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Global seafood trade has more than doubled from 1998 to 2008, and over half of these exports come from countries with income under $4,000 per year. However, these low-income exporters face increasingly stringent regulatory barriers when exporting seafood to developed markets such as the United States and Europe. While some regulations are required to protect domestic consumers, like other bilateral nontariff barriers, food safety regulations may have unintended consequences. For example, one might anticipate that food import refusals would result in the blocked products being sent to other countries, an occurrence known as trade deflection (Bown and Crowley 2007). Although the trade deflection effects of regional trade agreements and contingent protection such as antidumping duties have been extensively studied, very little work has considered the third-country trade effects of nontariff barriers. Agricultural applications include studies by Carter and Gunning-Trant (2010), Baylis, Malhotra, and Rus (2010; for antidumping), and Baylis and Perloff (2010; for suspension agreements). In this article, we analyze the trade diversion and deflection effects of food import refusals.

Anecdotal evidence suggests that food import refusals may result in rejected products being diverted to other export markets. For example, after the melamine-in-milk case in China, there was a rash of cheap Chinese-made milk chocolate available in India right before the festival of Diwali, which features the traditional giving of sweets. In 2003, after honey exports from some Chinese shippers to the European Union were blocked because they were found to contain antibiotics, Chinese honey containing antibiotics was found in the United States, having been transshipped through various countries, including Vietnam and Turkey (Lumpkin 2003). This trade deflection in refused food products raises the concern of health problems being transferred from wealthier regions with more vigorous inspection systems to unsuspecting third countries.

The increased global trade in seafood coupled with growing concerns over food safety has put developed countries under pressure to increase regulatory stringency over imports (Government Accountability Office 2010). The European Union (EU) is regarded as having strict import standards and has been held up as an example for the United States (Scott-Thomas 2010). Therefore, we believe it is important to understand whether these regulations facilitate trade by setting transparent standards or primarily act as barriers and result in food being directed to other markets.

Although regulations directed at food safety are frequently widely publicized, little research has been done on food import inspections, in large part because of the lack of data. A few articles have considered characteristics associated with import refusals (Allshouse et al. 2003; Baylis, Martens, and Nogueira 2009; Brooks, Buzby, and Regmi 2008; Buzby, Unnevehr, and Roberts 2008; Calvin 2003). In particular, Brooks, Buzby, and Regmi (2008) find that rising imports are highly correlated with more U.S. import refusals for products, and also with countries registering fast import growth. Of particular concern, Baylis, Martens, and Nogueira (2009) find evidence that while riskier foods and exporters increase the probability of a food import rejection, so does domestic pressure for trade protection. Thus, standards may be used as trade barriers.

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What are the effects of these barriers? Stricter regulations have been found to hinder trade in seafood. Anders and Caswell (2009) find that the U.S. introduction of mandatory Hazard Analysis Critical Control Point (HACCP) regulation increases seafood imports from developed countries while hampering imports from developing countries, supporting the view of standards as barriers versus that of standards as catalysts. Nguyen and Wilson (2009) extend HACCP research to include the EU and Japan and find that the introduction of these stricter standards reduce seafood trade. In an article studying HACCP in the EU, Otsuki, Wilson, and Sewadeh (2001) find that these standards on cereals, dried fruits, and nuts reduce exports from Africa.

Seafood is of particular interest in that it is a growth area of food trade and holds great potential for developing countries, which export the majority of the product. Furthermore, seafood is one of the products most frequently targeted by food safety violations. It receives the most import refusals in the United States and the EU (Buzby, Unnevehr, and Roberts 2008).

To our knowledge no one has looked at the trade effects of import refusals, and more specifically seafood refusals from the EU. In this article, we ask: Do food refusals alter patterns of trade? and more specifically: Do import refusals deflect food exports to other markets?

Background

Over the past twenty years, trade has dramatically increased in seafood products. The EU is the world's largest seafood importer. Between 1988 and 2008 the EU increased its imports of seafood products from just over €5,000 million to €16,000 million, in real terms. The largest portion of these imports consisted of Pacific salmon (8%), frozen shrimp (8%), and canned tuna (4%). Over 20% of both shrimp and tuna were imported from Ecuador, followed by Argentina and India for shrimp, and Seychelles and Mauritius for tuna (European Commission 2009).

Regulations

The EU has introduced enhanced safety restrictions and regulations to attempt to ensure the safety of this increasing volume of imports. Since the early 1990s, the EU has been working to implement HACCP, a system that lays the groundwork for food safety controls. Three council directives (91/943/EEC, 92/5/EEC, and 92/46/EEC) were implemented that contained HACCP-like standards for fishery products, meat products, and dairy products (respectively; Caswell and Hooker 1996; Ropkins and Beck 2000). These regulations were further developed by Council Directive 93/43/EEC, which laid the groundwork for HACCP standards to be applied to all food products. This directive was repealed and replaced by Regulation No. 852/2004, which was implemented in 2006, furthering the safety and hygiene regulations of 93/43/EEC (Food Standards Agency 2004). These process standards were supplemented by minimum required performance limits in 2002 (Nguyen and Wilson 2009).

Developing countries export most of the world's supply of seafood. However, they often have problems conforming to standards, such as HACCP, set by developed countries. On several occasions, imports to the EU have violated regulations and incurred bans of seafood products from the offending exporting countries. For example, the EU implemented several bans of fish from Kenya in the late 1990s, which led to a ban of all fish from Lake Victoria despite efforts to conform to EU standards. To help offset the effects of the ban, Kenya began diverting trade to Israel, Japan, Singapore, and the United Arab Emirates (Henson, Brouder, and Mitullah 2010). As a second example, recent concerns about shrimp from India led the EU to recommend random testing of 20% or more of the aquaculture products imported from India for antibiotic residue and microorganisms (Real 2010).

Refusals

The EU tracks import refusals using the Rapid Alert System for Food and Feed (RASFF), which is legally based in European Commission Regulation No. 178/2002. The RASFF reports several types of market notifications, as well as border rejections, which comprised 46% of all notifications in 2008. From 2004 to 2008, overall border rejections decreased after peaking in 2005, but between 2007 and 2008, rejections increased once again (European Commission 2008). In our data on EU refusals, from 1998 to 2008, fish and seafood are the targets of the largest number of food import refusals.

Model and Data

To analyze the trade diversion and deflection effects of food import refusals, we match EU import refusals by six-digit Harmonized System (HS) code with annual global bilateral trade flows from January 1998 through August 2008. Trade data come from the United Nations COMTRADE database and EU import refusal data from the European Commission. We include data on 156 country importers and 203 exporters of seafood products.[1]

Our model is based on a standard gravity model relating bilateral trade flows to the product of income, distance, and common border (Anderson and van Wincoop 2003; Bergstrand 1985; McCallum 1995). We also control for common language, lagged total seafood exports, and exchange rate. Income is measured as the gross domestic product (GDP) obtained from the World Bank; border, distance, and language come from Haveman and Robertson International Trade Data at Macalester University (http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html#Gravity) supplemented by information from the CIA World Factbook and timeanddate.com.

Anderson and van Wincoop (2003) raise the concern that gravity models are potentially biased due to omitted variables, since the remoteness variable ignores all trade barriers besides distance. To account for such unobserved country characteristics, we include both importer and exporter country fixed effects.

We estimate trade flows as a function of the above characteristics and the number of EU refusals faced by that exporter × product in the current year. We also include lagged trade values as an explanatory variable. The model specification is as follows:

$$(1)\quad lny_{ijkt} = \alpha + \beta_0 EURef_{jkt} + \beta_1 lny_{ijkt-1} + \beta_2 TotExports_{jt-1} + \beta_2 lnGDP_{ijt} + \beta_3 Exrate_{ijt} + \beta_4 Comlang_{ij} + \beta_5 InDist_{ij} + \beta_5 Border_{ij} + \varepsilon$$

We use the log of trade value in U.S. dollars of our six-digit HS code for product k, exported from country j to country i in year t as our dependent variable. Our main independent variable, $EURef_{jkt}$, is the number of refusals of product k for exporter j per product per year t. We also include the lagged log of trade value, lny_{ijkt-1}, as well as the variable $TotExports_{jt-1}$, which is the lagged total trade value of seafood products in U.S. dollars from exporter j as supplied by COMTRADE.[2] We measure $lnGDP_{ijt}$ in constant 2000 U.S. dollars by taking the natural log of the product of GDPs for exporting country j and importing country i for year t. GDP data come from the World Development Indicators of the World Bank. The amount of importer currency purchased for a unit of exporter currency is given as $Exrate_{ijt}$, obtained from the Penn World Tables. Binary variables are included for $Border_{ij}$ (1 for common border between i and j) and $ComLang_{ij}$ (1 for a common language between i and j).

Finally, we use two other specifications. First, we interact EU refusals with a variable for high-income importers and product perishability. High-income countries are defined as having a GDP per capita greater than $11,905 per year, and the perishable variable measures how perishable seafood products are based on their preparation: 0 for processed fish products, 1 for frozen fish, and 2 for fresh or chilled fish. Second, we separate out the more hazardous categories of refusals to determine if these product categories are also being deflected. We define hazardous refusals as those that are suspected of including toxins, parasites, and foreign objects.

To make the model tractable, we restrict our data to consider only those country product pairs that had an EU refusal at some point between 1998 and 2008. In table 1 we include means and standard errors of our dependent and independent variables. The first column includes only exports from country j to the EU that have more than one refusal per HS code per year. The second column includes all exports from country j that are imported by non-EU members only. Just as a comparison, the third and final column includes exports from country j to the EU that have no refusals per product per year.

[1] Specifically, we use those products falling under codes HS-03 and HS-16 (fishery products only).

[2] Because we use the natural log of trade value, our regression excludes all years and product country pairs with no bilateral trade. To test whether excluding the zero trade values introduces a bias, we also run the regressions using a Heckman selection model, and find the results qualitatively unchanged.

Table 1. Summary Statistics

Variable	Exports to EU If Refusals in Place >0	Exports to Non-EU Countries	Exports to EU If Refusals in Place = 0
Value (millions)	1.97(0.09)	1.48(0.05)	2.27(0.03)
Total Value$_j$(billions)	18.40(0.14)	17.20(0.05)	34.80(0.08)
EU Refusal	2.79(0.03)	0.76(0.01)	0.00(0.00)
GDP$_i$ (billions)	457.00(5.00)	685.00(6.47)	614.00(1.33)
GDP$_j$ (billions)	642.00(16.2)	1130.00(8.30)	767.00(3.52)
GDP per capita$_i$	17486.13(90.28)	10895.64(39.82)	18982.3(19.99)
GDP per capita$_j$	4899.58(73.47)	7920.33(34.67)	18063.4(26.24)
Exchange Rate	1.54(0.13)	166.48(6.53)	5.16(0.06)
Common Language	0.037(0.002)	0.15(0.001)	0.06(0.0003)
Distance	7866.88(32.02)	7361.75(23.91)	3487.07(7.94)
Border	0.01(0.001)	0.06(0.001)	0.15(0.0007)
Market Share(percent)	0.41(0.03)	0.36(0.01)	0.23(0.003)
Perishable	0.91(0.006)	0.91(0.002)	1.15(0.002)

Results

We first split the data to consider how an EU refusal affects trade flows into the EU and then ask how it affects trade flows to other third-party importers. Because the probability of a refusal is highly correlated with trade value, we instrument for EU refusals using a spatial lag. Since disease outbreaks are often regional, we assume that refusals of the same product from the same region excluding exports from country j will act as an instrument for refusals from country j. This variable is highly correlated with refusals ($\rho = 0.67$). Because of concerns of endogeneity with the lagged exports, we use the approach suggested by Holtz-Eakin, Newey, and Rosen (1988) and Arellano and Bond (1991) and instrument for the lagged exports using previous lags.

Results of the regression of instrumental variables are presented in the first column of table 2. As one might expect, we find that refusals decrease exports to the EU. Specifically, for an increase in one EU refusal, exports decrease by 43%. At the average level of refusals, this effect corresponds with a long-run elasticity of –0.017. Consistent with the standard gravity model, the product of GDP is positively correlated with seafood exports, and distance between the exporter and importer decreases exports.

In the second column, we present the results for trade deflection. Non-EU importing countries see a jump in imports of 3% from those countries and products facing an EU refusal, giving a long-run elasticity of 0.026. As above, the product of GDP for importer and exporter increases trade, and distance decreases trade. In this less restrictive sample, we see that a shared common border or language increases trade, while a more devalued importer currency decreases trade.[3]

Second, we were interested in observing whether this trade deflection was occurring largely to other high- or low-income importing countries (third column in table 2). We find that much of the trade is diverted to other high-income countries. Thus, we do not see strong evidence that exports are being diverted largely to developing countries. However, given that the sign on the overall trade deflection effect remains positive (although significant at only the 10% level), some of the trade is deflected to lower-income countries. Unlike Baylis, Malhotra, and Rus (2010), we do not observe greater trade deflection in perishable goods.

Last, we ask what types of refusals are more likely to result in that product being diverted to new markets. Specifically, we observe whether the stated reason of the refusal is an issue with serious health consequences, such as the presence of toxins, parasites, or foreign objects, and we separate out these rejections from those with potentially less severe health threats, such as misbranded products or products containing an additive not approved in the EU. Results of this regression are presented in the fourth column of table 2. We find that those more severe products do not result in trade deflection, while the more mild cases

[3] As robustness tests, we also included market share and a binary variable if the exporting country had a trade agreement with the EU as an explanatory variables. As one might predict, market share is positively correlated with trade flows, but none of the other coefficients changed substantially. The trade agreement variable is positive, as expected, however insignificant, and there were no changes in the other coefficients.

Table 2. Estimation Results

Variable	Base Model Importer in the EU	Base Model Importer Not in the EU	Model 2 Importer Not in the EU	Model 3 Importer Not in the EU
Import Refusals	−43.50***	3.09***	2.30*	16.77***
	(11.16)	(0.76)	(1.73)	(5.48)
Lagged Ln Value	0.08***	0.10***	0.10.***	0.10***
	(0.003)	(0.003)	(0.003)	(0.003)
Lagged Total Exports$_j$	2.90***	1.87***	1.83***	1.73***
	(0.73)	(0.37)	(0.38)	(0.38)
Ln GDP$_{ij}$	13.10***	5.09***	6.08***	2.76**
	(1.47)	(1.31)	(1.33)	(1.37)
Exchange Rate	15.79	−0.09*	−0.09*	−0.09**
	(12.49)	(0.05)	(0.05)	(0.05)
Common Language	2.91	2.21***	2.20***	2.13***
	(2.23)	(0.85)	(0.85)	(0.86)
Ln Distance	−4.70**	−1.78***	−1.83***	−1.67***
	(2.41)	(0.39)	(0.39)	(0.39)
Border	3.99	3.39***	3.42***	3.74***
	(4.90)	(1.13)	(1.13)	(1.14)
High Income$_i$ and Import Refusal			3.29**	5.90***
			(1.46)	1.27
High Income$_i$			25.63***	19.22***
			(6.90)	(6.93)
Perishable and Import Refusal			−0.82	
			(1.58)	
Perishable			−7.11*	
			(3.70)	
High Hazard Refusal				−15.97***
				(5.79)
High Income$_i$ and High Hazard Refusal				−5.80***
				(1.33)
Overall R^2	0.39	0.46	0.46	0.46

Note: Country fixed effects not reported, standard errors in parentheses, and asterisks indicate levels of significance: *** = 1%, ** = 5%, * = 10%.

of rejection result in the exporter increasing exports of that same product category to non-EU countries. We also see that these products are exported largely to higher-income countries, which presumably have the larger market for seafood. Thus, although we observe strong evidence that import refusals generate trade deflection, we see less evidence that serious health hazards are being sent to third countries.

Conclusions

Various authors have debated whether standards hinder trade. In this article, we ask whether nontariff barriers generated by food safety regulations cause trade deflection in seafood. Seafood trade is of particular interest given both its rapid expansion, importance as an export product for developing countries, and potential for serious food safety hazards.

Using data on EU food import refusals and seafood trade for 1998 to 2008, we find significant trade deflection caused by EU food import refusals. As one might expect, we observe a decrease in exports to the EU from the country and for that export product that is targeted by the refusal. During that same year, we see an average increase of 3% in that same export category, from the same exporting country, to all other export partners. This diversion occurs largely in product categories that face a refusal for less threatening health violations like misbranding, while more dangerous infractions are less likely to generate increased shipments to other markets. Perhaps not surprisingly given the market potential, these diverted exports are directed largely, but not exclusively, to other high-income countries. Thus, although refusals clearly affect trade patterns, we do not see strong evidence that health concerns are systematically being exported to developing countries. That said, given the clear ability of nontariff barriers to alter trade, the question remains as to whether they are supplementing developed countries' arsenals of protectionism.

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