Norwegian University of Life Sciences
School of Economics and Business

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Roberto J. Garcia and Thi Ngan Giang Nguyen

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By

Roberto J. Garcia and Thi Ngan Giang Nguyen

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Contact author: Roberto J. Garcia, School of Economics and Business, Norwegian University of Life Sciences, NMBU, Roberto.garcia@nmbu.no

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Abstract

Much has been written in the popular press and studied in the political-economics literature about the link between the awarding of the 2010 Noble Peace Prize to a Chinese dissident and China's trade sanction affecting Norway's whole, fresh/chilled salmon exports. Trade patterns show a break in Norway's salmon exports to China and a declining share of the Chinese market. However, since 2011 a curious trade pattern developed as Vietnam suddenly increased its import of Norwegian salmon. This paper establishes a relationship between the salmon markets of Vietnam and China since 2011, specifically addressing whether Vietnam's increased import of salmon is related to China's limiting of market access to Norwegian salmon. The sanction period acts as a structural break that divides trade flows into two sub-periods, July 1997 to February 2011 and March 2011 to December 2018. Vietnam's current monthly imports are negatively affected by lags in China's monthly imports with the sanction but had no effect before the sanction. An increase (decrease) in China's salmon imports from Norway "Granger causes" a decrease (increase) in Vietnam's imports from Norway. This provides statistical evidence of China's sanction on Norwegian salmon, but that the sanction integrated China and Vietnam's salmon markets through smuggling.

Keywords: Vietnam, China, Norway, salmon trade, sanction, Granger causality, and smuggling

JEL classification:
F13, F14, F51, P33

Market Integration through Transshipments: Implications of Sanctions on Salmon

1. Introduction

The Norwegian Nobel Committee (NNC) awarded the 2010 Peace Prize to Liu Xiaobo, a Chinese dissident, for his long and non-violent struggle for fundamental human rights in China (NNC, 2010). China had already signaled its discontent with the NNC for nominating him as a candidate for the Prize, citing meddling by Norway in the official internal affairs of the Chinese state, which considered him a criminal. In 2008, the Chinese government gave Xiaobo an 11-year jail sentence for "inciting subversion of state power" for advocating sweeping changes of China's system of government in favor of putting democracy, human rights, and the rule of law at the core of the political system (BBC, 2017).

Unsurprisingly, the announcement of the award brought a swift condemnation by Beijing, which had warned of damaged relations. The Chinese government summoned Norway's ambassador to the foreign ministry for the government to express its official disagreement with and protestation of the decision (BBC, 2010). Thus began a six-year period of tensions in diplomatic relations, of which a limited trade sanction on Norwegian salmon played a part. While China's government never formally declared a trade sanction, much has been written about it in the international popular press and industry newsletters (*News in English*, 2010; *Independent*, 2011; *Seafood Source*, 2012; *Financial Times*, 2013; *Undercurrent News*, 2015), and documented at the multilateral institutional level (World Trade Organization and World Organization for Animal Health). It has also been studied, though to a more limited extent, in the political-economics academic literature (Kolstad, 2016; Sverdrup-Thygeson, 2015; Chen and Garcia, 2016) establishing a link between the awarding of the Prize and consequences for bilateral trade.

The salmon sector was an obvious target for China because of its iconic association with Norway and because Norwegian salmon accounted for the dominant share of the Chinese market up to 2010. The sanction would entail a relatively small cost for China because of salmon's minuscule share of consumers' overall seafood protein intake, and other sources of salmon being readily available. Norway's salmon exports to China remained limited until after the normalization of relations in December 2016.

For the purpose of this study, the sanction period includes 2011, when Norwegian salmon exports to China started being adversely affected by stricter testing and longer quarantine times at the border, and when import license applications were approved for only small volumes of Norwegian salmon (Chen and Garcia, 2016), through 2018 when a partial ban and certification requirements on Norway's exports were still in effect (MTIF, 2019; *Undercurrent News*, 2019). While the period of China's sanction affected the Norway-China salmon trade, it also coincided with a curious pattern in the Norway-Vietnam salmon trade. Vietnam's salmon market, which had neither been substantial nor varying in volume, experienced a 13-fold increase in imports of Norwegian salmon from 2010 to 2011, from approximately 600 tons to 8000 tons (UN, 2019). More curious is that salmon imports into Vietnam appear to vary in accordance with import volumes of Norwegian salmon to China. That is, the sanctions affecting China-Norway trade could have had implications for the

Norway-Vietnam salmon trade because as Norway's exports to China decreased (increased), exports to Vietnam increased (decreased).

This study analyzes the effects of China's sanction on Norwegian salmon exports, but from the perspective of Vietnam. Vietnam's monthly import of whole, fresh/chilled salmon from Norway is analyzed from July 1997, when Vietnam began to import salmon regularly, through December 2018. The research addresses whether there is a statistical link between the sudden increase in Vietnam's salmon imports and the sanction period, 2011-18, and to analyze whether there is a statistical relationship between Vietnam's and China's market of Norwegian salmon. More specifically, an econometric model will estimate whether there is a structural break in the data series reflecting the sanction period and will establish whether there is a negative relationship between Vietnam's imports of Norwegian salmon and China's imports through Granger causality. Monthly trade data on whole, fresh/chilled salmon, classified under Chapter 3 of the Harmonized Commodity Description and Coding System (HS) of the tariff nomenclature at the HS 6-digit level (HS030212, HS030213, HS030214, or Atlantic and Pacific salmon) are used for the analysis. Evidence of such a relationship could support a hypothesis that Norwegian salmon was smuggled into China during the sanction period when China limited its market access to Norwegian salmon.

The paper is organized in six sections. In addition to the introduction section, a background section provides detail on the nature of the trade sanction and how it corresponds with the changes in the trends in Norway's salmon exports to China and Vietnam. This is followed by a discussion of related literature and relevant theory. A description of the variables created from the available data is provided prior to the model development in section four. The results are presented in section five with the main insights summarized in the conclusions, section six.

Chronology of sanctions and trends in Norway's salmon trade with China and Vietnam

China introduced new testing and quarantine procedures on fresh aquaculture coming from Norway on 13 December 2010 (WTO, 2011). The Beijing Capital Airport Entry-Exit Inspection and Quarantine Bureau issued an order to apply these procedures to Norwegian seafood entering through Capital Airport (Chen and Garcia, 2016). This order was followed by regulations to further strengthen inspection and quarantine procedures, singling out fresh/chilled salmon, under Document No. 9 entitled "Notice on Strengthening Inspection and Quarantine on Imported Salmon", issued on 20 January 2011, by the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) of the People's Republic of China (WTO, 2011).

Chen and Garcia (2016) further noted irregularities in China's import licensing regime. Interviews with stakeholders involved with importing salmon into China reported changes in 2011 of the approval of licenses concerning shipments from Norway. Previously, the AQSIQ approved licenses for any volume of salmon for which a trader applied, regardless of the country of origin. However, with the diplomatic tensions, license applications for salmon from Norway received approval only on small volumes (e.g., 10-30 tons).

Norway initially blamed the loss of its market share (a 70% reduction in its shipments) on China introducing politically-motivated measures such as a more burdensome licensing system, stricter testing and inspection, and more time-consuming quarantine procedures on

imports of fresh/chilled Norwegian salmon, coinciding with the awarding of the Prize. Norway raised its concerns through the WTO Secretariat, formally questioning the appropriateness of China's measures, the kinds of tests conducted, the scientific basis for the testing, whether the tests were conducted on all salmon shipments from all countries, and the need for understanding how the testing and quarantine procedures would safeguard consumers in China (WTO, 2011). China responded that the measures were based on existing laws and regulations, and because its authorities had detected numerous shipments of salmon from Norway being contaminated with fish lice, pathogenic microorganisms and containing an excess of veterinary drug residues, among other concerns, it led to the strengthening of existing procedures on imported salmon without singling out any WTO member state. Chinese experts opined that Norway's fresh/chilled salmon posed a high food safety risk, and that its failure to meet the inspection requirements is what caused the reduction in its exports (WTO, 2013).

Compounding the problem of marketing Norwegian salmon in China was compliance with the World Organization for Animal Health's (OIE) notification requirements. In 2014, the OIE added pancreas disease (PD) to the list of viral infectious diseases affecting salmon, along with infectious salmon anemia (ISA), that a country was required to monitor and notify its presence (OIE, 2019). The Norwegian Veterinary Institute (NVI, 2016) confirmed the presence of PD and ISA, and salmon lice, a parasite, in some salmon stocks in Norway. The Norwegian Food Safety Authority (NFSA) noted that the aquaculture industry faced serious challenges with outbreaks of ISA in Northern Norway and PD in Southern Norway and that combating salmon lice had become more difficult as drug-resistance increased (NFSA, 2016 and 2017). However, NFSA and NVI's intended concerns were with disease and measures to combat salmon lice as they related to welfare problems and mortality rates in farmed fish, but not with the safety or quality of Norwegian salmon for human consumption.

Nevertheless, China responded with a partial ban on Norwegian salmon, demanding guarantees that Norway source its fresh/chilled salmon from producing regions that were disease-free (*Undercurrent News*, 2015). The AQSIQ warned that it would increase testing for the presence of ISA-viruses in all salmon imported from Norway and announced that it would stop all imports of whole, fresh Norwegian salmon from infection regions. In March 2015, China formally banned all whole, head-on salmon from three Norwegian regions (Nordland, Troms and Trondelag), which accounted for about a fifth of Norway's salmon export to China in 2014 (*Undercurrent News*, 2015). For all other Norwegian regions, exports would only be accepted if accompanied by certificates guaranteeing that the salmon was free of PD and ISA. The NFSA stated that compliance would be a challenge because the regulation was inoperable as China did not differentiate between the variants of the ISA virus that caused the disease and the variant that was not pathogenic (*Undercurrent News*, 2015). The NFSA insisted that there was no risk that the ISA virus would contaminate Chinese salmon because Norwegian salmon went directly to consumer markets (*Seafood Source*, 2015a) and that there was no human health risk from ISA as there is no evidence that the virus can be transmitted to humans (NFSA, 2016). The NFSA also expressed concerns over whether other salmon exporting countries were subject to the same regulations.

The NFSA worked with Chinese authorities to ensure that China was satisfied with its requirement for a guarantee, i.e. the wording of the certificate stating that the salmon was free of ISA. Despite the normalization of diplomatic relations in November 2016 (MAF, 2016) and the lifting of the earlier "politically motivated" trade impediments, China continued to subject Norway's salmon exports to a very complex control regime of partial bans and

certification requirements until May 2019. China lifted the sanctions on fish-farming facilities belonging to Leroy Seafood Group, Nordlaks and SalMar with the signing of a bilateral protocol (MTIF, 2019), whose terms comply with the OIE aquatic code and the WTO Sanitary and Phytosanitary (SPS) Agreement (*Undercurrent News*, 2019).

Figure 1 provides a picture of the trends in China's total import of whole, fresh/chilled (Atlantic and Pacific) salmon and the change in import pattern of salmon from Norway, which coincides with the sanction associated with the 2010 Prize and continues through 2018 until the signing of the protocol. Norway's dominant share of China's salmon market averaged more than 80% until 2010, when the volumes of Norway's exports decrease in both absolute and relative terms. Despite a recovery in the export volume in 2012, the gap total imports and Norway's share is magnified.

[Figure 1 about here]

As the effects of the sanctions took hold in China, figure 2 shows how annual imports of whole, fresh/chilled Norwegian salmon began to increase into Vietnam in 2011. Import volumes increased from less than 1 000 tons to near 10 000 tons within the span of one year. Most salmon imports into Vietnam during 2010-18 are from Norway, accounting for more than 90%, by volume and value, of all whole, fresh/chilled (Pacific and Atlantic) salmon.

The increase in imports is sudden and seems disproportionate without an obvious change in any economic indicator in Vietnam's economy (e.g., national income, relative prices, population, or marketing effort) that can account for such a structural change in demand. The official trade data of Vietnam do not report transshipment or re-exporting of salmon. There are no accounts of the development of a salmon processing sector for smoking, canning or freezing of salmon products. Moreover, there are reports that indicate that the Vietnamese consume relatively little fresh salmon (*Financial Times*, 2018), as corroborated by the pre-2011 data. By contrast, China's middle-class exhibit preferences for Japanese-style raw fish, of which salmon is a featured ingredient and which is largely served in food service outlets.

[Figure 2 about here]

Since 2000, Norway has made a long-term commitment to marketing campaigns and spending to promote salmon in China. Seafood Norway, a government-sponsored lobby group, cultivated the Chinese market by investing heavily in their supply chains to ensure that exported fish reached wholesale and retail markets fresh (*Independent*, 2011). Norway's marketing was unmatched in China's seafood market, explaining its dominant share of the salmon market prior to 2011 (*Seafood Source*, 2015b). Similar efforts were not made in Vietnam.

Thus, if Vietnam's consumption patterns have not changed and preferences remain strong for Norwegian salmon in China, then illegal transshipments could be an explanation, particularly if wholesale level prices in China increased relative to the border price. Some estimates suggest that at least half of the salmon on the Chinese market may have been smuggled in 2018, and that around 80% of the salmon Norway sent to Vietnam was smuggled into China (*Undercurrent News*, 2018).

In figure 3, Vietnam's monthly tons of imports of Norwegian salmon are mapped against China's monthly imports of Norwegian salmon. The pattern, starting in 2011, suggests that as

imports into China decrease, imports into Vietnam increase, and vice versa. This raises two questions. First, from the data in figures 1 and 2, do the data provide statistical evidence that there is a structural break in the data on salmon import volumes into China and Vietnam? Second, from the data in figure 3, do the data provide evidence that import volumes in China drive the decision to import salmon into Vietnam?

[Figure 3 about here]

Evidence of a structural break in the data could establish a statistical link between the sudden increase in the volume of Vietnam's imports of Norwegian salmon and China's sanction limiting salmon on its market. The absence of any other obvious demand-side explanation for the change in Vietnam's import, nor any official trade statistics to support re-exports or other legal transshipments of salmon from Vietnam could suggest smuggling. Moreover, there are widespread newspaper accounts of salmon smuggling into China and of the authorities cracking down on smuggling rings (*Seafood Source*, 2019a; *Seafood Source*, 2019b; *Financial Times*, 2018). An inverse relation between imports into China and Vietnam, when no relationship would be expected to exist, would suggest that China's market is driving the imports into Vietnam where market agents have an incentive to profit from smuggling salmon into China.

Related literature and theory

With China's formidable economic growth in the 2000s and its position in international trade has come a greater capacity and willingness of the government to partake in economic diplomacy, particularly the use of policy to interfere with a country's exports to China when China perceives itself to be negatively affected in international relations. Fuchs and Klann (2013) study the trade effects on countries whose officials receive the Dalai Lama, the Tibetan spiritual leader. For China, the status of Tibet, and by extension the leadership role of the Dalai Lama, is an internal matter. Thus, diplomatic recognition through state visits of the Dalai Lama invites severe tensions in relations and a deterioration in trade relationships, mostly in the form of reduced access to China's market.

Fuchs and Klann estimate econometrically the extent to which official meetings with the Dalai Lama affect the volume of exports to China through a gravity model of trade during 1991-2008. The model includes the usual variables in a gravity model (GDP, population, and the exchange rate), and a dummy variable for time-specific factors, such as receiving the Dalai Lama. The dataset is split into two periods, 1991-01 and 2002-08. The later period includes the effects of China's membership in the WTO and the precipitous growth in China's economic and political power. The empirical results confirmed the existence of a "Dalai Lama effect", a negative effect on exports to China during 2002-08 following an official visit.

The awarding of the 2010 Nobel Prize met with an economic diplomacy response similar to other cases of interferences in China's internal matters. Statistics Norway (SSB, 2011 and 2012) offered early descriptive analyses on the economic effect of the award. SSB (2011) reported that apart from exports of fish there was no reduction in overall Norwegian exports even one year after the diplomatic tensions. Though Norway's trade balance with China worsened, both imports and exports increased in 2011. The effect of long-terms contracts were unknown and some sectoral groups were unsure of whether their sector would be

associated with the political effect of the award. It was noted that goods could be shipped via Hong Kong, but that no unusual shift in patterns had occurred, except in the case of fish exports.

The SSB (2012) follow-up study concluded that there were no major immediate changes and that overall trade was higher than before the award. Moreover, other factors, apart from worsening relations, could explain any sectoral effects on Norway's exports, such as a decline in global industrial activity and the slowdown in China's GDP growth. The biggest potential effect for Norway, it was argued, would be the effect of not creating new markets in China (SSB, 2012) and the lost economic opportunities because political estrangement erodes personal contacts and Chinese goodwill is based on maintaining close relations (Sverdrup-Thygeson, 2015).

Sverdrup-Thygeson (2015) studied whether the use of economic and political levers by China against Norway reflected yet another example the "Dalai Lama effect" whereby exports to China are sanctioned. By combining descriptive statistics with interviews of key political actors and business representatives Sverdrup-Thygeson focused on the effects of the political fall-out on Norway's exports up to 2013. Despite the immediate freezing of political relations, the suspension of bilateral free trade negotiations, cancellation of official visits, and obstacles to obtaining visas, the effect on Norway's overall goods exports to China was less severe than expected. This included the seafood sector except for the salmon sub-sector. Norway's total export value in goods to China increased in 2011, fell in 2012 but to levels that were above 2010, and trended back up through 2014, reaching record levels (UN, 2019).

The seafood sector, overall, did not suffer from any particular punitive border measures. However, the salmon sector has features that make it distinct relative to other export sectors. China processes Norwegian seafood for re-export, which contributes to employment in China, but whole, fresh salmon is a product internationally associated with Norway and is easily substitutable by imports of other countries, minimizing any adverse economic effects to China. Salmon is also the only major Norwegian export that goes directly into China's consumer market. The reduction in salmon exports may have been the result of discriminating inspection, quarantine and import licensing, but not to a popular consumer boycott, which is often associated with expressions of China's displeasure ignited by the state media, for example in matters involving a territorial dispute. However, in the case of the 2010 Prize, the public was largely unaware of Liu Xiaobo because the communist party had no interest to publicize him. Thus, because the overall trade relationship had not been adversely affected, Sverdrup-Thygeson concludes that China's intent was to continue economic relations more or less as usual. In this way, China's reaction to the 2010 Prize does not fit the pattern of the Dalai Lama effect found by Fuchs and Klann (2013).

Chen and Garcia (2016) combine personal accounts from interviews of stakeholders involved in the Norway-China salmon trade with changes in trade patterns of whole, fresh/chilled Norwegian salmon after the awarding of the Prize. The stakeholders' accounts corroborate the claims by the Norwegian Seafood Council (NSC), popular press reports, and official complaints lodged by Norway at the WTO of the application of disproportionate measures taken by China. Moreover, the stakeholders confirmed that while source shifting of salmon from other countries was one coping mechanism, importers appeared to be busting the sanction by circumventing the border measures by various other means. There were illegal transshipments involving rerouting of Norwegian salmon, mislabeling of country-of-origin documentation or smuggling, port shifting within China to ports where restrictions were less

strictly enforced, and synchronizing of import-licensing applications for the smaller volumes at various ports to get around the restriction of licenses on larger volumes.

Kolstad (2016) studied the effects of awarding the prize on Norwegian fish exports to China. Kolstad challenged the implicit assumption that exports should have been expected after 2010 to remain at the same high growth levels as those achieved in the years before 2010, arguing that the identification of a causal effect of the prize requires the construction of a credible counterfactual. Thus, a synthetic Norway is constructed from the weighted average of other countries. The 2000-09 period is used to compute the average of predictor variables to compare the synthetic exports against actual exports for 2011-14.

The evolution of exports and foreign policy in the synthetic control county is taken to be the counterfactual against which the actual evolution of Norwegian exports and foreign policy is estimated. While the awarding of the prize to a Chinese dissident is not unexpected, the timing of the decision could not be known *a priori*. Thus, the 2010 Prize could be viewed as an exogenous event. The results of this approach suggest that the effect on direct exports to China were substantial, particularly compared with other studies using more *ad hoc* counterfactuals. The differences in exports compared with their synthetic control units were greatest in 2012. It also noted that the sanctions appear to be temporary as in 2014 it appeared that Norway's fish exports were returning to previous levels. This may have been the case for all fish exports, but salmon exports would continue to be affected by China's ban based on SPS-related concerns, which Norway continued to contest as disproportionate (harsher than necessary to achieve the stated objective) and discriminatingly applied (applied to Norway to the exclusion of other salmon exporting countries).

These studies confirm the existence of the sanction and the effect of China's sanction on Norway's exports of salmon. While many of these studies acknowledge that smuggling of salmon may have occurred through Vietnam, the implications for Vietnam are not addressed directly. This study seeks to link changes in Norway's trade patterns with Vietnam to China's sanction but addresses the integrated nature of Vietnam's salmon market with China's.

Chen and Garcia (2016) emphasized that because consumer preferences for Norwegian salmon are strong enough in China, import restrictions motivated coping strategies by private sector agents to circumvent the barriers and bust the sanction. To explain sanction busting, Early (2009) compared the realist and the liberal perspectives. While the realist perspective considers trade as occurring among states, the liberal perspective focuses on the roles of firms and individuals on determining trade flows. Under the realist theory, sanction busting is the behavior of third countries. The specific actions of third countries depend on their relations with the sender country (the country imposing a trade sanction) and the target country (that country to which the sanctions are intended to adversely affect). The liberal theory explains sanction busting by economic considerations of firms and/or individuals engaged in trade. That is, if economic/trade sanctions create profitable opportunities available to economic agents, they will pursue their interest through sanction-busting activities (Early, 2009). The transshipment of Norwegian salmon through Vietnam would not be case of Vietnam's seeking to improve its relationship with Norway, but rather a result of private agents seeking rents.

Two common strategies of sanction busting by private sector agents are transshipment and smuggling. Miller, Kroodsma, Amo, Hochberg and Roan (2018) identified transshipment as a practice occurring when two vessels meet to exchange cargo, supplies or personnel, often

between vessels at sea and far from a home port. Andriamananjara et al. (2004) defines transshipment as the practice of routing an export shipment through an intermediate location before it reaches its destination, e.g., re-exporting. Transshipment can help to reduce shipping costs, take advantage of economies of scale or serve as a link along a regional supply chain to enhance the range of services or routes offered to consumers. This is not what seems to be happening in the case of transshipment between Vietnam and China in the trade of fresh/chilled Norwegian salmon. Miller et al. (2018) raise concerns with transshipment over traceability and transparency in the seafood industry which does apply in the context of smuggling fresh/chilled salmon. In the case of a sanction, the sender country, for example, imposes a boycott on the import of a specific commodity from the target country. If there are strong preferences for these good in the sender country, firms or individuals could be involved in illegal transshipment from third countries to circumvent border controls, a role that Vietnam seems to play.

Smuggling, the illegal means of moving a commodity from one side of a border to another (Bruns and Miggelbrink, 2012), is distinguished by two types of behavior. The first relates to prohibited goods and the second to avoiding customs and duties on import and/or exports (Pedani, 2008). Smugglers take advantage of borders to benefit from differences in demand and supply, differences in taxation or differences in the legality of trading certain goods (Bruns and Miggelbrink, 2012). The transshipment of salmon from Vietnam to China reflects both behaviors, finding access to the market around non-tariff barriers set up by the government and avoiding value-added taxes of some 11% (*Undercurrent News,* 2018).

Data and Methodology

The study uses monthly trade data from July 1997, when Vietnam first started importing salmon from Norway, until December 2018. The NSC provided data on monthly volume and value of exports of whole, fresh/chilled salmon from Norway to China and Vietnam. Dividing the value of exports by the volume exported gives the unit value of exports, free on board (fob).

Generally, market integration studies focus on tests of the relationship in prices across different markets. Here the focus is on the volume of trade flows. The study sets out to answer two questions. The first is whether a relationship exists between the sudden increase in imported volumes of Norwegian salmon into Vietnam coincides with the period of China's sanction on Norwegian salmon. The second is whether there is a structural break in the data series reflecting the implications of China's sanction on Norway's export of salmon to China (from 2010 with the politically-motivated measures until the removal of the SPS-related partial bans and certification requirements). To investigate whether Vietnam's imports of Norwegian salmon were influenced by China's imports of Norwegian salmon from the sanction period, a regression model of the changes in Vietnam's import volume on its own lags and on the lags of the change in China's import volume is estimated using ordinary least squares (OLS). Additionally, the structural break is tested to see if it changes the value of the estimated coefficients of the model, so that a conclusion on the role of the sanction can be made.

The first equation to be regressed uses the current month of Vietnam's quantity of imports as a dependent variable (VNQM) which is a function of lagged monthly import into both

Vietnam and China. That is, does China's import volume drive Vietnam's imports? This is expressed as:

$$(1)\ \Delta \ln VNQM_t = \gamma_0 + \Sigma\, \gamma_{1i}\, \Delta \ln VNQM_{t-i} + \Sigma\, \gamma_{2i}\, \Delta \ln CHQM_{t-i} + \varepsilon_t$$

where $\ln VNQM_i$ and $\ln CHQM_i$ are the quantities of whole, fresh/chilled salmon imported from Norway into and Vietnam and China, respectively (in logarithm form and first differenced) where the subscript i refers to the summed number of lags in the monthly import volume (from the current month's import volume, t), γ_0 and the γ_{1i} and γ_{2i} are parameters to be estimated and ε is the error term. The lag length is determined based on a selection procedure using the Akaike information criteria (AIC).

In earlier specifications, equation (1) was regressed including other variables of economic interest, which were suspected of affecting Vietnam's Norwegian salmon imports, such as real GDP, the exchange rate, and a price ratio of salmon from competing source countries. These variables were not significant in those regressions and were excluded.

To account for the role of the sanction, a dummy variable, SANCTION, is created for the period of sanction, where the variable takes on a value of one for the months when border measures were strengthened, partial bans imposed, and certification procedures required. The dummy variable tests for a structural break which can cause differences in the intercept or the slope or both (Gujarati, 2003). An interaction term between the dummy variable and the lags of the dependent variable and between the dummy variable and the lags of the independent variable is specified. This modifies equation (1) as follows:

$$\begin{aligned}(2)\ \Delta \ln VNQM_t = {} & \delta_0 + \Sigma\, \delta_{1i}\, \Delta \ln VNQM_{t-i} + \Sigma\, \delta_{2i}\, \Delta \ln CHQM_{t-i} + \delta_3\, SANCTION \\ & + \Sigma\, \delta_{4i}\, \Delta \ln VNQM_{t-i} \cdot SANCTION + \Sigma\, \delta_{5i}\, \Delta \ln CHQM_{t-i} \cdot SANCTION \\ & + \varepsilon_t.\end{aligned}$$

Once equation (2) is estimated, a test is conducted for the joint significance of the interaction terms and the dummy variable itself. The null hypothesis is that $\delta_3 = \delta_{4i} = \delta_{5i} = 0$ for all i, implying there is no structural break. A Wald test is performed to test for the structural break under the assumption that the month of the break is unknown. The test helps to determine whether and when there is a structural break occurring in the data (Stata, 2019). A single break divides the sample into two periods. Traditionally, a Chow test is used to test for a structural break, which compares the residual sum of squares of the sub-period regressions and the whole-period regression. One of the assumptions of the Chow test is that the error terms in the two periods are homoscedastic, restricting the test's performance (Gujarati, 2003). The Wald test, by contrast, is robust to unknown forms of heteroscedasticity (Stata, 2019). The null hypothesis is that there is no structural break in the data.

If it is determined that a structural break exists, equation (1) is re-regressed for the two sub-periods, July 1997 – February 2011 and March 2011 – December 2018. Granger causality is a probabilistic means of establishing causality, using empirical data to find patterns of correlation. Rather than estimating a cause-and-effect relationship, where Vietnam's (China's) previous imports cause Vietnam's current import volume, Granger causality allows the researcher to determine whether a particular variable precedes another in the time series. Granger's method for detecting causality between two variables expresses a stationary time series dependent variable (Vietnam's current import volume) as a function of its own lagged volume (Vietnam's previous months import volume) and of a lagged independent variable

(China's lagged imported volume). That is, the previous months import volume precedes the level of the current month's import volume. Granger causality establishes whether Vietnam's monthly salmon imports are linked to previous months import into Vietnam and into China. In the first period, prior to the sanctions, Vietnam's imports would be expected to be determined by its previous monthly imports and China's previous months' import would have no effect. In the sanction period, Vietnam's current import volume would be affected by China's previous months' imports if salmon had been smuggled.

Granger causality is a "bottom up" procedure, where the assumption is that the data-generating processes in a time series are independent variables. The data sets are analyzed to see if the variables are correlated. If the variables are not independent, then they are analyzed to see whether they are generated independently from each other. The null hypothesis to be tested is that Vietnam's current import volume of Norwegian salmon is not determined by Vietnam's previous months' import volume, nor by the previous months' import volume of Norwegian salmon into China.

Results and Discussion

First, the volume data are converted into natural logarithm form and are checked for stationarity using an augmented Dickey-Fuller test, where the original series are found to be non-stationary. First differences of the data are taken and the test repeated. The first differenced series are stationary at the 1% significance level.

Second, it is necessary to choose the optimum number of lags for Vietnam's import volume. Given this choice, the number of lags for China is set. The AIC, which works fine with quarterly data (Greene, 2003), compares alternative regressions of equation (1) using different numbers of lags. The final model is specified with five lags for both variables. No account is taken for the sanction in this initial regression.

Diagnostic tests for serial correlation and heteroscedasticity are undertaken. The Breusch-Godfrey LM test provides no evidence of serial correlation of the residuals, i.e., the residuals are not serially correlated at the 5% level. For heteroscedasticity, White's test and the Breusch-Pagan test are conducted. Because the p-value from the White's test is higher than 0.01 but lower than 0.05, the Breusch-Pagan test was undertaken. The p-value of that test is smaller than 0.01, allowing a rejection of the null hypothesis of constant variance (i.e., heteroscedasticity is present). The problem with heteroscedasticity is fixed by using robust standard errors, which can change the standard errors, but leaves the coefficients unaffected. Table 1 reports on the results of the regression of Vietnam's current salmon imports on five of its own lags and the five months of lags in China's salmon imports from Norway (with robust standard errors).

[Table 1 about here]

The R^2 estimate indicates that the model explains only about 16% of the variation in Vietnam's salmon imports from Norway. All the coefficients have negative signs. A negative coefficient on the lag on the volume of monthly imports suggests that higher import volumes in previous months into Vietnam or China should result in less import volume into Vietnam in the current month. For the lagged import volumes into Vietnam, only the coefficient on the lag of the first month is statistically significant and is so at the 1% level. For the lagged

import volumes into China, fours of the coefficients are statistically significant. In principle, China's import volume should not have any relation to Vietnam's salmon imports from Norway because the markets are separate (i.e., no official records of re-export or transshipment of Norwegian salmon). This provides some statistical evidence that there is a relationship between the two markets and could help explain how smuggling could be a means by which the markets are integrated.

Because China never officially declared its sanction on Norwegian salmon, there is no exact starting month of the sanction. Looking at the data on Vietnam's imports of Norwegian salmon, the volume suddenly increases by three times in March 2011. A similar effect on China's imports happened earlier in January 2011. Given that the dependent variable is Vietnam's monthly imports, March 2011 is a better indicator of the start of the structural break in the data.

In estimating equation (2) the inclusion of the dummy variable for the sanction period, SANCTION, and the interaction of the sanction with the lagged monthly import volumes allows a statistical test of whether there is a structural break occurring in March 2011. A Wald test was performed to test for an unknown structural break under the null hypothesis of no structural break. The joint significance of the dummy variable and the interaction terms serves as the evidence of the structural break. The test is a check on whether the data reject a null hypothesis of no structural break. The data support a structural break when a time series abruptly changes (Stata, 2109) and its statistical significance level is 1%. The Wald test detects the month of the break as April 2011. The estimation results for the choice of either March or April is inconsequential. The F-test yields a p-value of 0.000 which is lower than 0.01. Thus, the null hypothesis of no joint significance, or that the coefficients of the dummy and interaction terms are all equal to zero, can be rejected at the 1% level, implying a break.

In table 2, the results of the regression of equation (2) are reported, including the sanction dummy. The R^2 value indicates that the model explains 33% of the variation in Vietnam's imports. As with the regression of equation (1), the coefficients of all the lagged monthly import are negative. Thus, Vietnam's current import volume are negatively affected by both increasing volumes in lagged monthly imports into Vietnam and China.

[Table 2 about here]

There is no change in the intercept. The dummy variable, SANCTION, is not statistically significant at the 10% level. However, some of the interaction coefficients, between lagged monthly import volumes and the sanction period, by contrast, are statistically significant and positive.

For the purposes of performing Granger causality before and after the break, the study period is divided into the two sub-periods identified, from July 1997 until February 2011 (prior to the sanction) and from March 2011 until December 2018 (application of the sanction). The results of the Granger causality are reported in table 3. The null hypothesis to be tested is as follows: that Vietnam's current import volume of Norwegian salmon is not determined by Vietnam's previous months' import, nor by previous months' import volume of Norwegian salmon into China.

[Table 3 about here]

The R^2 values yielded by the regressions before and after the sanction explain 39% and 21% of the variation in quantity imported into Vietnam, respectively. The coefficients are different in the two periods. Unidirectional causality existed between Vietnam's current import volume and imports into China in previous months, but bidirectionality was not exhibited as there was no significant causality of China's import volume being driven by Vietnam's lagged monthly import volume. Unidirectional causality is an expected result as it is the sanction in China that drives imports into Vietnam. In the pre-sanction period, Vietnam's own previous months' imports negatively affected its current imports. Larger volumes imported in the five previous months reduced imports in the current period, the strongest effect being in the first lagged month, but all lagged coefficients are statistically significant. Vietnam's import volume was unaffected by imports into China, the expected result.

By contrast, during the sanction period Vietnam's current import volume was unaffected by its own previous months' import volumes. However, Vietnam's current import volume was affected by the previous months' imports into China for four of the five lagged months. (Only the second lagged month was not statistically significant.) This clearly shows that China's import situation is an important driver of Vietnam's import decision during the sanction period. The negative sign suggests that an increase in China's previous month's imports reduces Vietnam's current imports. This supports the hypothesis that smuggling occurred. When lagged import volumes of Norwegian salmon into China decrease, imports into Vietnam increase, and Norwegian salmon is smuggled into China. When lagged import volumes into China increase, current imports volumes into Vietnam decrease because the need to smuggle salmon decreases. This implies that the sanctions integrate the two markets, i.e., a scarcity of Norwegian salmon on China's market drives Vietnam's import volume and the scarcity met through smuggled salmon.

Table 4 shows the results of the F-test for Granger causality in the two sub-periods. For the pre-sanction period, the p-value is greater than 0.1, implying the null hypothesis of no joint significance (i.e., no Granger causality) cannot be rejected at the 10% level of significance. Thus, prior to the sanction, a change in China's import volume of Norwegian salmon did not "Granger-cause" a change in Vietnam's import volume of Norwegian salmon, as expected. However, for the regression of the sanction period, the F-test yielded a different result with a p-value lower than 0.01. Therefore, in the sanction sub-period, the change in Norwegian salmon imports into China did "Granger-cause" the change in Vietnam's current import of Norwegian salmon. The null hypothesis of no Granger causality is rejected at the 1% level of significance.

[Table 4 about here]

The regressions and tests performed offer compelling evidence that Vietnam's sudden increase in imports of Norwegian salmon is related to the sanction period, and that smuggling is reflected in the inverse relation that exists between Vietnam's current imports and China's previous months' import volume. Press accounts confirm that smuggling of salmon has occurred. Smugglers procure salmon at source, Norway, have it flown to Vietnam where a logistics company is used to transport the salmon to the border. Smugglers move the salmon across the border, and transports it onwards to Guangzhou, Shanghai, Shenzhen, Beijing and other cities for sale (*Undercurrent News*, 2018). Contraband also arrives at Chinese ports on vessels marked as domestic rather than international transport vessels (*Seafood Source*, 2018b). Other activities involve the import of salmon through formal channels but with under-reporting of the value of consignments (*Financial Times*, 2018) or the mislabeling of

salmon as mackerel or other lower-end species to pay lower customs duties or entering duty free for processors to re-export (*Seafood Source*, 2015a; 2019b).

Several factors motivated the AQSIQ's increased surveillance at various customs stations along China's border. China responded to its general economic slowdown with fiscal stimulus, which brought attention to the need to collect more tax revenue. Cracking down on smuggling fit into that objective. Legitimate taxpaying importers, distributors and retailers, concerned with unfair competition by informal actors and organized criminal smuggling operations alike, applied pressure on the government to crack down on tax avoidance (*Seafood Source*, 2019a). However, border controls were also specific to the illegal seafood trade related to food safety, a serious concern for the industry. Several incidents of smuggling and high-profile arrests (*Financial Times*, 2018; *Salmon Business*, 2018) created a narrative for the government's seriousness in addressing food safety. This complemented the ASQIQ's objective to formalize the trade and distribution channel for seafood marketing and to address corruption of customs and other officials (*Seafood Source*, 2016).

During the sanction period, fob monthly prices of fresh/chilled salmon at Norwegian ports intended for Chinese and Vietnamese markets moved in lockstep within a 5% range about 75% of the time. Thus, the cost of imported salmon, inclusive of tariffs, which are applied at the bound rate of 10% in both countries (WTO, 2019), is about the same. Cracking down on smuggling when demand was strong demand, while maintaining the sanction, led to rising wholesale prices of Norwegian salmon 50% higher year-on-year at the start of 2018, creating incentives for smugglers to profit from wholesale-border price differentials (*Undercurrent News*, 2018; *Seafood Source*, 2018a). Import volumes are driven by the effect of the sanction. There are no seasonality patterns in the data. Imports into Vietnam increase and decrease regardless of whether it is summer or winter. It could be that in summer fresh salmon is imported but then temporarily frozen in transit on the way to wholesale markets in China. This would lower the quality of fresh fish and/or could hurt consumers who pay for fresh fish but might be served salmon that has been frozen, if only for a few days.

Thus, the motivation for illegal transshipment must be based on the differential between the wholesale price in China and the cost of importing Norwegian salmon into Vietnam. Evidence that China's import volume influences Vietnam's import volume confirm that markets are becoming integrated through smuggling with domestic tax avoidance (value-added or sales taxes) and rent seeking reflected in the price differential between the wholesale market price in China and the border price in Vietnam. Further study of the market integration should seek to measure the extent to which price differences at the wholesale level in China and the landed price in Vietnam are interrelated.

Conclusions

The paper establishes two statistical relationships that conincide with China applying sanctions on Norwegian salmon after the NNC awarded the 2010 Peace Prize. First, there is a sudden increase in Vietnam's import volumes of Norwegian salmon. A structural break in the data is found to exist despite there being any significant change in import demand factors in Vietnam. Second, China and Vietnam's salmon markets appear become integrated through smuggling during the sanction period, March 2011 – December 2018. Econometric analysis and Granger causality tests of two sub-periods, the years prior to China's sanction and the

sanction period, give strong evidence that Vietnam is the source of smuggled salmon into China, corroborating newspaper reports of smuggling and arrests by China at the border.

More conclusive econometric evidence would look at the relationship between the wholesale prices of salmon in China and the relative border prices in China and Vietnam. With the signing of a protocol in 2019 between Norway and China and the removal of the partial ban on Norwegian salmon, the curious pattern of trade should be eliminated as the incentive for smuggling disappears. The NSC has already indicated that it expects Norwegian salmon exports to China to increase and assume a dominant share of the Chinese market.

The removal of the sanction should be a positive development for Chinese consumers and society overall as the marketing of salmon will flow along “regular channels”, helping to ensure quality and food safety, proper pricing and labeling, and reducing corruption, tax avoidance, rent-seeking behavior and illegal transshipments. It should also serve as notice to China’s executors of its foreign policy statecraft that a unilateral, undeclared sanction can be a costly signal of international relations because it is more easily busted by private agents who might be the cause of unintended societal costs.

References

Andriamananjara, S., H. Arce, and M.J. Ferrantino, 2004. *Transshipment in the United States*. http://doi.org/10.2139/ssrn.539682

BBC (British Broadcasting Corporation), 2017. "China's Propaganda War over Dying Nobel Prize Winner Liu Xiaobo", S. McDonell, 11 Jul 2017, accessed Jun 2019. https://www.bbc.com/news/blogs-china-blog-40552818

BBC, 2010. "China's Nobel Anger as Liu Xiaobo Awarded Peace Prize" 8 Oct 2010, accessed Jun 2019. https://www.bbc.com/news/world-asia-pacific-11505164

Bruns, B. and J. Miggelbrink, 2012. *Subverting Borders: Doing Research on Smuggling and Small-Scale Trade*. Wiesbaden: VS Research.

Chen, X. and R.J. Garcia (2016). "Economic sanctions and trade diplomacy: Sanction-busting strategies, market distortion and efficacy of China's Restrictions on Norwegian Salmon Imports", *China Information*, 30(1)29-57. DOI: 10.1177/0920203X15625061

Early, B.R. 2009. "Sleeping with Your Friends' Enemies: An Explanation of Sanctions-Busting Trade", *International Studies Quarterly*, 53(1):49-71.

Financial Times, 2013. "Norway Sees Liu Xiaobo's Nobel Prize Hurt Salmon Exports to China", R. Milne, 15 Aug, accessed Aug 2019. https://www.ft.com/content/ab456776-05b0-11e3-8ed5-00144feab7de

Financial Times, 2018. "China-Focused Salmon-Smuggling 'Syndicate' Spawns Raids", Kynge, J., 12 Apr 2018, accessed Jun 2019. https://www.ft.com/content/ee94b4fe-3df6-11e8-b9f9-de94fa33a81e

Fuchs, A. and N-H Klann, 2013. "Paying a Visit: The Dalai Lama Effect on International Trade," *Journal of International Economics*, 91(2013):164-77.

Greene, W., 2003. *Econometric Analysis*. Upper Saddle River, N.J.: Prentice Hall.

Gujarati, D.N., 2003. *Basic Econometrics*. New York: McGraw-Hill.

The Independent, 2011. "Norway's salmon rot as China takes revenge for dissident's Nobel Prize", M. Lewis, 6 Oct, accessed Aug 2019. https://www.independent.co.uk/news/world/europe/norways-salmon-rot-as-china-takes-revenge-for-dissidents-nobel-prize-2366167.html

Kolstad, I. (2016). "Too big to fault? Effects of the 2010 Noble Peace Prize on Norwegian exports to China and foreign policy", Christian Michelsen Institute, CMI working paper 2016:03.

MAF (Ministry of Foreign Affairs), 2016. "Full Normalization of Relations with China," Government of Norway, press release, 19 Dec 2016. Accessed Aug 2019 https://www.regjeringen.no/en/aktuelt/normalization_china/id2524797/

Miller, N.A., D.A. Kroodsma, J. Amos, T. Hochberg and A. Roan, 2018. “Identifying Global Patterns of Transshipment Behavior”, *Frontiers in Marine Science*, 5. htttp://doi.org/10.3389/fmars.2018.00240

MTIF (Ministry of Trade, Industry and Fisheries), 2019. “Protocol on Inspection, Quarantine and Sanitary Requirements for Atlantic Salmon Imported from the Kingdom of Norway into the People’s Republic of China,” Government of Norway, 20 May. Accessed Aug 2019 https://www.regjeringen.no/contentassets/00dab48a2b2e44709bd0bcd48f74f307/laksepr otokoll-norge-kina-20052019.pdf

News in English: Views and News from Norway, 2010. “Nobel Prize Can Carry High Price”, N. Berglund, 11 Oct. Accessed Aug 2019. https://www.newsinenglish.no/2010/10/11/nobel-prize-can-carry-high-price/

NFSA (Norwegian Food Safety Authority), 2016. *Annual Report 2015 – The Norwegian Food Safety Authority*. Oslo: NFSA, 22 Jun. https://www.mattilsynet.no/om_mattilsynet/annual_report_the_norwegian_food_safety_ authority_2015.22993/binary/Annual%20report%20The%20Norwegian%20Food%20Sa fety%20Authority%20(2015)

NFSA, 2017. *Annual Report 2016*. Oslo: NFSA, 3 Jul. https://www.mattilsynet.no/om_mattilsynet/annual_report_the_norwegian_food_safety_ authority_2016.26919/binary/Annual%20report%20The%20Norwegian%20Food%20Sa fety%20Authority%20(2016)

NNC (Norwegian Nobel Committee), 2010. “The Nobel Peace Prize for 2010”, press release, Oslo, 8 Oct 2010. Accessed Aug 2019. https://www.nobelprize.org/prizes/peace/2010/press-release/

NVI (Norwegian Veterinary Institute), 2016. *Fish Health Report 2015*. Oslo: Norwegian Veterinary Institute, report series no. 3, 4 Mar.

OIE (World Organisation for International Health), 2019, “OIE-Listed Diseases, Infections and Infestations in Force in 2019”. Accessed 2019 https://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2019/

Pedani, M.P., 2008. “Ottoman Merchants in the Adriatic: Trade and Smuggling”, Acta Histriae, 2(16):155-72.

Salmon Business, 2018. “Woman Arrested in Chinese Anti-Smuggling Operation Owned Company with SalMar”, 9 Apr., accessed Aug. 2019. https://salmonbusiness.com/woman-arrested-in-chinese-anti-smuggling-operation-owned-company-with-salmar/

Seafood Source, 2012. “Norwegian Salmon Exporters Feel China’s Wrath,” M. Godfrey, 29 May 2012, accessed Aug. 2019. https://www.seafoodsource.com/news/supply-trade/norwegian-salmon-exporters-feel-china-s-wrath

Seafood Source, 2015a. "New restrictions on Norway salmon entering China now under way", J. Wright, 24 Mar, accessed Jun 2019. https://www.seafoodsource.com/news/supply-trade/new-restrictions-on-norway-salmon-entering-china-now-under-way

Seafood Source, 2015b. "How Norway Set the Standard for Marketing Seafood in China", M. Godfrey, 24 Sep, accessed Aug. 2019. https://www.seafoodsource.com/features/how-norway-set-the-standard-for-marketing-seafood-in-china

Seafood Source, 2016. "China Customs Crackdown Hurting Hong Kong Seafood Distributors", M. Godfrey, 7 Oct., accessed Aug. 2019. https://www.seafoodsource.com/news/supply-trade/china-customs-crackdown-hurting-hong-kong-seafood-distributors

Seafood Source, 2018a. "December Raids in China Net 58 Seafood Smugglers", M. Godfrey, 4 Jan., accessed Aug. 2019. https://www.seafoodsource.com/news/supply-trade/december-raids-in-china-net-58-seafood-smugglers

Seafood Source, 2018b. "Salmon Smuggling Update: China Cracking Down on Triad Crime", M. Godfrey, 9 Apr., accessed Aug. 2019. https://www.seafoodsource.com/news/supply-trade/salmon-smuggling-update-china-cracking-down-on-triad-gangs

Seafood Source, 2019a, "China tackling tax evasion in seafood sector on many fronts", M. Godfrey, 11 Feb., accessed Jun. 2019. https://www.seafoodsource.com/news/supply-trade/china-tackling-tax-evasion-in-seafood-sector-on-many-fronts

Seafood Source, 2019b. "Salmon smuggling update: China cracking down on triad crime", M. Godfrey, 9 Apr 2018, accessed Jun 2019. https://www.seafoodsource.com/news/supply-trade/salmon-smuggling-update-china-cracking-down-on-triad-gangs

Stata, 2019. "Tests for Structural Breaks in Time-Series Data", accessed in Aug 2019. https://www.stata.com/stata14/structural-breaks/

Statistisk sentralbyrå (SSB, Statistics Norway), 2011. "Ingen Nobel-effekt foreløpig" [No Nobel Effect Yet]. Oslo: Statistics Norway publication, by I. Skivenes, 6 Sep., accessed Aug 2019. https://www.ssb.no/utenriksokonomi/artikler-og-publikasjoner/ingen-nobel-effekt-forelopig

SSB, 2012. "Mindre eksport til Kina, men mer laks" [Less export to China, but more salmon]. Oslo: Statistics Norway publication, I. Skivenes, 19 Nov., accessed Aug 2019. https://www.ssb.no/utenriksokonomi/artikler-og-publikasjoner/mindre-eksport-til-kina-men-mer-laks

Sverdrup-Thygeson, B., (2015). “The Flexible Cost of Insulting China: Trade Politics and the ‘Dalai Lama Effect’”, *Asian Perspective* 39(2015)101-23.

Undercurrent News, 2015. “China Warns of Partial Ban on Norwegian Salmon Imports”, E. Tallaksen, 19 Mar. Accessed Aug 2019. https://www.undercurrentnews.com/2015/03/19/china-warns-of-partial-ban-on-norwegian-salmon-imports/

Undercurrent News, 2018. “Norway Salmon’s ‘Big Three’ Deny Any China Smuggling Links as Prices Rise”, T. Seaman and L. Harkell, 6 Apr, accessed Aug 2019. https://www.undercurrentnews.com/2018/04/06/norway-salmons-big-three-deny-any-china-smuggling-links-as-prices-rise/

Undercurrent News, 2019. “China Lifts Salmon Sanctions on Leroy, SalMar, Nordlaks Plants”, 21 May. Accessed Aug 2019. https://www.undercurrentnews.com/2019/05/21/china-lifts-salmon-sanction-on-leroy-salmar-nordlaks-plants/

United Nations (UN), 2019. Comtrade online database, accessed Aug. 2019. https://comtrade.un.org/

WTO (World Trade Organization), 2011. “Quarantine and Testing Procedures Applied to Salmon Imported from Norway – Questions to China”, WTO document, Committee on Sanitary and Phytosanitary Measures, G/SPS/GEN/1090, dated 20 Jun.

WTO, 2013. “Specific Trade Concerns: Note by the Secretariat”, WTO document, Committee on Sanitary and Phytosanitary Measures, G/SPS/GEN/204/Rev.13, dated 26 Feb.

WTO, 2019. “Goods Schedules and Tariff Data”, WTO Secretariat, Member information for China and Vietnam, accessed Aug 2019, https://www.wto.org/english/thewto_e/countries_e/china_e.htm https://www.wto.org/english/thewto_e/countries_e/vietnam_e.htm

Table 1. Regression results of equation (1) with five lags

	Coefficient	Robust std. errors	t-statistic
lnVNQM			
Lag 1	-0.25926	0.07896	-3.28***
Lag 2	-0.03512	0.07280	-0.48
Lag 3	-0.05105	0.06616	-0.77
Lag 4	-0.05089	0.07639	-0.67
Lag 5	-0.01297	0.06827	-0.19
lnCHQM			
Lag 1	-0.21564	0.09783	-2.20**
Lag 2	-0.13631	0.09914	-1.37
Lag 3	-0.18445	0.09610	-1.92*
Lag 4	-0.19981	0.06750	-2.96***
Lag 5	-0.28336	0.09312	-3.04***
Constant	0.03469	0.02104	1.65
Observations	252		
F(10, 241)	3.8100		
R-squared	0.1569		
Root MSE	0.3278		

Note: ***, **, * denote statistical significance at the 1%, 5% and 10%, respectively.

Table 2. Regression inclusive of the sanction dummy and its interaction terms

	Coefficient	Robust std. errors	t-statistic
lnVNQM			
Lag 1	-0.66696	0.08841	-7.54***
Lag 2	-0.29932	0.10323	-2.90***
Lag 3	-0.29255	0.10322	-2.83***
Lag 4	-0.29689	0.10017	-2.96***
Lag 5	-0.12234	0.08491	-1.44
lnCHQM			
Lag 1	-0.24091	0.10323	-2.33**
Lag 2	-0.24223	0.10609	-2.28**
Lag 3	-0.87814	0.11263	-0.78
Lag 4	-0.07208	0.10943	-0.66
Lag 5	-0.32730	0.11006	-2.97***
SANCTION	-0.05893	0.04081	-1.44
lnVNQM_SANCTION			
Lag 1	0.82807	0.12796	6.47***
Lag 2	0.13952	0.14022	1.00
Lag 3	0.36096	0.13939	2.59***
Lag 4	0.23927	0.13535	1.77*
Lag 5	0.11472	0.12367	0.93
lnCHQM_SANCTION			
Lag 1	0.09646	0.13314	0.72
Lag 2	0.27497	0.13196	2.08**
Lag 3	-0.05929	0.13781	-0.43
Lag 4	-0.09468	0.13644	-0.69
Lag 5	0.18893	0.13572	1.39
Constant	0.06631	0.02511	2.64
Observations	252		
F(21, 230)	5.3800		
Prob > F	0.0000		
R-squared	0.3296		
Root MSE	0.2993		

Note: ***, **, * denote statistical significance at the 1%, 5% and 10%, respectively.

Table 3. Results of the Granger causality regression

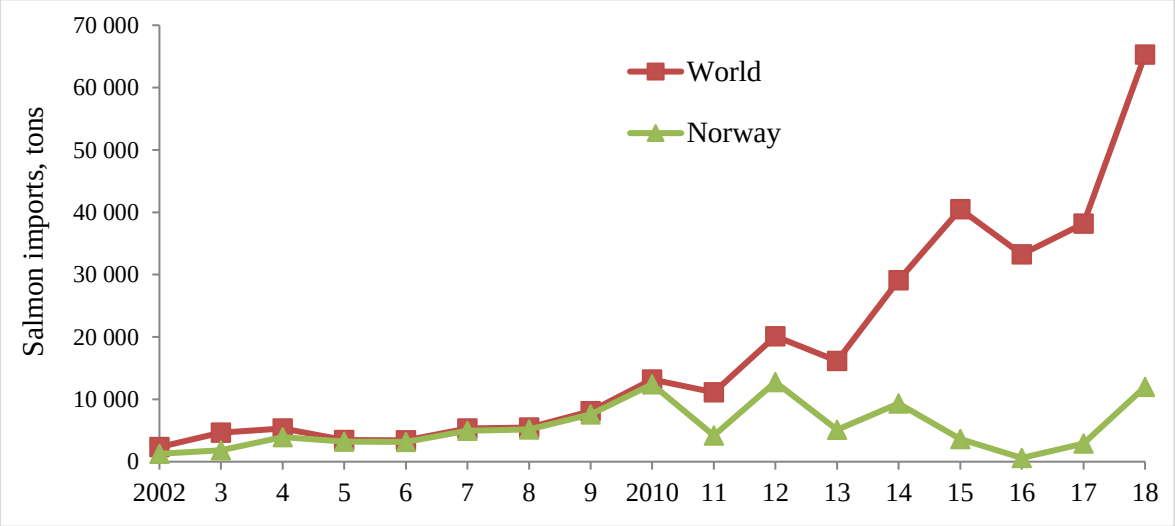
	Sub-period: Jul 1997 – Feb 2011			Sub-period: Mar 2011 – Dec 2018		
	Coeff.	Robust sdt error	t-stat	Coeff.	Robust sdt error	t-stat
lnVNQM						
Lag 1	-0.6513	0.0920	-7.08***	0.1222	0.1047	1.17
Lag 2	-0.2935	0.1223	-2.40***	-0.1720	0.1061	-1.62
Lag 3	-0.2937	0.1215	-2.42***	0.0960	0.1041	0.92
Lag 4	-0.2969	0.1076	-2.76***	-0.0636	0.1061	-0.60
Lag 5	-0.1396	0.0853	-1.64*	0.0121	0.1042	0.12
lnCHQM						
Lag 1	-0.0712	0.1289	-0.55	-0.2499	0.0938	-2.66***
Lag 2	0.0831	0.1393	0.60	-0.1260	0.0876	-1.44
Lag 3	0.2048	0.1463	1.40	-0.2134	0.0885	-2.41**
Lag 4	0.1288	0.1207	1.07	0.1743	0.0909	-1.92**
Lag 5	-0.2295	0.1255	-1.83	-0.2014	0.0913	-2.20**
Constant	0.0546	0.0232	2.36***	0.0247	0.0365	0.68
Observations		158		Observations	94	
F(10, 147)		9.310		F(10,83)	2.160	
Prob > F		0.000		Prob > F	0.028	
R-squared		0.389		R-squared	0.207	
Root MSE		0.271		Adjusted R	0.111	
				Root MSE	0.352	

Note: ***, **, * denote statistical significance at the 1%, 5% and 10%, respectively.

Table 4. Results of the test for Granger causality in the two sub-periods

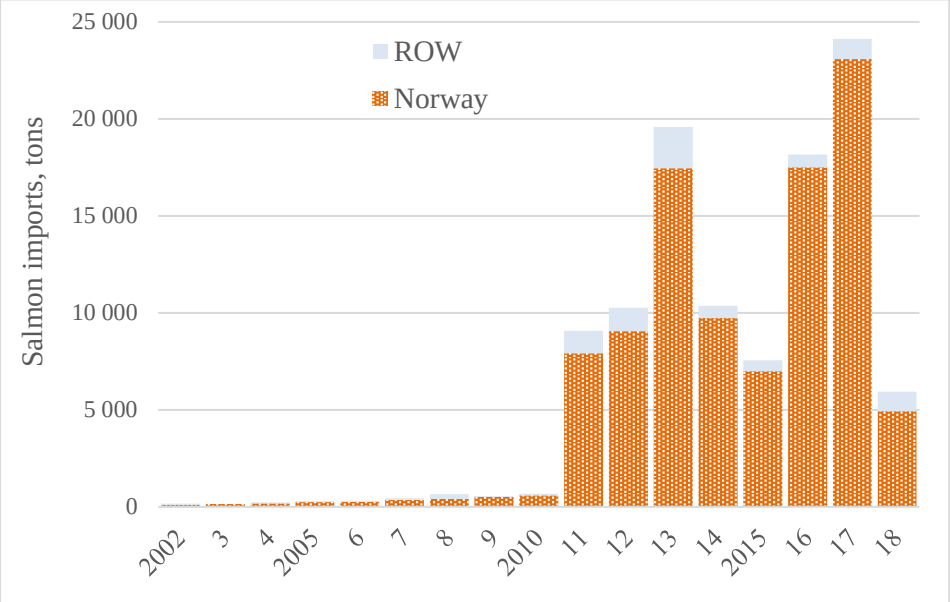
Sub-periods from July 1997 – February 2011	Sub-period from March 2011 – December 2018
Lag 1 lnCHQM = 0	Lag 1 lnCHQM = 0
Lag 2 lnCHQM = 0	Lag 2 lnCHQM = 0
Lag 3 lnCHQM = 0	Lag 3 lnCHQM = 0
Lag 4 lnCHQM = 0	Lag 4 lnCHQM = 0
Lag 5 lnCHQM = 0	Lag 5 lnCHQM = 0
F(5,147) = 1.4700	F(5,83) = 3.3900
Prob > F = 0.2014	Prob > F = 0.0078

Figure 1. Annual imports of whole, fresh/chilled Atlantic and Pacific salmon into China



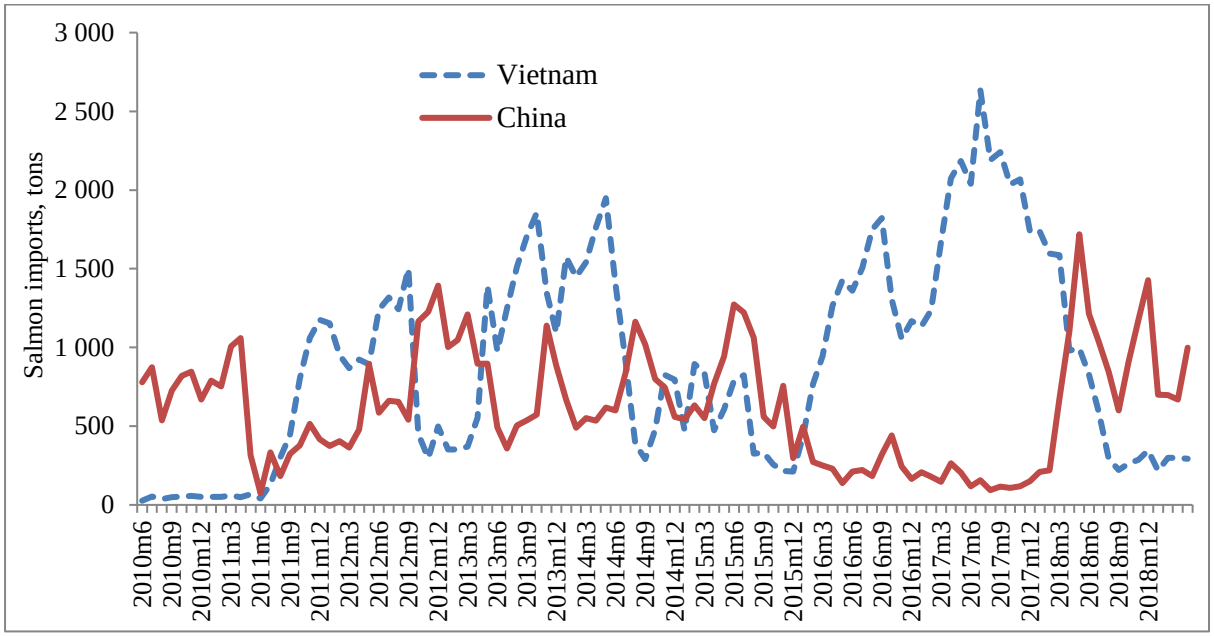
Source: UN Comtrade data.

Figure 2. Annual imports of whole, fresh/chilled salmon into Vietnam



Source: UN Comtrade data.

Figure 3. Monthly imports of whole, fresh/chilled Norwegian salmon into Vietnam and China



Source: Norwegian Seafood Council and UN Comtrade data.