ABSTRACT – It is a well-established theoretical result that the trade policy of a large country can directly affect its own and other countries’ welfare by affecting international goods prices. However, there exist very few empirical studies that analyze the effect of trade policy on international prices. With detailed data on unit values and tariffs, I show how policy actions in Europe disrupted the global shrimp market in a non-negligible way and set the stage for the current anti-dumping case in the US. The loss of Thailand’s preferential trade status in Europe and the international differences in food safety standards during the antibiotics crisis, have shifted esp. Thai, Vietnamese and Chinese shrimp exports away from Europe towards the US in the late 1990s and early 2000s. I document how these shifting markets have decreased US prices for shrimp significantly compared to those in Europe.
ABSTRACT—It is a well-established theoretical result that the trade policy of a large country can directly affect its own and other countries’ welfares by affecting international goods’ prices. However, there exist very few empirical studies that analyze the effect of trade policy on international prices. With detailed data on unit values and tariffs, I show how policy actions in Europe disrupted the global shrimp market in a non-negligible way and set the stage for the anti-dumping case in the United States. The loss of Thailand’s preferential trade status in Europe and the international differences in food-safety standards during the antibiotics crisis shifted especially Thai, Vietnamese, and Chinese shrimp exports away from Europe toward the United States in the late 1990s and early 2000s. I document how those shifting markets have decreased U.S. prices for shrimp significantly compared to those in Europe.

The shrimp anti-dumping case in the United States brings to the forefront the extent to which the world economy is global. It also highlights the different roles and interests of developed and developing countries. In 1997, the European Union retracted the preferential trade status of Thailand, the world’s premier shrimp exporter. In 2001, antibiotics were found in shrimp residue. The European Union declared a zero-tolerance policy that restricted exports especially from Vietnam and China and imposed 100 percent testing on shrimp from Thailand. Both events directly affected exporters’ allocation decisions, away from Europe toward the United States. I use these events to trace out the demand for shrimp in the United States versus Europe and to assess the impact of Europe’s tariff and non-tariff policies on the price of shrimp in the United States versus Europe. I show how the price response was primarily due to these exogenous changes overseas. This finding reinforces the perception that the U.S. shrimp anti-dumping case against six shrimp exporters that are also developing countries is a modern form of protection to improve the competitive position of U.S. shrimpers.¹ In addition, my findings make a broader, more positive point. I use the events in the shrimp market as a natural experiment to investigate a key proposition in international economics for which very little empirical evidence exists so far: Large countries can affect international prices through their trade policies. Finally, I show the non-negligible trade-diverting effects of international differences in food-safety standards, issues that will only become more important as talks about liberalizing agriculture proceed.²,³

¹ Blonigen and Prusa (2003) state that anti-dumping cases have long been viewed as protectionism tools.
² Maskus and Wilson (2001) and Baldwin (2000) analyze technical regulations as instruments of commercial policy in a unilateral, regional, and global trade context.
business by artificially low prices. Subsequently, the International Trade Commission ruled that the
exporters injured the industry and the U.S. Department of Commerce imposed high tariffs for Vietnam
and China, and markedly lower ones for the others countries.

The shrimp anti-dumping case emerged in an international shrimp market that had changed
dramatically over the years. Increasingly, the global shrimp trade had become a one-way flow from
developing-country producers to consumers in Europe, the United States, and Japan. To a large extent,
aquaculture was responsible for the surge of shrimp production in developing countries. The shrimp that
developed countries imported increasingly had been raised on farms in Asia and Latin America where
waterfront property and labor was cheaper and environmental laws less stringent. This surge of imports in
itself already posed a challenge for U.S. shrimpers who saw their U.S. market share slip from 43 percent
in 1980 to 12 percent in 2001 (Haby, et al. 2002). Two events overseas increased this challenge even
more and laid the groundwork for the anti-dumping case.

The size of the shrimp harvest or catch depends largely on meteorological and environmental
parameters, which is why studies with high-frequency data typically take the local supply of shrimp as a
given. In an international context, therefore, the main issue for exporters is to allocate a given shrimp
catch across markets in a profit maximizing way. In 1997, Thailand, the largest exporter of shrimp lost its
preferential trade status in the European Union. By 1999, it faced a much higher most favored nation
(MFN) tariff, while its main competitors retained preferential status. Consequently, Thai shrimp-exporters
shifted exports away from Europe toward the United States. In addition, in the fall of 2001 the European
Union discovered antibiotics in shrimp residue. The European Union proclaimed a zero-tolerance policy
for antibiotics. It restricted imports from especially Vietnam and China and subjected Thai shipments of
shrimp to 100 percent antibiotic testing. This induced a massive shift by Chinese, Thai, and Vietnamese
exporters away from European to U.S. markets with less stringent standards. The tariff change and the
antibiotics crisis are the instruments that I will use to estimate demand for shrimp, since they, for a given
demand in terms of consumer prices, shift the supply curve. I find that both events lead to a drop in the
relative shrimp price between the United States and Europe for the affected countries.

My analysis shows that the shift in exports and the lower relative price in the United States versus
Europe are a rational response to an exogenous change in the international environment: the change in
preferential tariffs and the antibiotics crisis. This finding reinforces the perception of the shrimp anti-
dumping case as a protectionist endeavor that was brought with the promise of not only higher prices but
also of a government payout. Indeed, with the Byrd Amendment in place, the Alliance that successfully
convinced the government of its case stood to directly receive the collected tariff revenue in what was

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4 A much cited reference is Barten and Bettendorf (1989).
once a very open market attuned to the United States’ strong demand for foreign shrimp—80 percent of
U.S. consumption stems from abroad.\(^5\)

I use the specific events in the shrimp market to study a broader issue that is difficult to analyze at
a more aggregate level without getting caught in endogeneity problems: the impact of tariff and non-tariff
policies on international prices. It is well known that a country’s terms of trade matter for its welfare.
Since it is a prominent result that a large country’s tariff policy can affect international prices and thus its
own and others’ terms of trade, one would expect a wealth of empirical studies to relate trade policy to
international prices.\(^6\) However, the existing empirical literature on that subject, except for CGE models, is
limited. The small-country assumption that takes prices as given is mostly maintained. The focus instead
has been on the impact of trade restrictions on the volume of trade.\(^7\) Exceptions are Romalis (2005) and
Chang and Winters (2002) in the context of preferential trade agreements.\(^8\) Romalis (2005) studies the
impact of NAFTA on trade volumes and prices with disaggregate data. His results, like those of Chang
and Winters (2002), emphasize that especially price effects matter for countries’ welfare, in spite of the
substantial volume effects in trade liberalization studies.

My analysis differs from the existing studies and strikes a balance between the view of an
integrated international market with only one world price and that of partially localized markets. Romalis’
(2005) perfect competition setting is in the tradition of the first, whereas Chang and Winters (2002) relate
better to the second approach with segmented markets.\(^9\) Chang and Winters extend Feenstra (1989) who
studies how tariffs are reflected in import prices. They introduce strategic interaction between exporters to
one and the same foreign market. They find a significant effect of MERCOSUR on the pricing decisions
of rivaling suppliers to Brazil. Like Chang and Winters (2002) and Feenstra (1989), I let exporters charge
different prices in different markets, a fact well-documented by the pass-through literature that
underscores that markets of internationally traded goods are localized.\(^10\) However, I let prices in one
market (United States) depend on the conditions in the other market (Europe) and vice versa. In
particular, my exporter is constrained in his decision to allocate exports to various markets by a given

\(^6\) The ability of countries to affect terms of trade is at the core of the theoretical analyses of preferential trading
standards on international prices. Mundell (1964) studies the terms of trade in the context of a preferential trade
agreement. Corden (1997) extensively discusses the “optimal tariff argument” for large countries and provides
many references.
\(^7\) My analysis relates to the trade diversion literature on the impact of non-MFN tariffs on trade volumes, and to
Bown and Crowley (2007) who look at third-country tariffs effects on bilateral trade.
\(^8\) Kreinin (1961) is a descriptive study of the effect of tariff changes on import prices and volumes.
\(^9\) For Goldberg and Knetter (1997), product markets are segmented if the buyer and seller location affect the terms
of the transaction by more than the marginal cost of moving goods from one location to the other.
\(^10\) The “pass-through” literature studies how exchange rate shocks affect prices of imported goods abroad. See
Knetter and Goldberg (1997) for an excellent survey.
amount of output—the shrimp harvest/catch. This creates an explicit link between the localized market in the United States and in Europe. What the exporter sends to one market will not go to another. In this way, relocating exports from one country to another can change the relative prices in both markets and new policies in one market will affect the other.\footnote{Goldberg and Knetter (1999) warn that the pass-through literature should not overlook the importance of trade restrictions. Directly relevant for my case, they indicate that with binding quantitative constraints in foreign markets, the local currency price that clears the market abroad can be invariant with respect to exchange rate changes. Consider for example an exporter who (with a given harvest) is forced out of the European market because of the antibiotics crisis. In this case, the law of one price will fail primarily because of the tariff restrictions (assuming it held before).}

I study shrimp exports for five of the countries subject to the anti-dumping case (Thailand, Vietnam, China, India, and Ecuador) plus Indonesia. These exporters had a significant and continuous presence in both the United States and European Union market between 1996 and 2004 and monthly data are available for that period.\footnote{Most U.S. production is warm-water shrimp from the Gulf of Mexico and the South Atlantic Region. Shrimp from the northwest and northeast coasts is cold-water shrimp.} The six countries accounted for about 70 percent of shrimp exports to the United States. Before discussing the stylized facts, model, data and specification, I first sketch the context of the shrimp market.

I. The Shrimp Market

Estimates by the U.N. Food and Agriculture Organization [FAO] in Figure 1 illustrate the worldwide expansion of shrimp production. Production increased from 0.31 million to 3.8 million metric tons between 1950 and 2002. A marked shift materialized in this period with a growing dichotomy between shrimp-consuming developed countries and shrimp-producing developing countries. As Figure 2 shows, the share of shrimp production by developing countries increased consistently and that of the main consumers—Japan, the United States and Europe—steadily decreased.\footnote{Aggregate data are not available after 2002.} According to Haby, et. al (2002), Japan, Europe, and the United States currently consumed some 60 percent of world production. International trade data tell a similar story. The FAO estimates that consumption at 0.3 million metric tons of exports in 1976 and 1.7 million tons in 2002. The European Union, United States, and Japan together consistently absorbed some 80 percent of these worldwide exports. In terms of world exports, as Figure 3 shows, the share of developing countries hovered around 60 percent. Europe’s share was about 15 percent in recent years and that of Japan and the United States was almost negligible.

Table 1 lists the 10 largest shrimp exporters into Europe and the United States for 1996, the beginning of our sample.\footnote{Aggregate data are not available after 2002.} The list contains the six countries that we study: Thailand, China, Vietnam, Ecuador, Indonesia, and India. Throughout, as a fraction of total worldwide exports, Thailand is the most...
important exporter, and it plays a central role in our analysis. Together, the six countries account for about 70 percent of U.S. imports in 1996.

An important factor behind the sustained growth of shrimp supply is aquaculture. According to Haby, et. al (2002), it increases esp. in the 1980s, starting from 5 percent of world production in 1980 to an impressive 30 percent at the end of the decade. In the 1990s growth tapered off and aquaculture’s share stabilized around 35 percent. Developing and emerging economies in general, and the countries that I study in particular, play a prominent role in shrimp farming and more broadly in aquaculture as such. Shrimp farming requires waterfront property that in many developed countries has higher value in other uses. In addition, developing countries have a low-wage workforce, and they are also less restricted by environmental laws. Water pollution and the destruction of mangrove areas are sometimes linked to shrimp culture. Note finally that a country’s shrimp output fluctuates significantly over time. Shrimp farming is risky. The crop is largely determined by weather and ecological conditions on the one hand. On the other hand, shrimp culture is also quite vulnerable to diseases that can severely reduce crops, as for China in 1993, Thailand in 1996 and 1997, and Ecuador in 1999.\textsuperscript{14}

In sum, the shrimp market has been a very important export market for developing countries since the 1980s. Shrimp production is often a more lucrative alternative to rice. Traditionally, the United States as a major consumer of shrimp had been a very open market for shrimp. Two events, however, challenged this position.

\textbf{a. Thailand’s changing GSP Status in the European Union}

There are interesting differences between Europe and the United States. The United States was, until recently, an open market with no tariffs on shrimp imports. In Europe, on the other hand, the MFN tariff for frozen shrimp was 12 percent and that for cooked and canned shrimp 20 percent.\textsuperscript{15} Of particular interest to us is how the European Union changed the tariffs for Thailand, the leading exporter of shrimp. Since 1971, the European Union granted developing countries unilateral tariff reductions under the Generalized System of Preferences (GSP) to support industrialization.\textsuperscript{16} The European Union regularly reviews its GSP. In 1996 it was decided, to Thailand’s surprise, to cut Thailand’s GSP benefits for shrimp in half from January 1997 on and to abolish them by 1999. Under the European Union’s GSP, raw and cooked shrimp were subject to respectively up to 4.5 percent and 6 percent tariff. From 1999 on, Thai shrimp faced an MFN tariff of 12 percent and 20 percent, while other exporters maintained their GSP status. This shifted Thai exports away from the European Union to the United States.

\textsuperscript{14} See Josupeti, 2004
\textsuperscript{15} There were no tariff changes in Japan over the period that is studied. (Josupeti, 2004).
\textsuperscript{16} According to Cuypers (1998), ASEAN countries have benefited most from the European Union’s GSP.
b. Antibiotics

In the summer and fall of 2001 reports surfaced in Europe about high levels of chloramphenicol and nitrofurans in shrimp shipments from East Asia. These antibiotics were banned in the European Union. Suspicion of widespread use of antibiotics in Asian shrimp farming gathered. The United States would increasingly monitor antibiotics in its imports. However, there was a significant difference between how the United States and European Union addressed the antibiotics problem that contributed to the shift in the global shrimp market.

—The European Union had a zero-tolerance policy for chloramphenicol based on the minimum detectable limit. This limit declined with new technology and is between 0.1 parts and 0.3 parts per billion (ppb), much stricter than in the United States (initially 5 ppb). The FDA gradually lowered its permissible limit to 1 ppb in May 2002 and to 0.3 ppb by the end of July 2003. Only when the crisis was virtually over in the fall of 2004, did the United States announce a testing method for nitrofurans and regular testing for 2005. The European Union limits nitrofurans to 0.1 ppbs.

—Enforcement also differs by destination. How the European Union handled Thai shrimp illustrates this well. The European Union has alternatives beyond temporary bans which it used against Vietnam or China. The European Union, for example, subjected up to a 100 percent of Thai shipments to testing at the height of the crisis in 2002 and 2003. Extensive testing causes costly delays of up to four weeks. Before the crisis the European Union tested about 10 percent of Thai shrimp. Comparable measures for the United States are not available. In 2003 the United States did hire more inspectors to increase testing.

—To prevent contamination of the food chain, the European Union initially destroyed the affected imports. Only in September 2004 as the European Union was revising its zero-tolerance policy did it consider the possibility of re-exporting or sending back to the exporter shrimp with lower ppbs.

The antibiotics crisis involved many shrimp exporters. Most seriously affected, however, were China, Vietnam, and Thailand. The crisis created according to seafoodbusiness.net quite some uncertainty for exporters. The European market for Asian shrimp, it states, had become a “crapshoot” during this period. To ease the crisis, shrimp exporters explicitly banned the use of antibiotics. They imported measure kits to test goods before exporting and certified them. Transshipments [and re-labeling] of contaminated shrimps form other countries was restricted. As with Thailand’s loss of GSP status, food-safety concerns provided an unanticipated surge of shrimp exports to the United States, paving the way for the anti-dumping petition in December 2003.

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17 For a chronology of the antibiotics crisis, see www.shrimpnews.com/Mitch.html.
19 This reportedly was the case for Indonesia and Ecuador, Shrimp Media Monitor, July 2004.
II. Stylized Facts.

Thailand, as the world’s premier exporter of shrimp, plays a key role in our analysis. The different panels of Figure 4 characterize Thai monthly exports to the United States and Europe between January 1996 and July 2004 and also those of our five other countries.

The first panel plots the gross tariff rate for Thai shrimp, $1 + \text{the ad valorem tariff rate}$. Throughout the period Thailand did not face any import tariffs for its shrimp in the United States—Our time period ended as the preliminary anti-dumping tariffs were announced by the Commerce Department. In the European market, on the other hand, one clearly sees a stepwise increase in the tariff from 4.5 percent before the revision of Thailand’s GSP status in 1997 to 9 percent and finally to 12 percent for frozen shrimp at the beginning of 1999 when Thailand gained full MFN status. Throughout I consider the market of frozen and cooked shrimps and prawns that have been the least processed.\(^{20}\)

The second panel is key and fairly suggestive. It illustrates how the Thai export market shifts away from Europe toward the United States. Since I have no comparable data for Japan, I plot Thai shrimp exports to the United States as a fraction of total exports to the United States and Europe. The exports are measured in terms of kilogram. From initially 72 percent in 1996, the United States share increased to 89 percent in 1999 after the tariff hikes. Finally, the share rose even more with the antibiotics crisis in late 2001. By early 2004, it had reached 97 percent. As Panels 4 and 5 show, the shifts away from Europe to the United States also stood out for China and Vietnam around the antibiotics crisis. The shares for the remaining countries in the remaining panels did not seem to change systematically, if at all, around that time.

To confirm the visual impression that the tariff hikes and the antibiotics controversy moved the market for Thai shrimp, I run a simple regression (1) for illustrative purposes. I relate the U.S. share in total exports to the United States ($x_{us}$) and the European Union ($x_{eu}$) to the relative U.S./E.U. tariff ($\text{Tariff}_{eu}$) and a dummy ($\text{Antibiotics}$) from fall 2001 to fall 2004 to capture the antibiotics crisis.

$$
\ln \left( \frac{x_{us,t}}{x_{us,t} + x_{eu,t}} \right) = \alpha + \beta_1 \ln \text{Tariff}_{eu,t} + \beta_2 \text{Antibiotics}_t + \epsilon_t \quad (1)
$$

The significant coefficient estimates in the first column of Table I show that increasing E.U. tariffs for Thai shrimp boosted exports to the United States relative to those to Europe. The antibiotics crisis also diverted shrimp exports to the United States. Note that this is a very robust relationship between shrimp exports, tariffs, and the antibiotics crisis. Adding different controls for the United States and European economy, as we do in the context of the model, will not change the basic pattern, see

\(^{20}\) For a detailed discussion of the data, see Section IV
Section V. To ensure we are not just capturing a general tendency of the shrimp market, I construct a panel with the U.S. share in total U.S. and E.U. exports for each of the other five shrimp exporters \( i \) relative to that of Thailand on the left. [The \( T \) refers to Thailand’s variables]:

\[
\ln \left[ \frac{\frac{xus_i}{xus_i + xeu_i}}{\frac{xTus_i}{xTus_i + xTeu_i}} \right] = \alpha_i + \beta_1 \ln Tariff_{eu_i} + \beta_2 Antibiotics_{eu_i} + \beta_3 AntibioticsYZ_{eu_i} + \beta_4 India_i + \epsilon_i 
\]

(2)

I allow for country effects and include a separate dummy for India in 1998, when exports to Europe were temporarily banned. Since mostly China and Vietnam were severely affected by the antibiotics crisis, I include an additional antibiotics dummy, \( Antibiotics_{YZ} \), for both. The Thai tariff is also part of the regression—since other countries’ tariffs did not change, they are part of the country effect. Here again, adding other variables in the context of the model will not alter sign, or significance.

The regressions confirm the initial results for Thailand. The tariff shifted the markets and so did the antibiotics crisis. Since the Thai share increased faster than that of the other countries in the wake of the tariff increase and the antibiotics crisis, we obtain a negative coefficient on tariff and a negative coefficient on \( Antibiotics \). The estimates suggest that the impact of the antibiotics crisis was even more dramatic in China and Vietnam. Adding the coefficient on the antibiotics dummy to the interaction with China and Vietnam gives a net positive effect. Since Thailand had already reallocated a significant part of its market after it lost its GSP status, this is not surprising. Also, the India dummy has the expected sign. It temporarily shifts Indian shrimp away from Europe to the United States.

I include in Table I a third column with a panel version of regression (1) for the five other countries together - not relative to Thailand. As before, the impact of the antibiotics crisis varies between China and Vietnam on the one hand and Ecuador, India, and Indonesia on the other hand. I include the dummy for India in 1998 and the Thai tariff. This regression is telling for its insignificant coefficients. In spite of the reallocation between the United States and the European Union, the E.U. tariff hike on Thailand is a major factor for all other countries. Similarly, the antibiotics crisis is not statistically significant for Ecuador, Indonesia, and India. Strategic interactions in the shrimp market may play a role. The regression suggests that the massive reallocation of Thai, Chinese, and Vietnamese exports from Europe to the United States after the tariff hike or the antibiotics crisis, is not matched by a comparable reallocation of exports in the other direction by unaffected countries. This important observation will help rationalize the focus of the model. In particular, I will concentrate on the exporter’s own decision of how to allocate her exports between two markets, rather than on any strategic interactions.

In the third panel, the bold line displays the changing dollar price [unit value] for 1 kilogram of Thai shrimp in the United States versus in Europe. A few observations are worth making. If the law of one price held, the ratio of the dollar price of Thai shrimp in the United States versus the dollar price in
Europe should be one throughout. If the law of one price held in differences, one should observe a constant for the entire period. Clearly, this is not the case, which makes studying price differences between both markets a meaningful exercise. In light of the extensive pass-through literature, this is not much of a surprise and illustrates the localized nature of international markets. [For comparison, I also include the ratio of the dollar price in the United States versus the euro price in Europe to show that not all the action is coming from the exchange rate.] As for the pattern of the dollar price ratio for Thai shrimp, the relative price clearly moves downward after 2001 and after the tariff reduction. The remaining panels plot for the other countries the relative price together with the changing share of their shrimp exports to the United States in the total U.S. and European exports.\(^{21}\) One can discern a pronounced downward movement of the relative dollar price for the Chinese and the Vietnamese shrimp. For Ecuador and Indonesia, no such pattern can easily be discerned. There is a bit of an upward price move for India.

**III. Model.**

In this section, I present a simple model to guide the empirics and to formalize the key idea that the above stylized facts suggest. The model motivates the controls that are needed in order to assess more rigorously the impact of tariff and non-tariff barriers on the price of shrimp. I focus on the decision of individual exporters to allocate exports between the European and U.S. market. This focus is motivated by the stylized facts above. In a first step, I assume there are multiple exporters from different countries. While an exporter may in reality strategically reallocate some of his exports in response to what happens to other competitors, I assume and the described facts suggest that the exporter primarily responds to the restrictions in his own export market.

I assume that the demand for shrimp varieties and their substitutes, \(c\), is determined at each moment in time by a CES utility function in the two destination markets, \(j\), Europe and the United States. I suppress the time subscripts.

\[
U_j = \left\{ \sum_i \left( \beta_{ij} c_{ij}^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)} \right\}^{\sigma/(\sigma-1)} \quad j = 1, 2 \tag{3}
\]

where \(\sigma\) is the elasticity of substitution and typically larger than 1.

Optimization yields the familiar demand for good \(i\) in country \(j\), \(c_{ij}\).

\[
c_{ij} = \beta_{ij} p_{ij}^{-\sigma} Y_j^{S/\sigma} / P_j^{S \cdot 1-\sigma} \quad j = 1, 2 \tag{4}
\]

\(^{21}\) The plots of the relative prices show a similar pattern when deflated by U.S. or E.U. consumer price index.
$P_j^S$ is a reference price index for shrimp varieties or more generally for other substitutes. It equals $\left\{ \sum \beta_i \right\}^{1/\sigma}$, $p_{ij}$ is the actual price that consumers in country $j$ pay for product $i$ inclusive of tariffs; $Y_j^S$ is the budget that country $j$ spends on shrimp and comparable products.

I consider shrimp a product that is differentiated by country of origin. In other words, I assume that there is complete international specialization in production. Therefore, $c_{ij}$ coincides with the total import demand for shrimp from country $i$. Since I am primarily interested in explaining shrimp prices and how these prices evolve over time, I rewrite Equation (4) as follows.

$$p_{ij} = \beta_{ij}^{1/\sigma} c_{ij}^{-1/\sigma} Y_j^S / P_j^S \sigma (1-\sigma) / \sigma \quad j = 1, 2 \tag{5}$$

Equation (5) is an inverse demand function that states how much consumers are willing to pay for shrimp. [I assume that $p_i$ has a negligible impact on the aggregate price index.] Since I later argue that tariff changes only imply supply shifts, it is important to emphasize that the willingness to pay is expressed in terms of the actual price consumers pay. Therefore, there is no shift in demand (willingness to pay) when a tariff is imposed, as long as $Y_j^S$ and $P_j^S$ are not affected, which I assume. Note that prices are expressed in local currency since these are the relevant ones for consumers—consumers are no international arbitrageurs. To express euro prices in dollars, one simply multiplies the left and right side with the euro–dollar exchange rate.

I am especially interested in how the price of shrimp compares in the United States versus Europe. Equation (6) gives the equation that is the basis for my estimates and that is derived from Equation (5). Following Chang and Winters (2002), I focus on real prices. Note that comparing shrimp prices in local currency as in Equation (6) is identical to comparing their dollar prices—the exchange rate that is needed to convert euro prices in dollars on the left side will cancel since it is also needed to convert the right side into dollars.\footnote{Obviously, if consumption and real income were expressed in dollars, which is often the case in international studies (not ours), only dollar prices would be appropriate.}

$$\frac{p_{1j}/P_{1j}^S}{p_{2j}/P_{2j}^S} = \left( \frac{\beta_{1j}/\beta_{2j}}{c_{1j}/c_{2j}} \right)^{1/\sigma} \left( \frac{Y_j^S / P_j^S}{Y_j^S / P_j^S} \right)^{1/\sigma} \quad j = 1, 2 \tag{6}$$

Equation (6) states that the relative consumption of the United States and Europe matters in these localized markets for how the relative shrimp price changes between those markets. Common movements underlying shrimp prices for country 1 and 2 are differenced out. Moreover, as the analysis of relative supply $x_{1j}/x_{1j}$ that in equilibrium equals relative consumption $c_{1j}/c_{1j}$ will make clear, the localized prices are explicitly linked through the exporter’s allocation decision, so that changes in one market affect the price in the other market. Let’s now specify the supply side of the model.
In agricultural economics inverse demand systems that take the quantity as given are fairly common, especially in studies of local fish markets with high frequency data. An oft-cited study is Barten and Bettendorf (1989). The motivation for this assumption is straightforward. Fish landings are fairly unpredictable as they are, to a large extent, determined by ecological circumstances and the weather. Moreover, since fish is perishable food, it has to be sold, so the amount that is caught determines the price. While this logic is widely accepted, in an international context, there is an additional level of complexity. Even when the total harvest is in the short run exogenous, foreign suppliers still have to decide how much of their catch or harvest they send to one particular market. Consequently, how much shrimp exporters decide to export to the U.S. versus the E.U. market does not only depend on the total harvest. It also depends on a comparison of both markets.

Since the interconnectedness of international markets is key to the analysis and since I work with high-frequency data, I explicitly consider an exporter’s short-term decision to allocate a given shrimp catch or harvest between two markets, which will be the United States and Europe. I assume that in order to maximize profits the exporter varies the export quantity between markets. In doing so, she can affect the price in the different export markets. The exporter takes as given the tariffs and considers the price net of tariffs, the exchange rate, the marginal costs, and the behavior of the other suppliers. The exporter $i$ maximizes the following profit function. I suppress the $i$ subscripts for the different exporters.

$$
\begin{align*}
\text{Max} & \quad E_i \tilde{p}_1 (x_1, \bullet) x_1 + E_2 \tilde{p}_2 (x_2, \bullet) x_2 - \alpha_1 x_1 - \alpha_2 x_2 \\
\text{s.t.} & \quad X = x_1 + x_2
\end{align*}
$$

where $E_j$ refers to the exchange rate between country 1 or 2 and the exporter’s home currency, $x_j$ refers to the quantity of the good exported to country $j$, $\tilde{p}_j$ is derived from Equation (5) and is the price that the exporter receives: the price net of tariffs that is a function of e.a., $x_j$; $\alpha_j$ captures the marginal cost of exporting to both markets, which among other things will be a function of bilateral distance.

I assume that the exporter maximizes profits in his domestic currency. She translates the foreign goods prices $\tilde{p}_{ij}$ into her own currency with the dollar and euro exchange rate. I assume that markets are localized, that is, producers can charge a different price in different markets. I allow for different marginal costs $\alpha$ of delivering shrimp to one market versus to another. Needless to say that different $\alpha$’s could

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23 Shrimp harvests in aquaculture (like trawling) are very dependent on ecological and meteorological circumstances. Note also that in the context of developing countries, storage technology, resources, and information to adjust production in response to prices tend to be less prevalent.

24 Considering multiple markets is consistent with the pricing to market literature, see Goldberg and Knetter (1997). Different, of course, is the given $X$, the focus on inverse demand curves and trade restrictions.
capture differences in transportation costs.\textsuperscript{25} I assume that the exporter knows the conditions in her export markets, i.e. she knows relationships (5). She thus understands how quantities affect prices in both export markets and takes this into consideration as she decides on how much to send where. Moreover, the exporter’s maximization is subject to the constraint that the exports to the United States and Europe add up to the exogenous quantity of the catch or harvest, \(X\). Consequently, any amount that the exporter sends to the United States does not go to Europe and the reverse. In this way, in spite of the exporter’s ability to charge a different price in different markets, the prices in Europe and the United States are closely linked. The exporter depresses the price in one localized market the more she exports to it, she props up the price in the other market where she exports less. The exporter’s decision on how much to export to either market is a function of the characteristics of both markets, the exchange rates, and the marginal delivery costs. In this way, changes in the conditions of one market will affect the export supply to the other market.

\[
x_{ij} = f_i[\tau_{i1}, \tau_{i2}, Y_1^S, Y_2^S, P_1^S, P_2^S, E_{i1}, E_{i2}, X, \alpha_{i1}, \alpha_{i2}], \quad j = 1, 2 \tag{8}
\]

where \(\tau_{i1}\) and \(\tau_{i2}\) refer to the tariffs in markets 1 and 2.

There is an important difference between my setup and that of Chang and Winters (2002), and Feenstra (1989). These authors consider a pricing decision (with market-specific marginal costs) that isolates markets from each other. I also allow for different prices across countries, yet I explicitly connect the different markets through the exporter’s allocation decision (of a given harvest). Because of this decision, circumstances in Europe, such as the antibiotics crisis will affect the amount of shrimp sent to the United States. The central empirical question is then, to what extent does the exporter affect the relative price of shrimp as she shifts markets. Note that there are different ways to rationalize the antibiotics crisis in my setup. One possibility is to consider it a change in Europe’s \(\alpha\); another option, since for China and Vietnam the crisis involves restrictions on the volume of exports, is to consider it really a constraint on how much \(x\) can go to Europe.\textsuperscript{27} In the latter case, if \(x\) were binding, the exporter would be unable to allocate his optimal choice of \(x\) to Europe and would be forced to export more to the United States than he wanted. There are also various ways in which my setup could be modified or generalized. One could wonder what would happen if instead of the exporter considered here, there were a multitude of small exporters from each country with no individual impact on the price in either market. If individual

\textsuperscript{25} In the appendix, I specify the maximization. I provide the closed-form solution for when \(\alpha_{ij}\) are the same. When \(\alpha_{ij}\) are different, no such solution can be obtained.

\textsuperscript{26} It takes 7 to 10 days to deliver Thai shrimp to Japan according to Seafood.com, and 20 to 30 days to deliver to the United States. Shipping Thai shrimp to Europe takes between 30 and 45 days.
exporters took the behavior of other exporters as given, their allocation decision in response to tariff changes or an antibiotics crisis would ignore the joint impact of their reallocation away from Europe to the United States on the prices. They, therefore, might relocate more than in the case considered here, triggering more of a relative price adjustment. Note that such modifications of the setup would not alter the basic insight: The exporter’s allocation decision links geographically separate markets, and it gives way to the question as to how relative prices move as she relocates exports in response to changing circumstances.

IV. Data Description.
The monthly shrimp data that I use cover the time period between January 1996 and July 2004.

a. Shrimp Trade Data
My analysis hinges on a comparison of the United States and the European market. I therefore only include countries that have an uninterrupted time series in either market. I use public information on the volume and the value of shrimp imports (which does not include tariff, freight, insurance fees, and other surcharges). By dividing value and quantity I impute the price of shrimp (unit value).

Shrimp import records for the United States are retrieved from the U.S. International Trade Commission’s Web site. The data source provides the U.S. import records from all the countries in the world. The imports are classified by Harmonized Tariff Schedule number and available at the 10-digit level. The values are reported in dollars, while the quantities are measured in pounds.

Data on shrimp imports for Europe are provided by Europe’s statistical agency, EUROSTAT. In our definition, Europe comprises 15 countries: Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden. The European import data are available at the 8-digit level and classified by HTS number. The values are reported in euros, while the quantities are measured in kilogram. Only data on shrimp imports from the major exporters are available.

I aggregate the data up to the 6-digit HTS number to get data for a sizable group of countries that export both to the United States and Europe and to obtain exports that are comparable between the United States and Europe. Thailand, Vietnam, China, Ecuador, India, and Indonesia all have continuous time series in both Europe and the United States during the entire period. I focus on the HTS category

Note that new standards can also affect the production process and the long-term survival of firms. Relevant for us here are only those effects that in the short term directly affect the allocation decision. At the most disaggregate HTS level category definitions vary. Like the FAO, I do not rescale the quantities to shell-on headless form, since it is not clear for the various categories which weight one should apply. Haby, et. al (2002) recommends some weights.
030613. This category excludes all the more-processed shrimp and prawn products, which is to say those that have been canned, frozen, and put into airtight containers or prepared with other fish or meat. These last products are categorized under the HTS category 160520 and will differentiate the shrimp by their country of origin. Finally, I translate all volumes into kilogram in order to make European and U.S. data consistent.

b. Shrimp Tariff Data
For the U.S. case, tariff data can be retrieved from the HTS archives of the USITC Web site. The six countries that we study have a zero tariff throughout the period. The preliminary tariffs imposed by the Commerce Department were announced only at the very end of the period that I study. For Europe, the specific tariff rates are found in the TARIC database of the European Commission. Since 1999, Vietnam, China, India, and Indonesia face a 4.2 percent tariff for HTS 030613. Before 1999, it was between 4.2 percent and 4.5 percent. The only country with a consistently lower tariff is Ecuador with 3.6 percent, except for 1996 where it was 4.5 percent. In the wake of European Union’s revision of its GPS tariff system, Thailand has seen its initial 4.5 percent tariff increase. From 1997 onward, it faced a tariff of up to 9 percent in. By 1999, Thailand had graduated from the GSP system and the regular MFN tariff of 12 percent since then. In the analysis, I will focus on the tariff change in Thailand, since this is the only significant tariff variation there is in the data.

c. Aggregate Data
To proxy for aggregate prices, I retrieve the CPI and the food price index for the United States and Europe from the Main Economic Indicators database of the OECD’s on-line library. To proxy for real income, I retrieve the monthly (not cyclically adjusted) industrial production index from the Federal Reserve http://www.federalreserve.gov for the United States and from EUROSTAT http://epp.eurostat.cec.eu.int for the same 15 countries of the European Union considered before. All of these indices have 2000 as the base year. The euro–dollar exchange rate is also taken from EUROSTAT. The exchange rate is a monthly average. To construct the aggregate shrimp indices for Europe’s and the U.S.’s main exporters, I use the unit values from the aggregate exports to the United States and European Union from their 11 most important exporters, respectively for HTS 030613 and 160520 combined (“ShrimpII”) and HTS 030613 (“ShrimpI”).

d. Antibiotics Crisis

30 The 11 countries include our 6 countries plus Argentina, Mexico, Brazil, the Philippines, and Malaysia.
The antibiotics crisis started in the summer of 2001 when high levels of antibiotics were discovered in shrimp residue. I take this as the starting point for a dummy that should capture the effect of the antibiotics crisis. By the fall of 2004, at the end of the data set, the crisis is largely over. Testing intensities have been reduced, and the restrictions reduced and abolished for most countries. I therefore let the end of the data set, July 2004, coincide with the end of the crisis. Especially China, Vietnam, and Thailand were affected by the antibiotics crisis. When I estimate a regression with multiple countries, I will allow for a separate antibiotics effect for on the one hand Ecuador, India, Indonesia and other hand the three countries mentioned before.

V. Specification and Results.

The question of interest is to determine how the price of shrimp is affected by the changing conditions in the export markets and especially where those relate to changes in trade policy. The main focus is on Thailand, the world’s premier exporter of shrimp, and on China and Vietnam. I include Indonesia, India, and Ecuador, to make sure that my findings for Thailand, China, or Vietnam are not reflective of the shrimp market as such.

Using the relative demand Equation (6), it is fairly straightforward to obtain regression (9) for the real relative shrimp price in the United States versus Europe, with three dummies for the four seasons as additional controls (spring is the benchmark).

\[
\ln \frac{Pus_t}{Pus_t^S} = \alpha + \beta_1 \ln \frac{cus_t}{ceu_t} + \beta_2 \ln \frac{Yus_t}{Yeu_t} + \beta_{3-5 \text{seasons}} I - 4 + u_t
\]  

(9)

As indicated in Section III, I compare the dollar price of shrimp in the United States to the euro price in Europe. This follows directly from the setup. Consumers are no arbitrageurs and base their consumption decision on the local price.\(^{31}\)

Note that the regressors in (9) include the United States and Europe’s relative real income, \(Y/P\), rather than their relative real spending on shrimp and substitutes, \(Y^s/P^s\), that the theory suggests. Since I do not have monthly spending data (that would be endogenous anyway), I assume that \(Y^s/P^s\) is a positive function of real income: \(Y^s/P^s = f(Y/P)\), with \(f'(\bullet) > 0\). The sustained increase in the consumption of

\(^{31}\) To explicitly compare dollar prices in Europe and the United States, one simply multiplies through the left-hand side with the dollar–euro exchange rate and also includes it on the right-hand side of the regression. Needless to say, the outcome is the same. I need dollar–euro prices, because of how I measure quantities, prices, and real income. All of these are not expressed in dollars for Europe. Consumption is in kilogram, real income is proxied by the index of manufacturing production and the aggregate price index tracks euro prices.
shrimp (and the suggestion in the literature that shrimp demand is fairly sensitive to upturns and downturns) makes one expect a coefficient of more than one. Of particular interest is the coefficient $\beta_1$. We expect a negative $\beta_1$, so that U.S. consumers only consume increasing amounts of, say, Thai shrimp relative to European consumers if indeed their price decreases relative to the price in Europe. To prevent any feedback effect from prices on quantities, I instrument for relative consumption in the United States versus Europe $\text{cus/ceu}$. As motivated by the model setup, the relative demand $\text{cus/ceu}$ is equal to relative supply $\text{xus/xeu}$ in equilibrium. Relative supply $\text{xus/xeu}$ is determined by the exporters’ decision. According to Equation (8) the decision is a function of all the other right-hand-side variables of regression (9). In addition, however, the exporter’s decision is based on other factors that do not affect the consumer willingness to pay. These factors—the antibiotics crisis and the retraction of Thailand’s preferential tariff—are then potential instruments to help trace out demand as they shift the supply curve while demand stays put.

Note that the exporter, not the consumer, is the one who compares multiple markets to decide on where to send his output. Any change in the relative cost factors may make him shift his export markets. From the specifics of the shrimp market we know that the antibiotics crisis and the loss of the GSP status were significant factors in the decision of exporters to send their goods to either the United States or to Europe. In the case of Thailand, for example, the zero-tolerance policy in Europe at the height of the crisis meant that its shrimp shipment would be tested, which would cost delays of a few weeks. It also gave way to uncertainty as to whether antibiotics would be found in the shipment, which raised the possibility that the shrimp would be destroyed. [Developing countries do not have the very sensitive machines that Europe uses to enforce its testing policy. Only by the end of the crisis will they import test kits mainly from the Netherlands.] The antibiotics crisis is a good instrument, since it primarily affects the producer who will reduce the exports to Europe and increase those to the United States. In the empirical implementation, I use a dummy for the period of the antibiotics crisis. It runs from August 2001 till the end of the sample in July 2004. In addition to the antibiotics crisis, I also choose the tariff as an instrument for relative consumption in regression (9). As argued before, a change in a tariff does not shift the demand equation (expressed in the actual prices that the consumer pays), yet it does have an impact on the allocation decision of exporters. I then estimate regression (9) by two stage least squares.

32 The National Marine Fisheries Service estimates that per-capita shrimp consumption increased in 1996 to 2001 by 48 percent. See http://www.st.nmfs.gov. Real per-capita income increased according to BLS by 10 percent.
33 The antibiotics crisis barely registers in the media in Europe and the United States, where it could affect consumer behavior. The actual anti-dumping case will attract much more attention.
34 In theory, the dollar–euro exchange rate is a candidate instrument. However, as an aggregate variable, it affects income and thus demand, whereas my instruments are specific to the shrimp market and identified with a shifting supply.
Table III presents the estimates of regression (9) for Vietnam and China. I correct the error in all cases for AR (1) autorcorrelation since the Durbin Watson is about 1 or smaller, suggesting positive autorcorrelation. I report the instrumental variable (IV) estimates that are very similar to the non-IV estimates. For each country separately, I present four different estimates. As indicated by the theory $P_S$ is a reference aggregate price index for shrimp or substitutes—I use $P_S$ to deflate the nominal shrimp prices. One can argue about how broadly this price index should be defined. I therefore estimate regression (9) with four different price indexes. The estimates are reported in Table III from left to right in decreasing order of the generality of the price index. The first column uses the Consumer Price Index (CPI), the second the Food Price Index (Food). In the third column, I take the unit value of shrimp (prepared and less prepared, HTS 160520 and 030613) for all major trading partners (“Shrimp I”) and the fourth column the unit value of only the less prepared shrimp (HTS 030613) for these countries (“Shrimp II”).

As one can see, the coefficient on relative consumption for China and Vietnam is significant in most instances at the 99 percent level, except for with the shrimp price index for China that is significant at 90 percent. The estimated coefficient has the expected sign: a higher willingness to consume in one market versus another requires a lower relative price. The coefficient on relative consumption is fairly robust and does not vary much across the different estimates. Moreover, the coefficient is also very similar across countries. The coefficient on relative income is positive for both countries; for Vietnam it is always significant and larger than 1. The seasonal dummies do not matter for Vietnam, yet they are significant for China in the fall (3) and sometimes in the winter (4) when prices tend to be somewhat higher. As one can see, there is a significant amount of autorcorrelation with the rho coefficient between 0.5 and 0.7. Overall the $R^2$ varies between 0.2 and 0.1 for Vietnam and China.

For both countries, I estimate a coefficient on relative consumption that is relatively small in size, on average in the order of $-0.11$ or $-0.085$ for Vietnam and China. In other words, relatively large shifts in consumption between the United States and Europe are needed to affect relative prices in a tangible way. Holding all else constant, an increase in relative consumption of about 9 percent or 11 percent is needed to decrease the shrimp price with 1 percent. The demand for shrimp seems to be fairly elastic ($\sigma$ is on average between 9 and 11).

We are, of course, interested in whether these estimates have anything to say about the impact of the antibiotics crisis on the relative prices. To get a sense of the magnitude of the impact, one can look at the magnitude of the coefficient on the antibiotics dummy in the first-stage regression that relates the exported quantities to the tariffs and to the other variables in the model. The first-stage regression approximates the exporter’s decision as defined by equation (8) and thus shows how exporters redirect their exports away from Europe toward the United States in response to Europe’s high food-safety

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35 The 11 countries include our 6 countries plus Argentina, Mexico, Brazil, the Philippines, and Malaysia.
standards. [I report the first-stage regression that STATA uses in order to obtain two-stage estimates in Table VI.] The coefficient of the Antibiotics dummy in column (a) of Vietnam’s and China’s block has the expected positive sign. The coefficient is significant at the 99 percent level. To gauge the impact of the antibiotics crisis, I multiply the average coefficient of relative consumption with 2.58 and 3.05, respectively the coefficient on antibiotics for Vietnam and China. The antibiotics crisis may thus, on average, have had a negative impact in the order of 0.29 percent on the real relative prices for Vietnam and 0.26 percent for China. All in all, in light of the fairly drastic shifts in trade patterns this is a fairly small number, even while taking into consideration the fact that the dummy is only a fairly crude proxy for the antibiotics crisis since it does not vary with its intensity.

Let’s now turn to Thailand whose estimates are reported in Table IV. The coefficient on relative consumption is negative and with on average –0.115 in the same order of magnitude as that for China and Vietnam. There is again a significant amount of autocorrelation and the $R^2$ is slightly higher. It ranges between 0.15 and 0.3. Comparing the estimates of the first-stage regression from Table VI column (a) and the average coefficient of relative consumption, we can again infer the impact of the antibiotics crisis. The coefficient on the antibiotics dummy is with 2.03 smaller for Thailand than it is for China and Vietnam. This is not so surprising. From the panels of Figure I we remember that the share of Thailand’s exports to Europe had already shrunk after it lost its preferential status and traded under a regular MFN tariff. Overall, the antibiotics crisis decreased the relative price in the United States versus in Europe with about 0.23 percent, again, a fairly small amount. With a fairly elastic shrimp demand, more significant quantities would have been needed to make a bigger dent in the relative price.

Now consider, on the other hand, the relatively strong impact of the tariff reduction. The coefficient on the tariff in the first-stage regression is statistically significant at 99 percent and as expected negative. The coefficient is about eight times as large as the coefficient on the antibiotics dummy and shows indeed a very strong response in terms of the export volume leaving Europe for the United States. Multiplied by the average consumption coefficient, the impact of a 1 percent tariff is in the order of a 1.85 percent drop in the relative price. As Europe retracted Thailand’s preferential tariff, Thailand’s gross tariff increased from 1.045 to 1.12, an increase of 7 percent. Holding all else equal, a similar tariff hike would cause a drop in the U.S. price relative to that of Europe of 12.85 percent. This suggests indeed that with a relatively elastic demand especially tariffs have the most pronounced direct impact on relative prices.

Note that the relative price on the left-hand side is inclusive of tariffs. To make sure Thailand’s changing tariff with which we adjust the price index on the left-hand side is not driving the result, I have estimated the relative prices regressions exclusive of the tariff. The results are very similar in all four cases.
One concern about running a regression such as (9) for only one country is that it may capture a change in the relative price that is common to shrimp markets for many exporting countries. To address this issue, I compare in the panel regression (10) the difference between the Thai relative price (denoted with capital $T$) and the relative price for the other five countries (denoted by $i$) Vietnam, China, Ecuador, India, and Indonesia. Each time, I subtract Equation (6) for Thailand from one of the other countries. Needless to say that $P^S$ for Europe and the United States drop out in this case, and so does the relative income term.

\[
\ln \frac{p_{us_{it}}}{p_{eu_{it}}} = \alpha_i + \beta_1 \ln \frac{c_{us_{it}}}{c_{Tu_{it}}} + \beta_2 \text{season} t - 4 + u_{it}, \tag{10}
\]

where I allow for country effects and the seasonal dummies. As the one-country regressions showed varying degrees of autocorrelation, I estimate the panel regression with generalized least squares and allow the autocorrelation coefficient to vary by panel. To instrument for the relative quantities consumed, I use as before the dummies for the antibiotics crisis, and a dummy for India in 1998 to capture the temporary ban on its exports to Europe. Since there is a marked difference in how countries were affected by the antibiotics crisis between China and Vietnam and the rest of the sample, I again include an additional antibiotics dummy for both countries. Since only the European tariff for Thailand changes, I only include the Thai European tariff in the first-stage regression as an instrument—all other tariff terms will be part of the constant of the regression. I also run a comparable regression for all countries of the sample relative to China and relative to Vietnam instead. For the regression relative to China, I now interact the antibiotics dummy with Thailand and Vietnam, for the regression relative to Vietnam, the interaction is with Thailand and China. I also include the India dummy.

The estimation results are summarized in Table V. They confirm the earlier results of the single-country regressions. In all cases is the coefficient on relative consumption negative and significant at the 99 percent level. Combining these estimates with the first-stage estimates of Table VI, we again find for Thailand a very strong response of relative prices to the retraction of Thailand’s GSP status that is of the same order of magnitude as the one-country estimates. The retraction of the Thai preferential tariff in Europe floods the U.S. market with Thai shrimp and increases the relative prices of other countries’ shrimp exports relative to those in Thailand. The impact of the antibiotics crisis is again relatively small. Again, there is a marked difference in how China and Vietnam are impacted by the antibiotics crisis (relative to Thailand) versus the other countries. Ecuador, India, and Indonesia see their relative price increase relative to Thailand in the wake of the antibiotics crisis, whereas Vietnam and China’s decreases.

37 Using different measures for $P^S$ already, in part, addresses this concern.
The results for China and Vietnam are also in line with the one-country regressions and confirm the earlier findings.

**Conclusion**

In a recent article, Anderson and Van Wincoop (2003) argue that it is essential to consider multilateral frictions of all trading partners to better understand what determines trade flows between two countries. In other words, not only do bilateral tariffs and restrictions matter, but also changing tariffs or conditions with third countries can affect countries’ bilateral trade. In arguing this way, Anderson and Van Wincoop address, in more general terms, the path-breaking question about trade creation/diversion that Viner (1950) had posed as the European Community emerged. My findings for the shrimp market follow this important line of research. I show specifically how the retraction of Thailand’s preferential tariffs in Europe affects the bilateral trade between Thailand and the United States, even though the U.S. tariffs do not change. Similarly, non-tariff frictions in Europe, i.e. more stringent food and safety standards, do not only directly affect bilateral trade between developing countries and Europe. They also have a non-negligible effect on the bilateral trade between the United States and these countries. Both phenomena, eroding preferences for developing countries and issues of international food and safety standards, are not about to disappear in current and future trade liberalizations, especially when it comes to liberalizing agricultural products.

Moreover, my findings add an important dimension to the existing results by investigating the price effects that such reallocations of exports may have. I use the specific events in the shrimp market as a natural experiment to investigate the impact of tariff and non-tariff changes on international prices. I show how Europe’s changing tariff policy with respect to the world’s premier exporter, Thailand, did put downward pressure on the relative price in the United States versus Europe. The same is true for how the higher food-safety standards that Europe imposed affected the relative E.U.–U.S. price for China, Vietnam, and Thailand. With my analysis of the shrimp market, I thus provide evidence that supports the well-established, but rarely investigated hypothesis that large countries through their trade policy can affect world prices. Moreover, as I study the impact of large countries on international goods prices, I offer a framework that strikes a balance between the more traditional notions of an integrated market with one world price and the more recent emphasis on segmented markets. Prices of internationally traded goods can be localized, yet they still will depend on policy changes in other (large) countries as exporters compare market conditions globally when they decide where to export to.

As argued, the trade policy changes overseas and their impact in the United States set the stage for the anti-dumping case against six developing countries in the United States—the largest anti-dumping case since the steel tariffs. More generally, the shrimp case casts a light on North–South relations. It
illustrates the leverage that developed countries have as the main consumers of (many of) the exports from developing countries on the price that these countries receive.

Finally, there is a last point that warrants mentioning in light of the increasing use of technical regulations as instruments of trade policy that Maskus and Wilson (2001) analyze and in light of the Doha round and its emphasis on increasing market access for developing countries. Even if the price effects of the export reallocations in response to safety restrictions are limited, the difference in standards and the sometimes lacking clarity about the exact nature of the standards is certainly disruptive, increases costs, and creates uncertainty for the exporters. The shrimp case raises issues that relate to the call for harmonizing food-safety standards and the call for more transparency of procedures. It also touches upon the need for a transfer of technology, so that developing countries themselves can determine whether their export products meet developed country standards, and also upon the call by some to include developing countries more fully in the process of setting standards. In this way, one can help prevent that SBS and TBT measures are used as ways to protect the interest of domestic industries or the interest of favored trading partners. Or, to paraphrase Baldwin (2000), one can try to avoid a two-tier system of regulatory protection—with developing countries in the second tier.
References


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Figure 1

World Total Shrimp Production 1950-2002
(million metric tons)

Note: Different shrimp species are added together with no rescaling.


Figure 2

Shares of World Production (percentage)

Note: EU15 includes Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden; LDC comprises of Argentina, Brazil, Mainland China, Ecuador, Indonesia, India, Mexico, Malaysia, Philippines, Thailand, and Vietnam. All shares are relative to world shrimp production. The data cover some 70 percent to 90 percent of world shrimp production.

Source: Calculations are based on FAO FishStat+. Total Production 1950–2002 database.
Figure 3

**Quantity Shares in World Shrimp Expo (percentage)**

Note: EU15 includes Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden; LDC comprises Argentina, Brazil, Mainland China, Ecuador, Indonesia, India, Mexico, Malaysia, Philippines, Thailand, and Vietnam. All shares are relative to world shrimp exports. The EU15’s aggregate includes intra-E.U. exports. The data covers 55 percent to 75 percent of world shrimp exports.

Figure 4: The Shrimp Market, Prices and Export Shares, 1996-2004

Panel 1: gross tariff rates on Thai shrimp exported to US and EU15

Panel 2: quantity share of Thai shrimp exported to US relative to US & EU15 total

Panel 3: price of Thai shrimp in US relative to EU15

- Without exchange adjustment
- With exchange adjustment
Note: EU15 consists of Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden.

Source: USITC, EUROSTAT
### Table I Export Quantity Shares of Some Major Shrimp Producers in 1996 (percentage)

<table>
<thead>
<tr>
<th>Country</th>
<th>Relative to World Shrimp Exports (a) 1996</th>
<th>Relative to U.S. Shrimp Imports (b) 1996</th>
<th>Relative to EU15 Shrimp Imports (c) 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>0.6</td>
<td>0.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.2</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Mainland China</td>
<td>3.7</td>
<td>3.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Ecuador</td>
<td>7.0</td>
<td>14.8</td>
<td>9.6</td>
</tr>
<tr>
<td>Indonesia</td>
<td>6.9</td>
<td>3.3</td>
<td>1.4</td>
</tr>
<tr>
<td>India</td>
<td>9.1</td>
<td>6.4</td>
<td>6.5</td>
</tr>
<tr>
<td>Mexico</td>
<td>3.1</td>
<td>10.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1.8</td>
<td>0.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Philippines</td>
<td>1.9</td>
<td>0.4</td>
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<tr>
<td>Thailand</td>
<td>18.8</td>
<td>24.5</td>
<td>10.2</td>
</tr>
<tr>
<td>Vietnam</td>
<td>3.5</td>
<td>11.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>56.6</td>
<td>76.2</td>
<td>36.0</td>
</tr>
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</table>

**Source:**
(a) based on FAO FishStat+, Commodities production and trade 1976–2002 databases.
(c) Based on EUROSTAT External trade database, E.U. trade since 1995 by CN8.
Table II Estimates of the Changing U.S. Export Shares.

(a) \[ \ln \left( \frac{x_{us_{it}}}{x_{us_{it}} + x_{eu_{it}}} \right) = \alpha_i + \beta_1 \ln\text{Tariff}_{eu_{it}} + \beta_2 \text{Antibiotics}_{it} + \beta_3 \text{Antibiotics}_{YZ_{it}} + \varepsilon_{it} \]

(b) \[ \ln \left( \frac{x_{us_{it}}}{x_{us_{it}} + x_{eu_{it}}} \right) = \alpha_i + \beta_1 \ln\text{Tariff}_{eu_{it}} + \beta_2 \text{Antibiotics}_{it} + \beta_3 \text{Antibiotics}_{YZ_{it}} + \beta_4 \text{India}_{it} + \varepsilon_{it} \]

where \( YZ \) are China and Vietnam

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>For Thailand Only</th>
<th>All Countries Relative to Thailand</th>
<th>All Countries except Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a)</td>
<td>(b)</td>
<td>(a)</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>0.12</td>
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<td>-0.06</td>
</tr>
<tr>
<td></td>
<td>0.02***</td>
<td>0.04***</td>
<td>0.04</td>
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<tr>
<td>Antibiotics YZ</td>
<td>0.87</td>
<td>0.87</td>
<td>0.87</td>
</tr>
<tr>
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<td>0.06***</td>
<td></td>
<td>0.06***</td>
</tr>
<tr>
<td>ln Thai Tariff EU</td>
<td>3.31</td>
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<tr>
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</tr>
<tr>
<td>R2</td>
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<tr>
<td>Obs.</td>
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</tbody>
</table>

*** Significant at 99 percent.
** Significant at 95 percent.
* Significant at 90 percent.

Standard errors underneath coefficient estimates.
### Table III Second-Stage Estimates for Vietnam and China

\[
\begin{align*}
\frac{\text{Pus}_t}{\text{Peu}_t} & = \alpha + \beta_1 \ln \frac{\text{cus}_t}{\text{ceu}_t} + \beta_2 \ln \frac{\text{Yus}_t}{\text{Ye}_t} + \beta_{3-5} \text{seasons} t - 4 + u_t \\
u_t & = \rho u_{t-1} + \epsilon_t
\end{align*}
\]

<table>
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<tr>
<th>Exploratory Variable</th>
<th>CPI</th>
<th>Food</th>
<th>ShrimpI</th>
<th>ShrimpII</th>
<th>CPI</th>
<th>Food</th>
<th>ShrimpI</th>
<th>ShrimpII</th>
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<tbody>
<tr>
<td>ln cus/ceu</td>
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<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
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<td>-0.07</td>
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<tr>
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<td>0.03***</td>
<td>0.03***</td>
<td>0.03***</td>
<td>0.03***</td>
<td>0.32***</td>
<td>0.04*</td>
<td>0.04*</td>
</tr>
<tr>
<td>ln(( \frac{Y_{us}}{P_{us}} )/( \frac{Y_{eu}}{P_{eu}} ))</td>
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<td>1.82</td>
<td>1.62</td>
<td>1.75</td>
<td>1.96</td>
<td>0.96</td>
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<td>1.01</td>
</tr>
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<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
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<td>-0.02</td>
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<td>0.06***</td>
<td>0.06***</td>
<td>0.06***</td>
</tr>
<tr>
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<td>0.01</td>
<td>0</td>
<td>0.01</td>
<td>0.14</td>
<td>0.13</td>
<td>0.09</td>
<td>0.1</td>
</tr>
<tr>
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<td>0.07</td>
<td>0.07</td>
<td>0.07***</td>
<td>0.07*</td>
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</tr>
<tr>
<td>Rho</td>
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<td>0.48</td>
<td>0.55</td>
<td>0.56</td>
<td>0.64</td>
<td>0.64</td>
<td>0.75</td>
<td>0.74</td>
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<td>0.09***</td>
<td>0.09***</td>
<td>0.08***</td>
<td>0.08***</td>
<td>0.08***</td>
<td>0.08***</td>
<td>0.07***</td>
<td>0.07***</td>
</tr>
<tr>
<td>R²</td>
<td>0.2</td>
<td>0.19</td>
<td>0.12</td>
<td>0.13</td>
<td>0.17</td>
<td>0.16</td>
<td>0.09</td>
<td>0.11</td>
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<td>D.W.</td>
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<td>1.62</td>
<td>1.76</td>
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<td>2.3</td>
<td>2.5</td>
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<td>102</td>
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</tr>
</tbody>
</table>

*** Significant at 99 percent.
** Significant at 95 percent.
* Significant at 90 percent.

Standard errors underneath coefficient estimates.
Table IV Second-Stage Estimates for Thailand

\[
\frac{\text{pus}_t}{\text{peu}_t} = \frac{\text{Pus}_s}{\text{Peu}_s} = \alpha + \beta_1 \frac{\text{cus}_t}{\text{ceu}_t} + \beta_2 \frac{\text{Yus}_t}{\text{Yeu}_t} + \beta_{3-5} \text{seasons}\ 1 - 4 + u_t
\]

\[u_t = \rho u_{t-1} + \varepsilon_t\]

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
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<th>IV</th>
<th>IV</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln cus/ceu</td>
<td>–0.12</td>
<td>–0.11</td>
<td>–0.11</td>
<td>–0.12</td>
</tr>
<tr>
<td></td>
<td>0.03***</td>
<td>0.03***</td>
<td>0.02***</td>
<td>0.02***</td>
</tr>
<tr>
<td>ln(Yus/Pus)/(Yeu/Pus)</td>
<td>1.38</td>
<td>1.43</td>
<td>–0.17</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>0.68**</td>
<td>0.69**</td>
<td>0.52</td>
<td>0.53</td>
</tr>
<tr>
<td>Season1</td>
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<td>0.02</td>
<td>0.01</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0.04</td>
<td>0.04</td>
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<td>0.04</td>
</tr>
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<td>Season3</td>
<td>0.08</td>
<td>0.07</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>0.04*</td>
<td>0.04*</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Season4</td>
<td>0.13</td>
<td>0.12</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>0.05**</td>
<td>0.05**</td>
<td>0.14</td>
<td>0.04</td>
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<tr>
<td>Rho</td>
<td>0.69</td>
<td>0.72</td>
<td>0.41</td>
<td>0.44</td>
</tr>
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<td>0.07***</td>
<td>0.07***</td>
<td>0.07***</td>
<td>0.08***</td>
</tr>
<tr>
<td>R²</td>
<td>0.17</td>
<td>0.15</td>
<td>0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>D.W.</td>
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</tr>
<tr>
<td>obs.</td>
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<td>102</td>
<td>102</td>
<td>102</td>
</tr>
</tbody>
</table>

*** Significant at 99 percent.
** Significant at 95 percent.
* Significant at 90 percent.
Standard error underneath coefficient estimates.
Table V Second-Stage Estimates Relative to Vietnam, Relative to Thailand and Relative to China

\[
\begin{align*}
\ln \left( \frac{p_{est}}{p_{eu}} \right) &= \alpha_i + \beta_1 \ln \left( \frac{c_{est}}{c_{eu}} \right) + \beta_{2-4} \text{seasons}_1 - 4 + u_{it} \\
\ln \left( \frac{p_{Xus}}{p_{Xeu}} \right) &= \alpha_i + \beta_1 \ln \left( \frac{c_{Xus}}{c_{Xeu}} \right) + \beta_{2-4} \text{seasons}_1 - 4 + u_{it} \\
\end{align*}
\]

\[
u_{it} = \rho u_{it-1} + \varepsilon_{it}\]

\(X = \) Vietnam, Thailand, or China.

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Relative to Thailand</th>
<th>Relative to Vietnam</th>
<th>Relative to China</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\ln(cus/ceu))</td>
<td>-0.17</td>
<td>-0.07</td>
<td>-0.07</td>
</tr>
<tr>
<td>((cXus/cXeu))</td>
<td>0.02***</td>
<td>0.02***</td>
<td>0.02***</td>
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<tr>
<td>Season1</td>
<td>-0.02</td>
<td>0</td>
<td>-0.03</td>
</tr>
<tr>
<td></td>
<td>0.03</td>
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<td>0.03</td>
</tr>
<tr>
<td>Season3</td>
<td>0.02</td>
<td>0.02</td>
<td>-0.08</td>
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<tr>
<td></td>
<td>0.03</td>
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<td>0.03***</td>
</tr>
<tr>
<td>Season4</td>
<td>-0.12</td>
<td>-0.01</td>
<td>-0.09</td>
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<tr>
<td></td>
<td>0.03***</td>
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<td>0.03**</td>
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<td>Obs.</td>
<td>515</td>
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<td>515</td>
</tr>
</tbody>
</table>

*** Significant at 99 percent.
**  Significant at 95 percent.
*   Significant at 90 percent.
Standard errors underneath coefficient estimates.
Table VI First-Stage Regressions for Thailand, Vietnam, China, and Relative to These Countries

(a) $\ln \frac{Yus_{it}}{Yeu_{it}} = \alpha + \beta_1 \text{Antibiotics}_i + \beta_2 \ln \text{Tariff}_{eu} + \beta_3 \ln \frac{Yus_{it}}{Yeu_{it}} + \beta_4 \ln \frac{Pus_{it}}{Peu_{it}} + \epsilon_{it}$

(b) $\ln \frac{Yus_{it}}{Yeu_{it}} = \alpha_i + \beta_1 \text{Antibiotics}_it + \beta_2 \text{Antibiotics}_{YZit} + \beta_3 \text{India}_{it} + \beta_4 \ln \text{Tariff}_{eu_{it}}$

$+ \beta_5 \ln \frac{Yus_{it}}{Pus_{it}} + \beta_6 \text{season}_i - 4 + \epsilon_{it}$

if $X$ is Thailand, China, or Vietnam, $YZ$ comprises the other two countries.

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Thailand (a)</th>
<th>Thailand (b)</th>
<th>Vietnam (a)</th>
<th>Vietnam (b)</th>
<th>China (a)</th>
<th>China (b)</th>
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<tr>
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<td>-2.69</td>
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<tr>
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<td>0.22***</td>
<td>0.13***</td>
<td>0.16***</td>
<td>0.16***</td>
<td>0.22***</td>
<td>0.17***</td>
</tr>
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<td>0.19***</td>
<td>0.25***</td>
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<td>0.27***</td>
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<td>India</td>
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<td>0.41***</td>
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<td></td>
<td></td>
<td>0.44***</td>
</tr>
<tr>
<td>lnThai Tariff</td>
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<tr>
<td>lnYus/Yeu</td>
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<td>-5.99</td>
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</tr>
<tr>
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<td>Season4</td>
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<td>0.03</td>
<td>0.18</td>
</tr>
<tr>
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<td>no</td>
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<td>$R^2$</td>
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</tr>
</tbody>
</table>

*** Significant at 99 percent.
** Significant at 95 percent.
* Significant at 90 percent.

Standard errors underneath coefficient estimates.
Appendix First-Order Conditions for the Exporter

The exporter \( i \) maximizes the following profit function.

\[
\max_{x^i} E_1 \tilde{p}_1 (x_j, \bullet) x_i + E_2 \tilde{p}_2 (X - x_j, \bullet) - \alpha_1 x_i - \alpha_2 (X - x_i),
\]

where \( \tilde{p}_1 \) and \( \tilde{p}_2 \) are prices net of tariffs and functions of \( x_j \). Since \( x_j = c_j \) in equilibrium, \( x_j \) is defined by Equation (5).

F.O.C. \(^{38}\) when \( \alpha_1 = \alpha_2 \):

\[
\frac{E_1 \beta_1^{1/\sigma} \tau_1^{-1} Y_1^{S^{1/\sigma}}}{P_1^{S^{(1-\sigma)/\sigma}}} \left(1 - \frac{1}{\sigma}\right)x_1^{-1/\sigma} = \frac{E_2 \left(\beta_2^{1/\sigma} \tau_2^{-1} Y_2^{S^{1/\sigma}}\right)}{P_2^{S^{(1-\sigma)/\sigma}}} \left(1 - \frac{1}{\sigma}\right)(X - x_1)^{-1/\sigma}
\]

Supplies to the two markets

\[
x_1 = X \left[\frac{E_1^{-\sigma} \beta_1^{-1} \tau_1^{\sigma} Y_1^{S^{-1}}}{P_1^{S^{\sigma-1}}} \left(\frac{E_2^{-\sigma} \beta_2^{-1} \tau_2^{\sigma} Y_2^{S^{-1}}}{P_2^{S^{\sigma-1}}} + 1\right)^{-1}\right]
\]

\[
x_2 = X \left[1 - \left(\frac{E_1^{-\sigma} \beta_1^{-1} \tau_1^{\sigma} Y_1^{S^{-1}}}{P_1^{S^{\sigma-1}}} \left(\frac{E_2^{-\sigma} \beta_2^{-1} \tau_2^{\sigma} Y_2^{S^{-1}}}{P_2^{S^{\sigma-1}}} + 1\right)^{-1}\right]\right]
\]

F.O.C. when \( \alpha_1 \neq \alpha_2 \):

\[
\frac{E_1 \beta_1^{1/\sigma} \tau_1^{-1} Y_1^{S^{1/\sigma}}}{P_1^{S^{(1-\sigma)/\sigma}}} \left(1 - \frac{1}{\sigma}\right)x_1^{-1/\sigma} - \alpha_1 + \alpha_2 = \frac{E_2 \left(\beta_2^{1/\sigma} \tau_2^{-1} Y_2^{S^{1/\sigma}}\right)}{P_2^{S^{(1-\sigma)/\sigma}}} x \left(1 - \frac{1}{\sigma}\right)(X - x_1)^{-1/\sigma}
\]

\(^{38}\) I assume that the own price and tariff have a negligible impact on the aggregate price index.