The Impact of HACCP Implementation on U.S. Imports

Rui Chen[1], Nobert Wilson[1] and Valentina Hartarska[1, 2]

[1] Department of Ag. Economics and Rural Sociology, Auburn University, AL; [2] Department of Finance, Auburn University, AL

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

- 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.

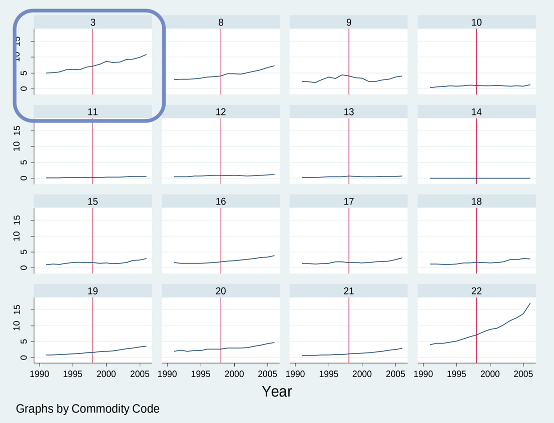

Figure 1. U.S Fishery Import (3) and U.S. Import of Other Edible Commodity (8-22)

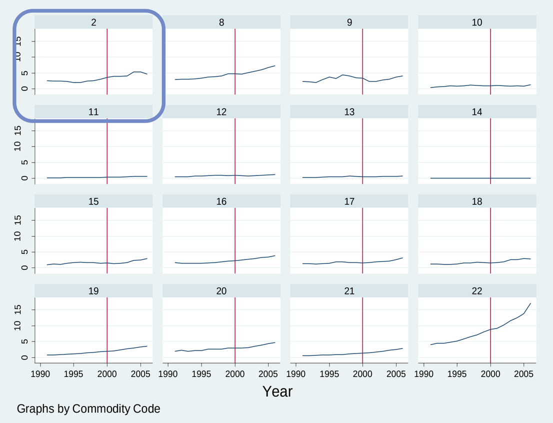

Figure 2. U.S Meat Import (3) and U.S. Import of Other Edible Commodity (8-22)

Objective

The specific objectives of this paper are to determine:

- the effect HACCP implementation using a difference-in-difference (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);

Data

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.

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

$$\ln(\text{Import}_{jtc}) = \alpha_0 + \alpha_j + \alpha_t + \alpha_c + \beta_1 \text{Enforcement Time of HACCP}_t + \sum_{i=4}^{9} \beta_i X_{jtc} + \varepsilon_{jt}$$

Fixed Effect Panel Model with Difference-in-Difference based on Gravity Specification

$$\ln(\text{Import}_{jtc}) = \alpha_0 + \alpha_c + \alpha_j + \alpha_t + \beta_1 \text{HACCP Products}_c + \beta_2 \text{Enforcement Time of HACCP}_t + \beta_3 \text{HACCP}_c * \text{Time}_t + \sum_{i=4}^{9} \beta_i X_i + \varepsilon_{jt}$$

- where X_{ij} are control variables (GDP_j, Distance_{ij}, $\text{Regional Trade Agreement}_{ij}$, contiguity_{ij}, $\text{Common Currency}_{ij}$, Colony_{ij} ,); α_j, and α_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).

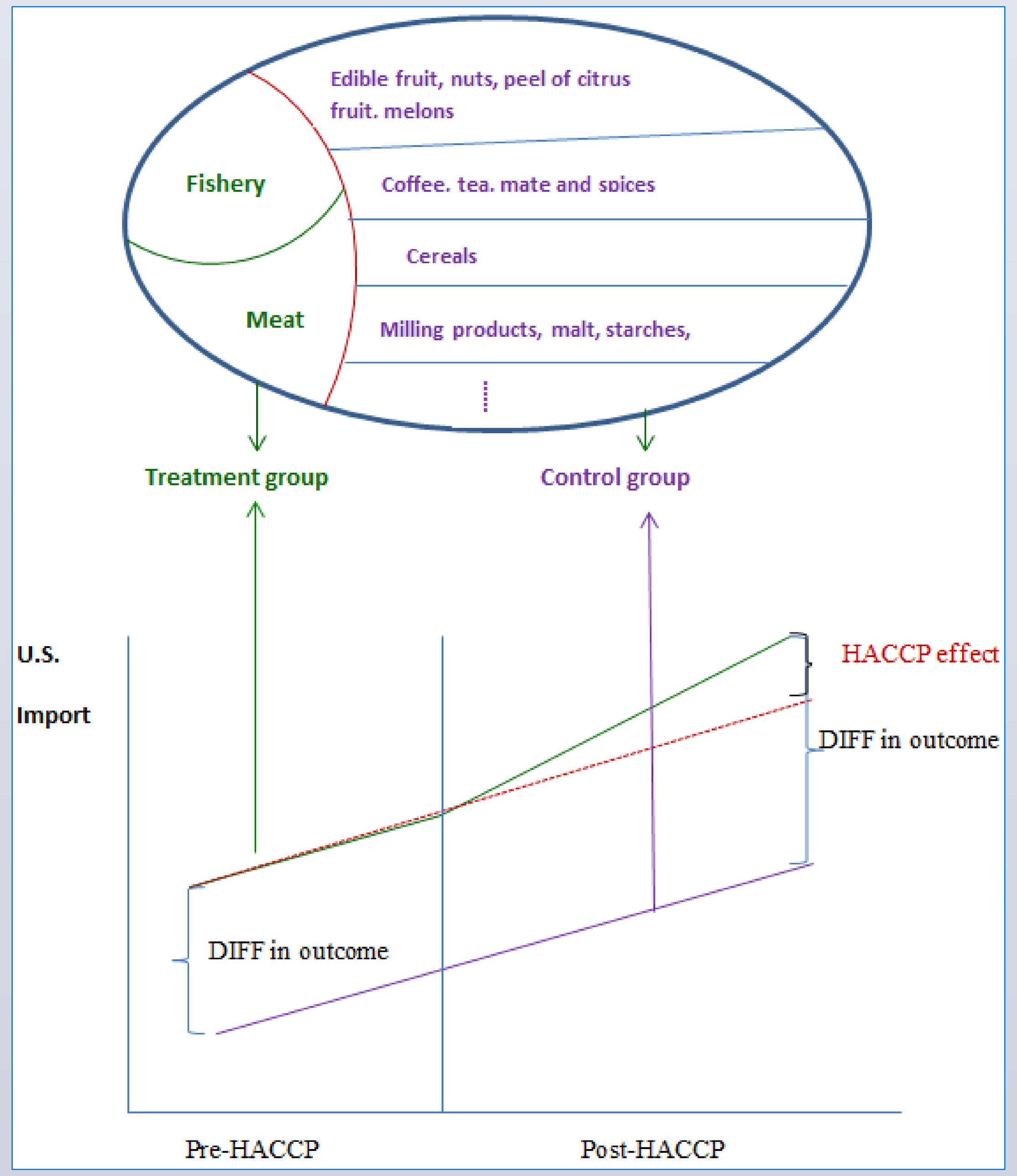

Figure 3. The graphical Explanation of Difference-in-Difference Estimation

Results

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

	Fixed Effect Panel without DID	Fixed Effect Panel l with DID	Fixed Effect Panel without DID	Fixed Effect Panel with DID
	U.S. Fishery Import		U.S. Meat Import	
Variables	ln(import)	ln(import)	ln(import)	Selection
Enforcement Time of HACCP	0.537***	0.240***	-0.056	0.438***
	(0.124)	(0.060)	(0.401)	(-0.071)
HACCP Products		2.944***		1.995***
		(0.078)		(-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***
	(0.101)	(0.050)	(0.317)	(-0.049)
RTA	-0.690**	0.217*	0.332	0.214*
	(0.331)	(0.116)	(0.444)	(-0.12)
Contiguity		5.049***		6.076***
		(0.315)		(-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	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Commodity fixed effect		Yes		Yes
Diff(T-C): Baseline		2.944***		1.995***
		(0.078)		(0.135)
Diff(T-C): Follow-up		3.296***		1.824***
		(0.076)		(0.16)
Diff-in-Diff		0.353***		-0.17
		(0.059)		(0.183)
No. Baseline control		15361		25190
NO. Baseline treated		2775		404
No. Follow-up control		36963		20662
No. Follow-up treated		6169		250
Log pseudo likelihood				
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.

Heckman Selection Model with Difference-in-Difference Specification

$$\text{Pro}(\text{Import}_{ijt}) = \alpha_0 + \alpha_i + \alpha_j + \alpha_t + \beta_1 \text{HACCP Product}_i + \beta_2 \beta_1 \text{Enforcement Time of HACCP}_{t_t} + \beta_3 \text{HACCP}_i * \text{Time}_t + \sum_{i=4}^{9} \beta_i X_i + \beta_{10} \text{Common language}_{ij} + \varepsilon_{ijt}$$

$$\ln(\text{Import}_{ijt}) = \alpha_0 + \alpha_i + \alpha_j + \alpha_t + \beta_1 \text{HACCP Product}_i + \beta_2 \text{Enforcement Time of HACCP}_t + \beta_3 \text{HACCP}_i * \text{Time}_t + \sum_{i=4}^{9} \beta_i X_i + \beta_{10} \text{IMR}_{ijt} + \varepsilon_{ijt}$$

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.

Table 2. Results of Heckman Selection Model with Difference-in-Difference for U.S. Fish and Meat Imports

	Heckman selection model fishery import		Heckman selection model meat import	
Variables	ln(import)	Selection	ln(import)	Selection
HACCP Products	4.004*** (0.199)	4.660*** (0.558)	1.533*** (0.124)	-1.445*** (-0.16)
Enforcement Time of HACCP	0.746*** (0.113)	3.255*** (0.324)	0.277*** (0.082)	15.588*** (-0.469)
HACCP*Time	0.138*** (0.006)	0.128** (0.055)		
Importer's GDP	0.610*** (0.036)	-0.773*** (0.183)		
Exporter's GDP	0.216*** (0.007)	0.106*** (0.022)	0.532*** (0.059)	0.0003*** (0.00003)
ln_Distance	-2.293*** (0.031)	-0.862*** (0.034)	-2.104*** (0.245)	0.0028521 6.772472
Contiguous	0.167*** (0.020)	-0.646*** (0.007)	2.830*** (0.304)	28.00 (41511.7)
Colony	0.895*** (0.019)	0.383*** (0.045)	1.119*** (0.325)	14.575 (45700.76)
EU15	0.607*** (0.013)	-0.070 (0.169)		
NAFTA	8.061*** (0.040)	3.246*** (0.250)		
Common language		0.300*** (0.033)		-3.883 (32901.75)
Inverse Mills Ratio			0.661*** (0.102)	
Common Currency			-4.138*** (0.374)	24.195 (33124.29)
RTA			0.214* (0.124)	-1.157** (-0.492)
Constant	14.321 (0.403)	10.628 (0.630)	24.632*** (2.175)	-41.226 (58265.33)
Importer fixed effect	Yes	Yes		
exporter fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Diff(T-C): Baseline			1.533***	
			(0.124)	
Diff(T-C): Follow-up			1.407***	
			(0.149)	
Diff-in-Diff			-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

***, **and * significant at 1%, 5%, and 10%, respectively; numbers in parentheses are robust standard errors clusters. Rho is the correlation coefficient between the errors 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 calculated based on the selection equations.

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.