U.S. fishery imports, but no effect in U.S. meat imports no matter what we use as a control.