SMALL FISH - BIG ISSUES
THE EFFECT OF TRADE POLICY ON THE GLOBAL SHRIMP MARKET

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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.

The recent shrimp anti-dumping case in the US brings to the fore, in a very revealing fashion, the extent to which the world economy is a global economy. It also highlights the very different roles and interests of developed and developing countries in this global economy. In 1997 the EU retracted the preferential trade status of Thailand, the world's primer shrimp exporter. In 2001 antibiotics were found in shrimp residue. The EU declared a zero tolerance policy that restricted exports esp. from Vietnam and China and imposed 100 percent testing on Thai shrimp. Both events directly affected exporter's allocation decision, away from Europe towards the US. I use these events to trace out the demand for shrimp in the US vs. Europe and to assess the impact of Europe's tariff and non-tariff policies on the price of shrimp in the US vs. Europe. I show how the price of shrimp from developing countries dropped in the US primarily in response to these exogenous changes overseas. This finding reinforces the perception that the current US anti-dumping case against six developing countries is a modern form of protection, to improve the competitive position of US shrimpers.[2] In addition, my findings make a broader, more positive

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[2] It is not my aim to establish whether or not there is legally an antidumping case. Blonigen and Prusa (2003) state that anti-dumping cases have long been viewed as a protectionist tool to improve the competitive position of the complainant against other companies. For information on antidumping cases see Prof. Blonigen's website http://darkwing.uoregon.edu/~bruceb/.

point. They provide empirical evidence of a key proposition in international economics for which very little empirical evidence exists so far: Large countries such as the US and Europe have the ability to affect international prices through their trade policies. Moreover, in doing so, they affect the welfare of other nations. Finally, I show the non-negligible trade diverting effects of international differences in technical barriers and food safety standards, issues that will only become more important as talks about liberalizing agricultural products in the Doha round proceed.[3] [4]

In the fall of 2002 the Southern Shrimp Alliance, a coalition of shrimp fishermen, was formed to fight "unfair" competition from developing countries. In December 2003 the Alliance called for punitive tariffs ranging from 30 to 349 percent against Thailand, Vietnam, India, Brazil, Ecuador and China.[5] The US shrimpers charged that they were driven out of business by the artificially low prices of these exporters in US markets. Since then, the International Trade Commission has ruled that the exporters indeed injured the domestic industry. [6] In the broadest trade complaint since the steel tariffs in 2002, the Commerce Department then imposed tariffs of up to 93 and 112 percent for the two non-market economies of the group, Vietnam and China, and markedly lower tariffs for most of the other countries. [7]

The shrimp antidumping case emerged in a market that has changed dramatically over the years. If the 1980s was a 'lost decade' for much of the Third World, it was also the decade of shrimp in much of Asia and other emerging economies. Increasingly, global shrimp trade is a one-way flow from developing country producers to consumers in Europe, the US and Japan. To

[3] Maskus and Wilson (2001) and Baldwin (2000) describe and analyze the increased use of technical regulations as instruments of commercial policy in a unilateral, regional and global trade context. Moenius (2000) is one of the few thorough empirical studies on the topic. Moenius finds that standards that are specific to the importing country (i.e. that are not shared by others) on average deter bilateral trade for agricultural products. My estimates for the shrimp case are consistent with this. In addition, I show the trade diverting impact related to different international standards and the impact on prices.

[4] Much information about the US shrimp industry is available on the web: www.fao.org provides many references to articles and statistics for shrimp and fish in general, www.shrimpnews.com/ offers extended reports and compilations of press reports on shrimp farming, antibiotics crisis, etc. Shrimp Media Monitor, a newsletter on shrimp farming and related issues can be found at http://www.enaca.org/. Also worth mentioning are http://www.seafood.com/ and http://www.globefish.org/. For a good survey of the US shrimp industry and its context, see Haby et. al (2002).

[5] See Wall Street Journal, 2004, EC Prep Monthly, 2004. Conspicuously absent from the anti-dumping case is Mexico that reportedly helped finance the anti-dumping lawsuit.

[6] Under WTO rules the label non-market economy makes pursuing anti-dumping measures easier. When calculating fair prices for products from non-market suppliers, the Commerce Department can ignore the countries' own cost and instead use data from free-market economies at a similar stage of development, see Shrimp Media Monitoring, July 2004.

[7] The initially imposed tariffs by the Commerce Department on average ranged between 6.4 percent for Thailand and 37 percent for Brazil. Some of the tariffs would corrected downward later. The Southern

a large extent responsible for this surge in foreign shrimp is aquaculture. Imported shrimp are no longer caught at sea as they are in the US. Instead, they are raised on shrimp farms along the coasts of Asia and Latin America where waterfront property is more affordable, labor cheaper and the environmental law less stringent.[8] This surge of foreign trade in itself already posed a significant challenge for local US shrimp producers who saw their US market share slip from 43 percent in 1980 to 12 percent in 2001 (Haby et. al., 2002). However, two events overseas increased the challenge even more.

The size of the shrimp harvest or catch to a large extent depends on meteorological and environmental parameters, which is why high-frequency studies typically take the local supply of shrimp as given.[9] 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 leading worldwide exporter of shrimp lost its preferential trade status in the European market. By 1999 it faced a much higher most favored nation [MFN] tariff, while its main competitors continued to benefit from preferential treatment.[10] This tariff hike made Thai shrimp exporters shift their exports away from the EU towards the US. Finally, in the fall of 2001 another new contentious issue arose that relates to the so-called TBTs, technical barriers to trade, and the SPSs, the sanitary and phytosanitary measures. The EU discovered antibiotics in shrimp residue. The EU proclaimed a zero tolerance policy for antibiotics. It restricted imports from esp. Vietnam and China and subjected Thai shipments of shrimp to 100 percent testing -- all of which are major exporters to the US and to Europe. This induced another massive shift esp. by Chinese, Thai and Vietnamese exporters away from the EU to the US that imposes less stringent standards. The tariff change and the antibiotics crisis are the instruments that I use to estimate demand, since they for a given demand in terms of consumer prices shift the supply curve. They allow us to assess the impact of Europe's tariff and non-tariff policies on the price of shrimp. I find that both events lead to a drop in the relative shrimp price between the US and Europe for the affected countries.

My analysis shows that the shift in the direction of exports and the lower relative price in the US vs. Europe are a rational response to an exogenous change in the international environment. This finding reinforces the perception of the current anti dumping case as primarily a protectionist endeavor that was brought with the promise of not only higher prices but also of a

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Shrimp Alliance had sought duties for these countries between 32 percent and 166 percent; see Shrimp Monitoring, August 2004.

[8] These factors explain the dominant role of developing countries in fish aquaculture in general.

[9] A highly cited reference is Barten and Bettendorf (1989), see also Holt (2002)

[10] After the tsunami disaster the EU will be giving back the preferential status to Thailand.

government payout. Indeed, with the Byrd Amendment still in place, the Alliance that successfully convinced the government of its case now stands to directly receive the tariff review that is collected in what was once a very open (zero tariff) market attune to the US's strong demand for foreign shrimp - 80 percent of US consumption stems from abroad. [11]

My finding that tariff and non-tariff policies have an impact on international prices is important beyond the specifics of the shrimp case. A significant influence on an open economy's welfare is its terms of trade. Since it is a well-established theoretical result that a large country's tariff policy affects international prices and thus the terms of trade of its own or of other countries, one would expect a wealth of empirical studies to relate trade policy to international prices. [12] However, the existing empirical literature on that subject, except for Computable General Equilibrium models[13], is rather limited. [14] The focus instead has been in particular on the impact of trade liberalizations/restrictions on the volume of trade. Notable exceptions are Romalis (2005) and Chang and Winters (2002) in the context of preferential trade agreements.[15] Romalis (2005) studies with very disaggregate data the impact of NAFTA on trade volumes *and* prices. His results, like those of Chang and Winters (2002), emphasize that especially price effects, in spite of the substantial volume effects in trade liberalization studies, matter for countries' welfare.

My analysis, however, differs from the existing studies and strikes a balance between an integrated international market with one world price and partially localized markets. Romalis' (2005) perfect competition setting is more in the tradition of the first, Chang and Winters (2002) on the other hand relate better to the second approach with segmented markets. Chang and Winters extend Feenstra (1989) who studies the extent to which 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

[11]See Wall Street Journal, 2004

[12] The ability of countries to affect terms of trade is at the core of the theoretical analyses of preferential trading agreements and the GATT by Bagwell and Staiger (1998, 1999). Mclaren (2000) emphasizes the potential impact of 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.

[13] See for example Brown (1987)

[14] More generally, the small country assumption that takes international prices as given is common in the empirical literature on growth and purchasing power parity; see Debaere and Lee (2004) for a discussion. Easterly et al. (1993) and Barro and Sala-i-Marin (1995), for example, include countries' terms of trade as explanatory variable in their growth regressions. In studies of the real exchange rate, the terms of trade are often included as a regressor, see De Gregorio and Wolf (1994). Acemoglu and Ventura (2002) who explain countries' terms of trade and relate them to their growth performance are a notable exception.

[15] Kreinin (1961) is a descriptive study of the effect of tariff changes on import prices and volumes. Bernhofen and Brown (2005) show with historical data how Japan's trade liberalization affected its prices.

different prices in different markets, a fact well-documented by the pass-through literature that underscores that markets of internationally traded goods are to some extent localized.[16] At the same time, I let prices in one market depend on the conditions in the other market and vice versa. In particular, the exporter that I study is constrained in his decision to allocate exports to different markets by a given amount of output – the catch or the shrimp harvest. This creates an explicit link between the localized market in the US and the one in Europe. What the exporter decides to export to one market will not go to another. In this way, relocating exports from one country to another can change the relative price that the exporter receives in both markets and changing policies in one market will have effects on the other.

I study shrimp exports for five of the countries subject to the antidumping case, Thailand, Vietnam, China India and Ecuador plus Indonesia. Together they account for over 65 percent of shrimp exports to the US. These exporters of warm-water shrimp have a significant presence in both the US and EU market and monthly data are available for all of them between 1996 and 2004.[17] Before discussing the stylized facts, the model, the data and the specification, I first sketch the context of the shrimp market. I also discuss in some detail the changes in tariff and non-tariff measures that so dramatically affected the direction of the trade flows for the last 10 years and that set the stage for the anti-trust case. These changes are suggestive of the impact that the recently imposed anti-dumping tariffs may have on the shrimp market in the near future.

I. The shrimp market

Figure 1 presents recent estimates by the UN Food and Agriculture Organization [FAO] that illustrate the worldwide expansion of shrimp production. Production increases from 0.31 to 3.8 million metric tons between 1950 and 2002. A marked shift materializes in this period. As Figure 2 illustrates, the share of shrimp production by developing countries increases consistently and that of the main consumers -Japan, the US and Europe- steadily decreases. Haby et. al. (2002) estimates that Japan, Europe and the US currently consume some 60 percent of world production. International trade data tell a similar story. There is a growing dichotomy between, on the one hand, shrimp consuming developed countries and, on the other hand, shrimp producing developing countries. The FAO estimates some 0.3 million metric tons of exports in 1976 and 1.7 million tons in 2002. The EU, the US and Japan absorb some 80 percent of these worldwide

[16] The"pass-through" literature studies the extent to which exchange rate shocks trigger price changes for imported goods in a foreign market. There is ample evidence of price discrimination and incomplete pass-through. For a good survey, see Knetter and Goldberg (1994).

[17] Most US 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.

exports. However, as Figure 3 shows the three main consumers' absorption is not growing in a similar way. Especially Japan's share is declining and that of the EU and the US is rising -- which is often attributed to Japan's lackluster demand due to its economic downturn.[18] Finally, in terms of world exports, the share of developing countries hovers around 60 percent, see Figure 4; that of Europe is some 15 percent and those of Japan and the US are almost negligible in recent years.

Table 1 lists the 10 largest shrimp exporters into Europe and the US for 1996, the beginning of our sample, and 2002.[19] The list contains the six countries that we study: Thailand together with 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 and 65 percent of US imports in 1996 and 2002. Note that the market shares in the EU market are typically lower -- this is in part because the EU total includes intra-EU trade. Still, comparing the changing shares esp. for Thailand and China between 1996 and 2002, one is struck by the extent to which exports seem to be leaving Europe and entering the US.[20] In a growing US market the shares of China and Thailand either grow or stay the same, whereas their share in the US plummets. On the other hand, for Ecuador and India one observes parallel tendencies in the US and EU market: both shares either drop or rise. Indonesia's share increases somewhat more in Europe.[21]

An important factor behind the sustained growth of shrimp supply that is identified in the literature 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 tapers off and aquaculture's share stabilizes around 35 percent.[22] 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. The strength of emerging economies in shrimp farming and aquaculture are well understood. 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 to prepare the shrimp, often by hand, 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

[18] Note that the EU numbers are gross imports, i.e. not excluding intra-EU trade.
[19] Aggregate data are not available after 2002.
[20] This will be even clearer for the more disaggregate data that run till 2004.
[21] There is strong growth for Brazil and Argentina – Note that shrimp from Argentina is mostly cold-water shrimp.
[22] The predominance of shrimp farming in these countries is one of the reasons why I will not investigate the impact of turtle protecting devices and the impact they had on shrimp trade. In addition, for the

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.[23]

In conclusion, it is fair to say that the shrimp market has been a very important export market for developing countries since the 1980s. Shrimp exports are often considered a more lucrative alternative to rice production. Traditionally, the US as a major consumer of shrimp has been a very open market for shrimp. Two events, however, have challenged this position.

a. Thailand's changing GSP status in the EU

There is an interesting difference in tariff policy among the three main consumers of shrimp. The US was, until recently, an open market with no tariffs on shrimp imports. Japan also has low tariffs: 1.8 percent on fresh shrimp, 4.8 percent on cooked and 6 percent on frozen and canned shrimp. (Josupeti, 2004). The major exception is Europe. Its MFN tariff for frozen shrimp is 12 percent and that for cooked and canned shrimp 20 percent. Of particular interest to us is how the EU changed the tariffs for Thailand, the leading exporter of shrimp.

Since 1971 the EU grants developing countries unilateral and autonomous tariff reductions under the Generalized System of Preferences (GSP).[24] As agreed by the UNCTAD, this preferential treatment of developing country exports is meant to support the industrialization in developing countries. The EU regularly reviews its GSP. In 1995 it adopted a new graduation system that reduces a country's preferences based on the extent of specialization in certain sectors and its development, see Cuypers, 1998. In 1996 it was decided to cut in half Thailand's GSP benefits for shrimp from January 1997 on and to abolish them by 1999. Under the EU's GSP, raw and cooked shrimp are subject to respectively up to 4.5 and 6 percent tariff. From 1999 on Thai shrimp, however, faces an MFN tariff of up to 12 and 20 percent tariff, while most of the other major importers maintain their preferential status. As I will show phasing out the Thai GSP status will shift Thai exports away from the EU to the US.

b. Antibiotics[25]

Western Hemisphere the issue was resolved in 1996 before the period that I study. For countries such as Thailand and Indonesia it was in practice never much of an issue.

[23] See Josupeti, 2004

[24] According to Cuypers (1998) ASEAN countries are among the countries that have benefited most from the EU's GSP.

[25] For a chronology of the antibiotics crisis, see "The rise and fall of chloramphenicol" at www.shrimpnews.com/Mitch.html.

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 are banned in the EU as they are potentially harmful in humans. Suspicion of widespread use of antibiotics in Asian shrimp farming gathered. For the next three years an antibiotics crisis would affect trade with East Asian countries in various ways. Japan and the US would also increasingly monitor antibiotics in their imports. However, there was a significant difference between how these two countries addressed the antibiotics problem compared to the strict EU approach. As I will show this difference in food and safety standards contributed to the shift in the global shrimp market.

- The EU has a zero tolerance policy for chloramphenicol that is based on the minimum detectable limit. This limit continues to decline with advancing technology and is between 0.1 and 0.3 parts per billion (ppb), a much stricter standard than in the US (initially 5 ppb) and Japan (even higher).[26] The FDA will gradually lower its permissible limit to 1 ppb in May 2002 and to 0.3 by the end of July 2003. Only when the crisis is virtually over, in the fall of 2004, does the US announce a testing method for nitrofurans and that it would start regular testing for it in 2005. The EU limits nitrofurans to 1 ppbs.
- The level of enforcement also differs among the main destination markets. It depends on the sampling frequency next to the accuracy of the testing. The way the EU handled Thai shrimp illustrates this well. The EU has other alternatives beyond temporary bans which it used against Vietnam or China. The EU for example subjects up to a 100 percent of all Thai shipments to testing at the height of the crisis in 2002 and 2003. It should be noted that extensive testing can cause costly delays of between two to four weeks. For reference, before the crisis the EU tested about 10 percent of Thai shrimp. For comparison, Japan increases its inspections from Vietnam, China and Thailand to up to ten percent of imports during the crisis. Comparable measures for the US testing intensity are not available. Only in 2003 does the US hire more inspectors to increase testing.
- To prevent contamination of the food chain, the EU initially destroyed the affected imports. Only in September 2004 as the EU is revising its zero tolerance policy does the EU consider the possibility of re-exporting or sending back to the exporting country shrimp with lower ppbs.

The antibiotics crisis involved many shrimp exporters. Probably 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 them and certified them. They also restricted transshipments [and re-labeling] of contaminated shrimps form other countries through their port.[27]

As in the case of Thailand's loss of its GSP status, food safety concerns regarding banned substances provided an unanticipated surge of shrimp exports to the US. The outcry of foreign dumping gathers momentum, esp. in the Southern shrimp state Louisiana in the wake of the antibiotics debacle. It gives way to the Southern Shrimp Alliance that files its anti-dumping petition in December 2003.

II. Stylized Facts

Thailand, as the world's primer exporter of shrimp, plays a key role in our analysis. The different panels of Figure 5 characterize Thai exports to the US and Europe and those of our five other countries on a monthly basis between January 1996 and July 2004. Throughout I consider the market of frozen and cooked shrimps and prawns that have been the least processed.[28] The first panel plots the gross tariff rate for Thai shrimp, 1 + the ad valorem tariff rate. Throughout the period Thailand does not face any import tariffs for its shrimp in the US -- Our time period ends as the preliminary antidumping tariffs are announced by the Commerce Department.[29] 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 first 9 percent and then finally to a 12 percent tariff for frozen shrimp at the beginning of 1999 when Thailand gained full MFN status.

The second panel is key for the analysis and fairly suggestive. It illustrates how the Thai export market shifts away from Europe towards the US over this period. Since I have no comparable data for Japan, I plot Thai shrimp exports to the US as a fraction of total exports to the US and Europe. The exports are measured in terms of volume, kilogram, not in value. From initially about 72 percent in 1996, the US share increases to about 89 percent in 1999 after the tariff hikes. Finally the share rises even more as the antibiotics crisis materializes in late 2001. By early 2004 the share has reached 97 percent. From all other plots of the US share in total

[26] See http://www.seafood.com/
[27] This reportedly was the case for Indonesia and Ecuador – Shrimp Media Monitor, July, 2004.
[28] For a detailed discussion of the data, see section IV
[29] Note that the antidumping case may have affected shrimp exports before the actual tariffs were known, esp. after the initial ITC ruling in January 2004 that the domestic industry was hurt. This, however, is too close to the end of our sample to be able to consistently detect a statistically significant effect.

European and US exports, the shifts away from Europe towards the US around the antibiotics crisis stand out in the markets for Vietnam and China. The shares for the remaining countries, on the other hand, do not seem to change much – only for Indonesia is a slight increase.

To confirm the visual impression that the tariff hikes and the antibiotics controversy are key elements that have moved the market for Thai shrimp, I run a simple regression for illustrative purposes. On the left-hand side I have the logarithm of the US share in total exports to the US and the EU. As explanatory variables I consider the relative US/EU tariff and a dummy for the period from the fall of 2001 to the fall of 2004 to capture the antibiotics crisis.

$$ln\left[\frac{xus_t}{xus_t + xeu_t}\right] = \alpha + \beta_1 lnTariffeu_t + \beta_2 Antibiotics_t + \varepsilon_t \qquad (1)$$

, where *xeu/xus* stand for the export volume to either Europe or the US, *Tariffeu* is the Thai tariff rate in Europe, *Antibiotics* is the dummy for the crisis.

The first column of Table II provides the coefficient estimates of regression (1) for Thailand. As one can readily see, both coefficients are significant at 99 percent. The increasing tariff for Thai shrimp in the EU has boosted exports to the US relative to those to the EU. The antibiotics crisis, it turns out, seems to also have diverted shrimp exports to the US. Note that this is a very robust relationship between shrimp exports, tariffs and the antibiotics crisis. Adding different controls for the US and European economy, as we do in the context of the model, will not change the basic pattern, see section V. [30] To further complement the visual impression, and to make sure we are not just capturing a general tendency of the shrimp market as such, I run a variation on regression (1). I construct a panel with each time the US share in total US and European exports for one of the other five shrimp exporters *i* relative to Thailand's share on the left-hand side. [The Thai variable is referred to with a capital *T*]:

$$ln\left[\frac{xus_{it}\big/xus_{it} + xeu_{it}}{xTus_t\big/xTus_t + xTeu_t}\right] = \alpha_i + \beta_1 lnTariffeu_{it} + \beta_2 Antibiotics_{it} + \beta_3 AntibioticsYZ_{it} + \beta_4 India_t + \varepsilon_t \qquad (2)$$

I allow for country effects and include a separate dummy for India in 1998, when exports to Europe were temporarily banned. Since especially China and Vietnam were also severely affected by the antibiotics crisis, I include an additional antibiotics dummy, *AntibioticsYZ* for both. The Thai tariff is also part of the regression – since other countries' trade do not change,

they are part of the country effect. Here again, adding other variables will not alter sign, or significance. The regressions confirm the initial results for Thailand. The tariff has shifted the markets and so has the antibiotics crisis. Since the Thai share increases 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 US.

I finally include in Table II a third column with the estimates for a panel regression (1) for the five other countries together - not relative to Thailand. As before, I let the impact of the antibiotics crisis vary between China and Vietnam on the one hand and Ecuador, India and Indonesia on the other hand. I again include the dummy for India in 1998 and the Thai tariff. This regression is telling for its insignificant coefficients. Indeed, for all the reallocation between the US and the EU, the EU tariff hike on Thailand does not seem to be 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, however, suggests that it is not the case that the massive reallocation of Thai, Chinese and Vietnamese exports from the EU to the US in the wake of either the tariff hike or the antibiotics crisis, is matched by an equally massive reallocation of the exports in the other direction by countries not affected by the crisis. This is an important observation that will, in part, help rationalize the focus of the model. I will concentrate on the exporter's decision of how to allocate her exports between two markets.[31]

In the third panel of Figure 5 the bold line finally displays the changing dollar price [unit value] for 1 kilogram of shrimp in the US versus in Europe. A few observations are worth making. If, the law of one price would hold, then the ratio of the dollar price of Thai shrimp in the US vs. the dollar price in Europe should be one throughout – or if the law of one price held in differences, one should observe a constant for the entire time period. Clearly, this is not the case,

[30] In the appendix I include first stage regressions of export quantities with other controls for the characteristics of the US/EU market. They confirm the basic findings of regression (1).

[31] I do not have the necessary data to check, but the hypothesis is that the gap that is left by the three shifting countries is filled by higher prices on the one hand and on the other hand by the supply by the newcomers – fast growers such as Brazil or Argentina.

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. It illustrates to a certain extent the localized nature of international markets. [For comparison I also include the ratio of the dollar price in the US vs. the euro price in Europe to show that not all the action between both prices 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 five panels plot for the other countries the changing share of its shrimp exports to the US in the total US and European exports.[32] The panels also include the relative price of shrimp in the US vs. Europe – again expressed in dollars in both locations. 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

While the different panels of Figure V are fairly impressive and the initial regression results suggestive, the evidence that they present is not conclusive since many other factors could affect the market for shrimp. In this section I present a simple model that should guide the empirics and formalize the key idea. 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. It focuses on the decision of individual exporters as they choose to allocate their exports between two markets, Europe and the US. This focus is motivated in part by the stylized facts that were just described. In a first step, I assume that there are multiple exporters that are all coming from different countries. While an exporter may in reality strategically reallocate some of his exports between the US and EU in response to what happens to the foreign competitors, I assume and the described facts suggest that the exporter primarily responds to the restrictions in his own export market.[33]

I assume that the demand for shrimp varieties and their substitutes, c_i, is determined at each moment in time by a CES utility function in the two destination markets j, Europe and the US – I suppress the time subscripts.

$$U_j = [\Sigma_i (\beta_{ij} c_{ij}^{(\sigma-1)/\sigma})]^{\sigma/(\sigma-1)} \qquad j=1,2 \qquad (3)$$

[32] The plots of the relative prices of shrimp as found in Fig. 5 show a similar pattern when deflated respectively by the consumer price index of the US and of Europe.
[33] In their analysis of MERCOSUR, Chang and Winters (2002) emphasize this strategic component.

where σ is the elasticity of substitution and typically larger than 1.

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

$$c_{ij} = \beta_{ij}\, p_{ij}^{-\sigma}\, Y_j^S / P_j^{S\,1-\sigma} \qquad j=1,2 \qquad (4)$$

P_j^S is a reference price index for shrimp varieties or more generally for other substitutes. It equals $[\Sigma_i \beta_i p_i^{1-\sigma}]^{1/1-\sigma}$; 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 its country of origin. In other words, I assume that there is complete international specialization in the production of shrimp. 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.

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

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 that the consumer pays. 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 has to multiply left- and right-hand side with the euro-dollar exchange rate.

In the analysis, I will be especially interested in how the price of shrimp compares in the US vs. Europe. Equation (6) gives the equation that will be the basis for my estimates and that is derived from (5). Following Chang and Winters (2002), I focus on the real prices. Note that comparing the 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-hand side will cancel since it is also needed to convert the right-hand side into dollars.[34]

$$\frac{p_{i1}/P_1^S}{p_{i2}/P_2^S} = (\beta_{i1}/\beta_{i2})^{1/\sigma}(c_{i1}/c_{i2})^{-1/\sigma}\left(\frac{Y_1^S/P_1^S}{Y_2^S/P_2^S}\right)^{1/\sigma} \qquad j=1,2 \tag{6}$$

Equation (6) states that in these localized markets the relative consumption of the US and Europe matters for how the relative shrimp price actually 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_{i1}/x_{i2} that in equilibrium equals relative consumption c_{i1}/c_{i2} 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 for example of local fish markets with high frequency data. And oft cited study is that by Barten and Bettendorf (1989), see also Holt (2002). The motivation for this assumption is fairly straightforward. Fish landings during a given period are on the one hand 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.[35] While this logic is widely accepted, in an international context, there is an additional level of complexity that the literature seems to struggle with.[36] 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 US vs. the European market does not only depend on the total shrimp 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 US and Europe. I assume that in order to maximize profits the exporter varies the export quantity between markets. In

[34] 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.

[35] Shrimp harvests in aquaculture like trawling are very dependent on ecological and meteorological circumstances.

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[37]:

$$\underset{x1,x2}{Max}\ E_1 \tilde{p}_1 (x_1,\bullet)\, x_1 + E_2 \tilde{p}_2 (x_2,\bullet)\, x_2 - \alpha_1 x_1 - \alpha_2 x_2 \qquad (7)$$

$$\text{s.t.} \qquad X = x_1 + x_2$$

, 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 price that the exporter receives -- the price net of tariffs that is a function of e.a. x_j; α_j captures the marginal cost of exporting to both markets.

I assume that the exporter maximizes profits in his domestic currency. He translates the foreign goods prices $\tilde{p}_{ij}$ into his 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 α of delivering shrimp to one market versus to another. Needless to say that differentα*'s* could capture differences in transportation costs.[38] 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 US and Europe add up to the exogenous quantity of the catch or harvest, *X*. So that any amount that the exporter sends to the US 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 US are closely linked.[39] 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

[36] Nielsen (2001) presents estimates for fish markets while assuming that markets are domestic, arguing that an adjustment of the estimation strategy is in order in an open economy.

[37] In the appendix, I specify the maximization. I provide the closed-form solution for when α_{ij} are the same. When α_{ij} are different, no such solution can be obtained.

[38] It takes 7-10 days to deliver Thai shrimp to Japan according to Seafood.com. For transporting Thai shrimp from Thailand to the United States typically 20 to 30 days are needed. Shipping Thai shrimp to Europe takes between 30 and 45 days.

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.

$$x_{ij} = f_j [\tau_{i1}, \tau_{i2}, Y_1^S, Y_2^S, P_1^S, P_2^S, E_{i1}, E_{i2}, X_i, \alpha_{i1}, \alpha_{i2}] \qquad j = 1,2 \qquad (8)$$

This is an important difference between my setup and that of Chang and Winters (2002) and Feenstra (1989). The mentioned 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. Because of this decision, circumstances in Europe, such as the antibiotics crisis will affect the amount of shrimp sent to the US. The central empirical question at issue will then be, as the exporter shifts markets, to what extent does he affect the relative price of shrimp. 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 α; 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.[40] 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 US than he wanted. There are also various ways in which my setup could be modified or generalized. One could wonder for example 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 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 US on the US price (negative) and the European price (positive). 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 for my analysis: The exporter's allocation decision links geographically separate markets and it gives way to the question as to how relative prices move as he/she relocates exports in response to changing circumstances.

[39] In other words, the ratio of local prices is more than the ratio of two prices that are entirely determined by local conditions.

[40] 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 short-term directly affect the allocation decision.

IV Data Description

The monthly shrimp data that I use cover the time period between January 1996 and July 2004. Even though the monthly data are publicly available, they have so far only been rarely used in empirical work. The present section describes the sources for these data.[41]

a. Shrimp trade data

My analysis hinges on a comparison of the US and the European market. I therefore can only include countries that have an uninterrupted time series in either market. I obtain information on the volume and the value of shrimp imports (which does not include tariff, freight, insurance fees, and other surcharges) from various websites. By dividing value and quantity I impute the price of shrimp (unit value). Note that unit values of commodities such as shrimp [that are always expressed in terms of weight] are much better proxies for prices than in the case of, say, manufacturing products.

Shrimp import records for the US are retrieved from the US International Trade Commission's website (USITC on http://dataweb.usitc.gov/). The data source provides the US import records from all the countries in the world. The imports are classified by Harmonized Tariff Schedule number and they are available at the 10-digit level. The values are reported in dollars, the quantities are measured in pounds.

Data on shrimp imports for Europe are provided by Europe's statistical agency, EUROSTAT (at http://epp.eurostat.cec.eu.int/). 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 are classified by HTS number. The values are reported in euros, the quantities are measured in kilogram. For Europe, only data on shrimp imports from the major exporters are available. These are Argentina, Brazil, Mainland China, Ecuador, Indonesia, India, Mexico, Malaysia, Philippines, Thailand, Vietnam, and the US.

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 US and Europe and to obtain exports that are comparable between the US and Europe.[42] I use the data for Thailand, Vietnam, China, Ecuador, India and Indonesia that all have continuous time series in both Europe and the US during the entire

[41] I only discuss the data sources for the estimation here. The sources of Figures 1-4 are mentioned underneath the figures.

[42] At the most disaggregate HTS level category definitions vary.

period.[43] I focus on the HTS category with number 030613. This category excludes all the shrimp and prawn products that have been processed more, i.e. that have been canned, frozen and put into airtight containers or prepared with other fish or meat. These last products are categorized under of HTS category 160520. HTS 030613 comprises frozen and cooked shrimp of different families, i.e. the cragnon, the prenaeus, the parapenaeus, etc. Finally I translate all volumes into kilogram in order to make European and US data consistent.

b. Shrimp tariff data

Both the US and Europe apply import tariffs based upon the 8-digit HTS number. In the US case, tariff data can be retrieved from the HTS archives provided on the above-mentioned USITC website. The six countries that we study have a zero tariff throughout the period – The preliminary tariffs imposed by the Commerce Department were announced at the end of the period that I study. For Europe, the specific tariff rates can be found with the look-up facility which is based on the Integrated Tariff of the European Communities (TARIC). The TARIC database is maintained by the European Commission (http://europa.eu.int/comm/). Since 1999 Vietnam, China, India and Indonesia face a 4.2 percent tariff for HTS 030613. Before 1999 it was between 4.2 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 EU's revision of its GPS tariff system, Thailand has seen its initial 4.5 percent tariff increase. From 1997 on wards 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 Consumer Price Index and the Food Price index for the US and Europe from the Main Economic Indicators database, which is a service of the OECD's online library (source OECD on http://new.sourceOECD.org/.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 US and from EUROSTAT http://epp.eurostat.cec.eu.int/ for the same 15 countries of the EU considered before. All of these indices have 2000 as 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

[43] 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.

and US's main exporters I use the unit values from the aggregate exports to the US and EU from their 11 most important exporters, respectively for HTS 030613 and 160520 combined ("ShrimpII") and HTS 030613 ("ShrimpI"). [44]

d. Antibiotics crisis

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, restrictions reduced and abolished for most countries. I therefore let the end of the dataset, July 2004, coincide with the end of the crisis. Many countries were affected by the antibiotics crisis, yet especially China, Vietnam and Thailand. When I estimate a regression with multiple countries, I allow for a separate 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 the extent to which the price of shrimp is affected by the changing conditions in the export market and in particular by the tariff and non-tariff barriers in Europe. The main focus is on Thailand, the world's primer exporter of shrimp, and on China and Vietnam. Thailand lost its preferential status in the period that I study and like China and Vietnam it got tangled up in the antibiotics crisis. I study to what extent these changing market conditions have redirected shrimp exports of these countries from Europe to the US and whether these reallocations impacted on the prices. I include Indonesia, India and Ecuador in the analysis, to make sure that my findings for Thailand, China or Vietnam are not reflective of broader trends in or characteristics of the shrimp market.

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

$$\ln \frac{pus_t / Pus^S_t}{peu_t / Peu^S_t} = \alpha + \beta_1 \ln \frac{cus_t}{ceu_t} + \beta_2 \ln \frac{Yus_t / Pus_t}{Yeu_t / Peu_t} + \beta_{3-5} seasons1-4 + u_t \quad (9)$$

[44] The 11 countries include our 6 countries plus Argentina, Mexico, Brazil, the Philippines and Malaysia.

As indicated in section III, in the specification I compare the dollar price of shrimp in the US to the euro price in Europe. This follows directly from the setup, since consumers are by assumption no arbitrageurs and they base their consumption decision on the local price. If one wanted to explicitly compare dollar prices in Europe and the US, one simply has to multiply through the left-hand side with the dollar-euro exchange rate and also explicitly include it on the right-hand side of the regression. Needless to say, this would not affect the outcome.[45]

Note that the regressors in (9) include the US 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.

$$Y^s/P^s = f(Y/P) \quad \text{with} \quad f'(\bullet) > 0 \tag{10}$$

The sustained increase in the consumption of / demand for shrimp (and the suggestion in the literature that shrimp demand is fairly sensitive to upturns and downturns) makes one expect a more than one for one increase in spending on shrimp as real income increases – the characteristic of a luxury good.[46]

Of particular interest is the coefficient β_1. We expect a negative β_1, so that US 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 US vs. Europe *cus/ceu*. As motivated by the model setup, the relative demand *cus/ceu* is equal to relative supply *xus/xeu* in equilibrium. Relative supply *xus/xeu* is determined by the exporters' decision. According to equations (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 are potential instruments to help trace out demand as they shift

[45] The reason why the dollar-euro prices are more convenient relates to how I measure the quantities consumed, the price indices and real income. Contrary to what is often the case in international studies, all of these measures are not expressed in dollar terms for Europe. Consumption is measured in kilogram, real income is proxied by the index of manufacturing production and the aggregate price index measures changing euro prices.

[46] For reference, the National Marine Fisheries Service estimates that per capita shrimp consumption increased between 1996 (beginning of our sample) and 2001 from 2.5 pounds to 3.7 pounds (an increase by 48 percent), see http://www.st.nmfs.gov. Real per capita income over that same period increased according to the BLS by 10 percent.

the supply curve while demand stays put: the antibiotics crisis and the retraction of Thailand's preferential tariff.

Note that the exporter, not the consumer, is the one who compares multiple markets to decide on where to send his output to and 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 US 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 US.[47] 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.[48] In addition to the antibiotics crisis, I also choose the tariff as 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.[49] I then estimate regression (9) by two stage least squares.

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 mostly is about 1 or smaller, suggesting positive autocorrelation. 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

[47] The antibiotics crisis barely registers in the media in Europe and the US where it could affect consumer behavior. The actual antidumping case will attract much more attention.
[48] See Section V for alternative ways to interpret the antibiotics crisis in the context of the model.
[49] In theory, the dollar-euro exchange rate would be a candidate instrument. However, if one would insist on measuring shrimp prices in dollars it would lose its usefulness. Moreover, since the exchange rate is an aggregate variable (that may affect income and thus demand), I prefer the two other instruments that are specific to the shrimp market and clearly identified with a shifting supply.

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").[50]

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 vs. another requires a lower relative price. The coefficient on relative consumption is fairly robust, and does not vary much across the different estimates. Moreover, it 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 autocorrelation 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 US and Europe are needed to affect relative prices in a tangible way. Holding all else constant, an increase in relative consumption of about 9 or 11 percent is needed to decrease the shrimp price with 1 percent. The demand for shrimp seems to be fairly elastic (σ 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 towards the US in response to Europe's high food safety standards. [I report the first stage regression that STATA uses in order to obtain two-stage estimates in Table A1 of the Appendix.[51]] 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

[50] The 11 countries include our 6 countries plus Argentina, Mexico, Brazil, the Philippines and Malaysia.
[51] This first stage regression approximates (i.e. we have no closed form solution) a regression of $ln\ (x_{us}/x_{ew})$ based on the supply equation (8).

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 1A 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 V 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 US vs. 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 US. Multiplied by the average consumption coefficient, the impact of a one 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 by 7 percent. Holding all else equal, a similar tariff hike would cause a drop in the US price relative to that of Europe of 12.85 percent.[52] This suggests indeed that with a relatively elastic demand esp. tariffs have the most pronounced direct impact on relative prices.

A 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

[52] Note that the relative price on the left-hand side is inclusive of the tariff. To make sure that it is not Thailand's changing tariff with which we adjust the price index on the left-hand side that is driving the result, I have estimated the relative prices regressions exclusive of the tariff. The results are fairly similar in all four cases.

countries.[53] To address this issue, I compare in the panel regression (11) 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 US drop out in this case.

$$\ln \frac{pus_{it} / peu_{it}}{pTus_t / pTeu_t} = \alpha_i + \beta_1 \ln \frac{cus_{it} / ceu_{it}}{cTus_t / cTeu_t} + \beta_{2-4} season1-4 + u_{it}, \qquad (11)$$

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 A1, 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 US market with Thai shrimp and increases the relative prices of other countries' shrimp exports relative to those of 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

[53] Using different measures for P^S already in part addresses this concern.

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. 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 in order to better understand what determines trade flows between two countries. In other words, not only bilateral tariffs and restrictions matter, changing tariffs or conditions with third countries also affect countries' bilateral trade. In arguing this way, Anderson and Van Wincoop address in more general terms a path-breaking question that Viner (1950) had posed as the European Community emerged. Viner studied the impact of a specific friction, tariffs, in the context of regional trade agreements such as customs unions or free trade agreements. He found that a country that enters a regional agreement in which non-MFN tariffs are lowered only among members may increase its imports from other members at the expense of non-member countries. In this way, regional agreements may divert trade and bilateral trade between members and non-members may change even though their bilateral tariffs remain unaltered. 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 US, even though the US 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 US and these countries. Both phenomena, eroding preferences for developing countries and issues related to international food and safety standards, are not about to disappear in current and future trade liberalizations, esp. 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. As I analyze the shrimp market, I show how Europe's changing tariff policy with respect to the world's primer exporter, Thailand, did put downward pressure on the relative price in the US vs. Europe. The same is true for how the higher food safety standards that Europe imposed affected the relative EU-US price for China, Vietnam and Thailand. With my analysis of the shrimp market, I thus provide evidence that supports the well-established hypothesis that large countries through their trade policy can affect world prices - a hypothesis with only limited empirical evidence so far to

support or to reject it. 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 US set the stage for the current anti-dumping case against six developing countries here in the US - the largest anti-dumping case since the steel tariffs. I find that esp. tariffs have a strong impact on the price (and quantity). This finding should give pause in light of the recent anti-dumping tariffs imposed by the Commerce Department. Since tariff changes in the order of 7 percentage points were sufficient to significantly reduce Thailand's presence in the European market, one would expect that the very high tariffs especially for China and to a lesser extent for Vietnam and Brazil should virtually shut these countries out of the US market and redirect their exports to Japan and Europe. 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 and 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.

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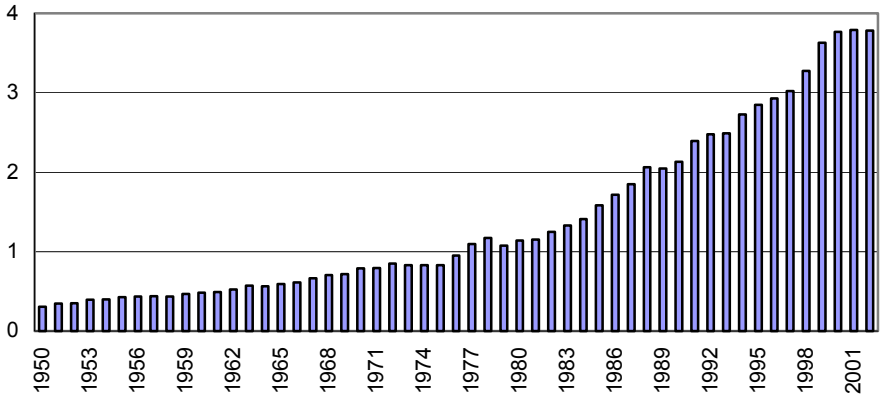
Figure I

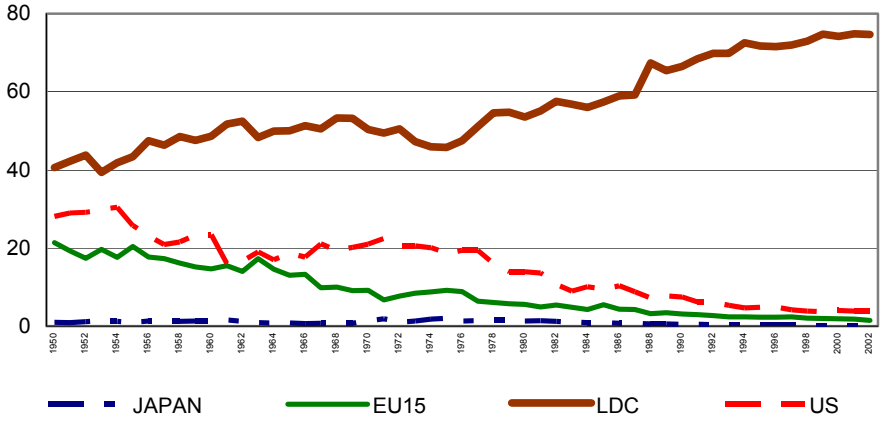
World total shrimp production 1950-2002
(million metric tons)



Note: different shrimp species are added together with no rescaling.
Source: FAO FishStat+, Total Production 1950-2002 database; downloadable from http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp/

Figure II

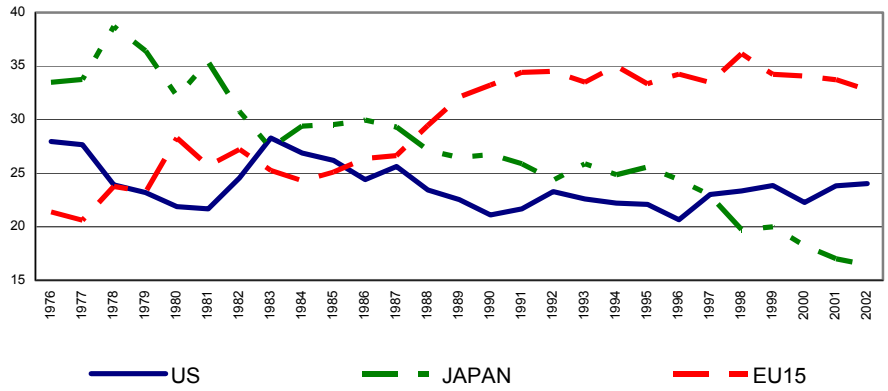
World production shares of a sample (percent)



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 the shares are relative to world shrimp production. Over the period 1950-2002, the sample covers some 70 to 90 percent of world shrimp production.
Source: calculations based on FAO FishStat+, Total Production 1950-2002 database; downloadable from http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp/

Figure III

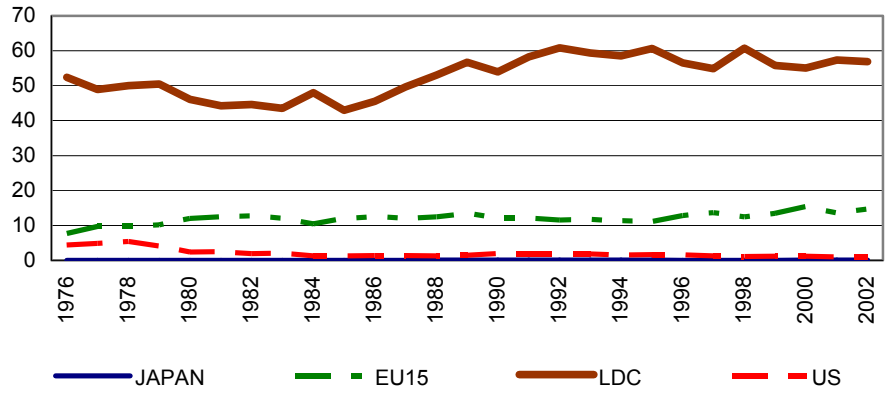
Quantity shares in world shrimp imports 1976-2002
(percent)



Note: **EU15** includes Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden. All the shares are relative to world shrimp imports. The EU15's import aggregate does not exclude intra-group imports. Over the period 1976-2002, the sample covers some 75 to 85 percent of world shrimp imports.
Source: calculations based on FAO FishStat+, Commodities production and trade 1976-2002 database; downloadable from http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp/

Figure IV

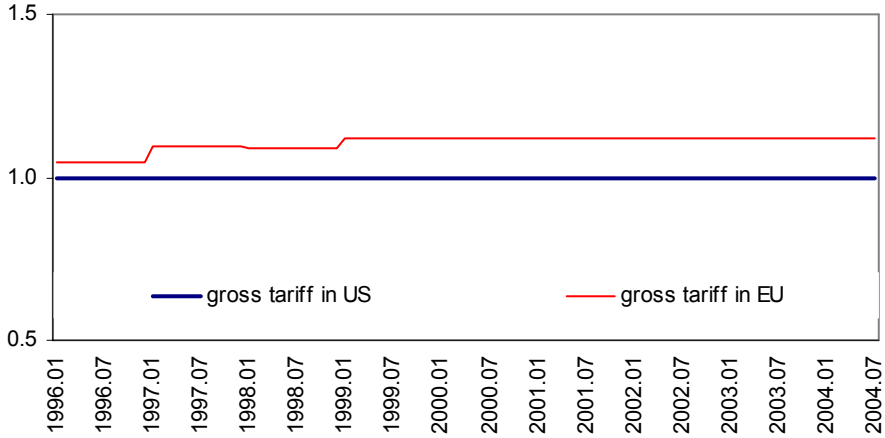
Quantity shares in world shrimp exports 1976-2002
(percent)



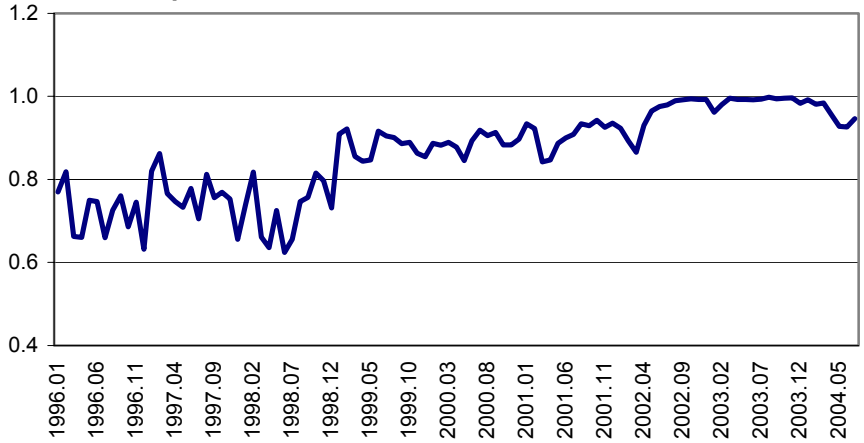
Note: **EU15** includes Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden; **LDC** comprises of Argentina, Brazil, Mainland China, Ecuador, Indonesia, India, Mexico, Malaysia, Philippines, Thailand, and Vietnam. All the shares are relative to world shrimp exports. The EU15's export aggregate does not exclude intra-group exports. Over the period 1976-2002, the sample covers some 55 to 75 percent of world shrimp exports.
Source: calculations based on FAO FishStat+, Commodities production and trade 1976-2002 database; downloadable from http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp/

Figure V

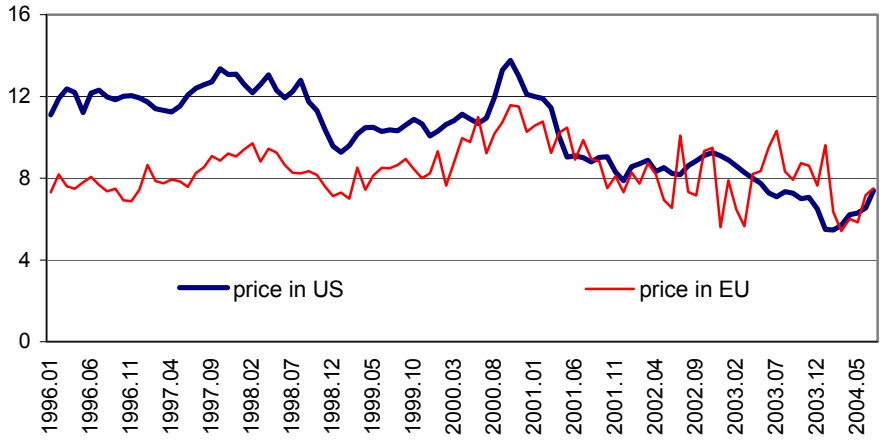
Panel 1: gross tariff rates on Thai shrimp group 3 exported to US and EU15



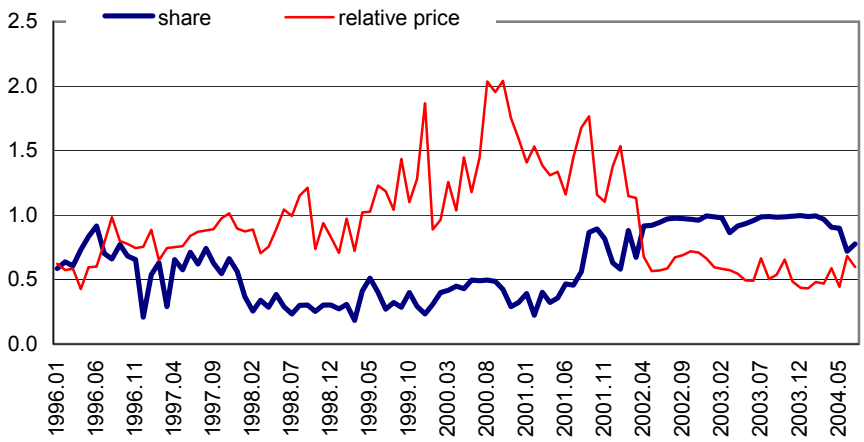
Panel 2: quantity share of Thai shrimp group 3 exported to US relative to US & EU15 in total



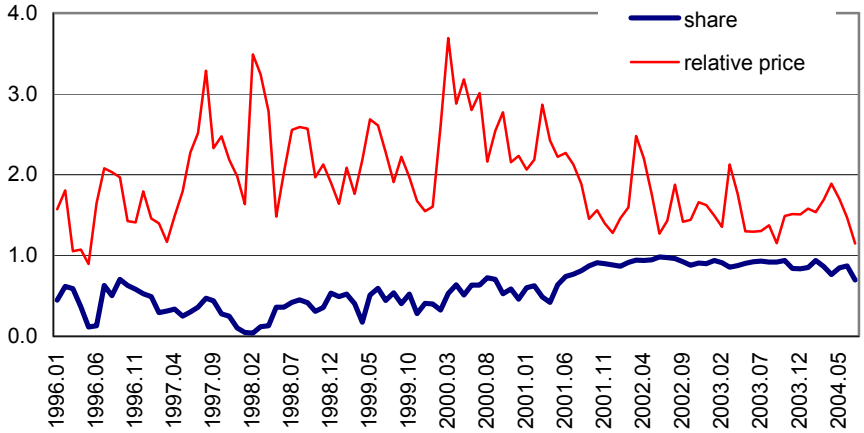
Panel 3: prices of Thai shrimp group 3 exported to US (Dollar) and EU (Euro) per kilogram



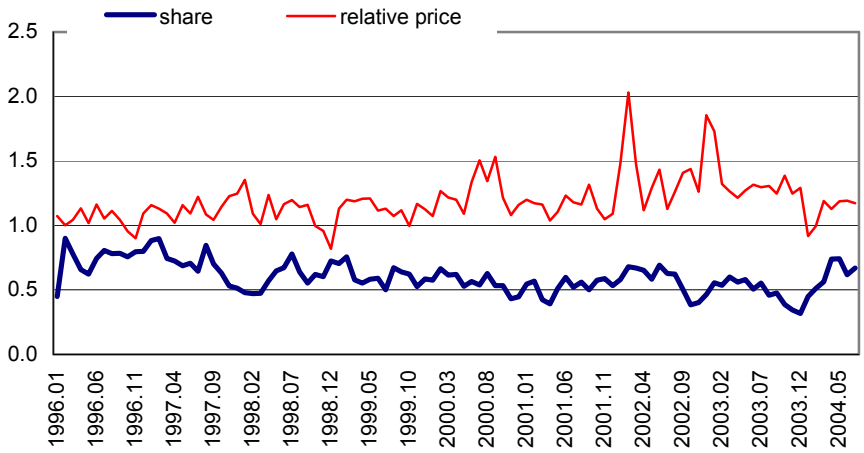
China: export share to US & relative price US/EU15



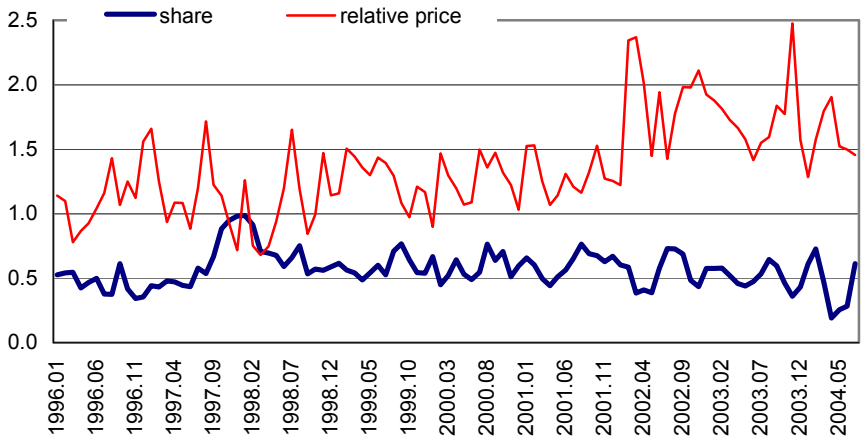
Vietnam: export share to US & relative price US/EU15



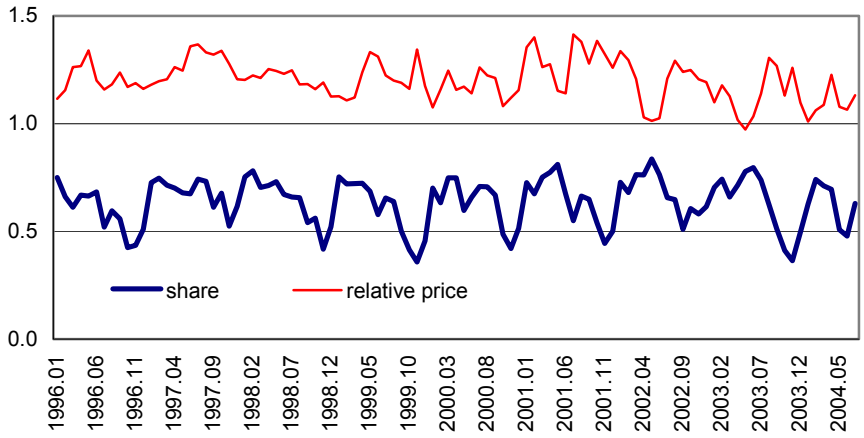
Indonesia: export share to US & relative price US/EU15



India: export share to US & relative price US/EU15



Ecuador: export share to US & relative price US/EU15



Note: EU15 consists of Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden.
Source: for shrimp import data in the US: USITC website: http://dataweb.usitc.gov/
for shrimp import in EU15: EUROSTAT website: http://epp.eurostat.cec.eu.int/

Table 1
Export quantity shares of some major shrimp producers in 1996 and 2002 (percent)

Country	Relative to world shrimp exports (a)		Relative to US shrimp imports (b)		Relative to EU15 shrimp imports (c)	
Year	1996	2002	1996	2002	1996	2002
Argentina	0.6	3.2	0.0	0.6	2.2	11.1
Brazil	0.2	2.4	0.8	4.2	0.1	4.7
Mainland China	3.7	8.0	3.5	11.7	1.6	0.7
Ecuador	7.0	2.8	14.8	6.1	9.6	3.0
Indonesia	6.9	6.8	3.3	3.6	1.4	3.7
India	9.1	10.2	6.4	9.1	6.5	7.9
Mexico	3.1	1.6	10.7	5.1	0.6	0.1
Malaysia	1.8	2.6	0.3	0.3	2.9	2.9
Philippines	1.9	1.3	0.4	0.3	0.0	0.4
Thailand	18.8	12.8	24.5	23.8	10.2	1.7
Vietnam	3.5	5.3	11.2	9.2	0.9	0.7
Total	56.6	56.9	76.2	74.1	36.0	37.0

Source: (a) based on FAO FishStat+, Commodities production and trade 1976-2002 database; downloadable from http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp/
(b) based on the NBER-managed trade database, Harmonized System Imports Commodity by Country, 1989-2001; downloadable from http://www.internationaldata.org/usixd/wp5515d.html/
(c) based on EUROSTAT External trade database, EU trade since 1995 by CN8; downloadable from http://epp.eurostat.cec.eu.int/

Table II Estimates of the Changing US export Shares

(a) $$ln\left[\frac{xus_{it}}{xus_{it}+xeu_{it}}\right] = \alpha_i + \beta_1 lnTariffeu_{it} + \beta_2 Antibiotics_{it} + \beta_3 AntibioticsYZ_{it} + \varepsilon_{it}$$

(b)
$$ln\left[\frac{xus_{it}/(xus_{it}+xeu_{it})}{xTus_t/(xTus_t+xTeu_t)}\right] = \alpha_i + \beta_1 lnTariffeu_{it} + \beta_2 Antibiotics_{it} + \beta_3 AntibioticsYZ_{it} + \beta_4 India_{it} + \varepsilon_{it}$$

where *YZ* are China and Vietnam

explanatory var.	**For Thailand only** (a)	**all countries rel. to Thailand** (b)	**all countries except Thailand** (a)
Antibiotics	0.12	-0.18	-0.06
	0.02***	0.04***	0.04
AntibioticsYZ		0.87	0.87
		0.06***	0.06***
lnThai Tariff			
EU	3.31	-3.95	-0.64
	0.33***	0.67***	0.65
fixed effects	No	Yes	Yes
R2	0.73	0.36	0.39
obs.	103	515	515

*** significant at 99 percent
** significant at 95 percent
* significant at 90 percent
standard errors underneath coefficient estimates

Table III Estimates for Vietnam and China

$$\ln \frac{pus_t / Pus^S_t}{peu_t / Peu^S_t} = \alpha + \beta_1 \ln \frac{cus_t}{ceu_t} + \beta_2 \ln \frac{Yus_t / Pus_t}{Yeu_t / Peu_t} + \beta_{3-5} seasons1-4 + u_t$$

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

	Vietnam				**China**			
explanatory var.	IV CPI	IV Food	IV ShrimpI	IV ShrimpII	IV CPI	IV Food	IV ShrimpI	IV ShrimpII
ln cus/ceu	-0.11	-0.12	-0.1	-0.1	-0.1	-0.1	-0.07	-0.07
	0.03***	0.03***	0.03***	0.03***	0.03***	0.32***	0.04*	0.04*
$\ln(Y_{us}/P_{us})/(Y_{eu}/P_{eu})$	1.98	1.82	1.62	1.75	1	0.91	0.67	0.8
	0.86**	0.86**	0.90*	0.98*	0.96	0.96	1.02	1.01
season1	0	-0.01	-0.02	-0.03	0	0	-0.02	-0.03
	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
season3	0.11	0.09	0.09	0.1	0.2	0.19	0.17	0.18
	0.06*	0.06	0.06	0.07	0.06***	0.06***	0.06***	0.06***
season4	0.02	0.01	0	0.01	0.14	0.13	0.09	0.1
	0.07	0.06	0.07	0.07	0.07**	0.07*	0.07	0.07
Rho	0.48	0.48	0.55	0.56	0.64	0.64	0.75	0.74
	0.09***	0.09***	0.08***	0.08***	0.08**	0.08***	0.07***	0.07***
R^2	0.2	0.19	0.12	0.13	0.17	0.16	0.09	0.11
D.W.	1.82	1.82	1.76	1.78	2.31	2.3	2.5	2.47
obs.	102	102	102	102	102	102	102	102

*** significant at 99 percent
** significant at 95 percent
* significant at 90 percent
standard errors underneath coefficient estimates

Table IV Estimates for Thailand

$$\ln \frac{pus_t / Pus_t^S}{peu_t / Peu_t^S} = \alpha + \beta_1 \ln \frac{cus_t}{ceu_t} + \beta_2 \ln \frac{Yus_t / Pus_t}{Yeu_t / Peu_t} + \beta_{3-5} seasons1-4 + u_t$$

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

explanatory var.	IV CPI	IV Food	IV ShrimpI	IV ShrimpII
ln cus/ceu	-0.12	-0.11	-0.11	-0.12
	0.03***	0.03***	0.02***	0.02***
$\ln(Y_{us}/P_{us})/(Y_{eu}/P_{us})$	1.38	1.43	-0.17	0.05
	0.68**	0.69**	0.52	0.53
Season1	0.03	0.02	0.01	0
	0.04	0.04	0.04	0.04
Season3	0.08	0.07	0.03	0.04
	0.04*	0.04*	0.04	0.04
Season4	0.13	0.12	0.06	0.06
	0.05**	0.05**	0.14	0.04
Rho	0.69	0.72	0.41	0.44
	0.07***	0.07***	0.07***	0.08***
R^2	0.17	0.15	0.31	0.31
D.W.	2.23	2.25	2.07	2.08
obs.	102	102	102	102

*** significant at 99 percent
** significant at 95 percent
* significant at 90 percent
standard error underneath coefficient estimates

Table V Estimates Relative to Vietnam, relative to Thailand and relative to China

$$\ln \frac{pus_{it} / peu_{it}}{pXus_t / pXeu_t} = \alpha_i + \beta_1 \ln \frac{cus_{it} / ceu_{it}}{cXus_t / cXeu_t} + \beta_{2-4} seasons1-4 + u_{it}$$

$$u_{it} = \rho_i u_{it-1} + \varepsilon_{it}$$

X= Vietnam, Thailand or China

explanatory var.	rel. to Thailand	rel. to Vietnam	rel. to China
ln(cus/ceu)	-0.17	-0.07	-0.07
(cXus/cXeu)	0.02***	0.02***	0.02***
season1	-0.02	0	-0.03
	0.03	0.03	0.03
season3	0.02	0.02	-0.08
	0.03	0.03	0.03***
season4	-0.12	-0.01	-0.09
	0.03***	0.03	0.03**
Loglikelihood	101.38	82.29	9.49
Obs.	515	515	515

*** significant at 99 percent
** significant at 95 percent
* significant at 90 percent
standard errors underneath coefficient estimates

Appendix

A1. First Order Conditions for the Exporter

The exporter *i* maximizes the following profit function.

$$\underset{x1}{Max}\ E_1 \tilde{p}_1 (x_1,\bullet)\, x_1 + E_2 \tilde{p}_2 (X - x_1,\bullet) - \alpha_1 x_1 - \alpha_2 (X - x_1),$$

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.[54] when $\alpha_1 = \alpha_2$:

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

Supplies to the two markets

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

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

F.O.C. when $\alpha_1 \neq \alpha_2$:

$$\left(E_1 \beta_1^{1/\sigma} \tau_1^{-1} Y_1^{S\,1/\sigma} \Big/ P_1^{S(1-\sigma)/\sigma} \right) (1 - 1/\sigma) x_1^{-1/\sigma} - \alpha_1 + \alpha_2 = \left(E_2 \left(\beta_2^{1/\sigma} \tau_2^{-1} Y_2^{S\ 2^{1/\sigma}} \right) \Big/ P_2^{S(1-\sigma)/\sigma} \right) x$$

$$(1 - 1/\sigma)(X - x_1)^{-1/\sigma}$$

[54] I assume that the own price and tariff have a negligible impact on the aggregate price index.

Table A1 First-Stage Regressions for Thailand, Vietnam, China and relative to these countries

(a) $$\ln\frac{xus_t}{xeu_t} = \alpha + \beta_1 Antibiotics_t + \beta_2 lntariffeu_t + \beta_3 \ln\frac{Yus_t}{Yeu_t} + \beta_4 \ln\frac{Pus_t}{Peu_t} + \varepsilon_t$$

(b) $$ln\frac{xus_{it}/xeu_{it}}{xXus_t/xXeu_t} = \alpha_i + \beta_1 Antibiotics_{it} + \beta_2 AntibioticsYZ_{it} + \beta_3 India_{it} + \beta_4 \ln tariffeu_{it} + \beta_5 \ln\frac{Yus_t / Pus_t}{Yeu_t / Peu_t} + \beta_{6-8} season1-4 + \varepsilon_{it}$$

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

	Thailand		**Vietnam**		**China**	
	(a)	(b)	(a)	(b)	(a)	(b)
explanatory var.						
Antibiotics	2.03	-2.07	2.58	-2.69	3.05	-3.26
	0.22***	0.13***	0.16***	0.16***	0.22***	0.17***
AntibioticsYZ		3.01		1.80		1.51
		0.19***		0.25***		0.27***
India		1.17		1.62		1.46
		0.31***		0.41***		0.44***
lnThai Tariff EU	-16.32	-20.43				
	5.35**	2.19***				
lnYus/Yeu	1.33		0.71		-5.99	
	3.25		2.39		3.19*	
season1	0.17	-0.08	-0.06	-0.17	-0.21	0.26
	0.21	0.12	0.22	0.16	0.29	0.17
season3	0.19	-0.15	0.42	-0.18	0.175	0.11
	0.22	0.12	0.22*	0.11	0.3	0.17
Season4	0.26	-0.38	0	0.04	0.07	-0.13
	0.22	0.13***	0.23	0.16	0.03	0.18
cntry effects	no	yes	no	Yes	no	Yes
R^2	0.71	0.56	0.71	0.51	0.67	0.55
obs.	103	515	103	515	103	515

*** significant at 99 percent
** significant at 95 percent
* significant at 90 percent
standard errors underneath coefficient estimates