Welfare Effects of Trade Associations:
The Case of the Chilean Salmon Export Industry*

Thomas Eisenberg†
University of Delaware

Manuel Estay‡
University of Concepción

Debi Prasad Mohapatra§
University of Massachusetts

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Abstract

This paper examines the welfare consequences of a trade association in an exporting country on consumers in destination countries. We estimate a structural model of the Chilean Salmon exporting industry that endogenizes firms' pricing and export decisions. Our results show that the trade association has a strong positive effect on consumer utility and requires higher marginal costs of production, which is consistent with mechanisms of higher quality products and lower trade frictions. We also document robust evidence of collusive activity among trade association members. Our counterfactual analysis reveals that eliminating the trade association would still significantly *decrease* consumer welfare in destination countries.

Key Words: Trade Association, Chilean Fish Industry, Collusion, Consumer Welfare, Endogenous entry

JEL classification: D22, L13, L44, L66, Q22

1 Introduction

Trade associations are a significant way for industries and governments to coordinate the performance of a group of firms. In particular, in the context of exporting firms, this is usually done to enforce product quality standards, share information, minimize supply-chain friction, and coordinate business practices between firms. These improvements may benefit the consumers in the export destination countries. However, the existence of a trade association may also raise concerns for consumer welfare. Specifically, the member firms may get involved in collusive activity, which could harm both consumers and non-member firms (Levenstein and Suslow (2006)). Additionally, firms not in the trade association may also stand to lose by not having access to information or

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†Department of Economics, University of Delaware, USA. Email: tome@udel.edu.

‡Department of Economics, University of Concepción, Interdisciplinary Center for Aquaculture Research (INCAR), Concepción, EfD-Chile, Concepción, Chile, Email: mestay@udec.cl.

§Department of Resource Economics, University of Massachusetts Amherst, USA. Email: dmohapatra@umass.edu.

practices necessary to ensure quality and hence face increased barriers to export to a destination country. They also lose by not participating in the collusive agreement. Thus, the overall welfare effect of the association's existence is an open question that requires empirical investigation.

Using detailed data on prices, sales, association membership, and product variety, this paper provides the first welfare analysis of trade associations by measuring the costs and benefits of an association's existence. We conduct this exercise in the context of the Chilean salmon farming and export industry, which depends on a trade association named *SalmonChile* (*SC*).[1] This consortium, which comprises a large share of total salmon and trout sales in Chile (generally at least 60%, often significantly more), provides an excellent example for examining the welfare effects of trade associations for several reasons. First, *SC* does not contain all of Chile's fish industry firms, which provides cross-sectional variation in membership status. Second, we observe firms joining and leaving the consortium during our sample period providing intertemporal variation in the association's structure. Third, the exporting firms within and outside the consortium sell differentiated products across multiple destinations. This allows us to employ well-developed techniques from demand estimation literature to infer the consumer preferences and elasticities of demand.

We use our estimates and a structural model of the firm's pricing and export decisions to answer the following research questions: Does a trade association's existence positively affect consumers' valuations of fish products? Do firms within *SalmonChile* get involved in the collusive activity? How does a trade association in the exporting country affect the consumer welfare in the destination countries? While the welfare consequences of the trade association are significant in the Chilean context, where the economy relies heavily on exports, these associations are common in international trade, especially in developing countries.[2] They are often strategically supported by governments in developing countries to boost target industries. Thus, studying the case of *SC* can have general implications. It can guide policymakers to determine whether a trade association's formation (or continued existence) benefits the consumers in destination countries.

Our analysis starts with descriptive and reduced-form evidence showing that firms within the consortium tend to charge higher prices controlling for a wide range of fixed effects. This is robust

[1] This paper uses trade association, union, and consortium interchangeably, which refers to *SalmonChile*.

[2] For example, there are other associations in Chile such as "Asoex", the Fruit Exporters Association, or "Asexma", the Chilean Exporters Association, among others https://www.export.gov/apex/article2?id=Chile-Principle-Business-Associations.

to multiple methods that control for possible selection into the consortium. However, any precise causal effect can only be identified with more assumptions, as within-market competition induces cross-firm spillovers. Additionally, without a structural model, we cannot distinguish the effects of product differentiation, collusion, marginal cost differences, and firms' endogenous export decisions on consumer welfare. While the theoretical literature on trade associations, such as Vives (1990) and Raith (1996), find that the welfare implications are highly ambiguous and dependent on the specifics of a market's competition and information structures, the empirical literature, such as Roberts, Xu, Fan, and Zhang (2018), and Piveteau (2021) emphasizes on the role of demand and firm-specific factors as key determinants of welfare effects.

To capture these economic factors, we develop a tractable two-stage structural model that estimates firms' destination-specific fixed costs of planning a shipment conditional on consortium membership, the marginal cost of production, and the consumer preferences for different product attributes while allowing firms to get involved in the collusive activity. We follow Berry, Levinsohn, and Pakes (1995) and Nevo (2001) and estimate consumer preferences using a discrete-choice random coefficient demand model. We use the assumptions in Roberts, Xu, Fan, and Zhang (2018) to apply this type of model to an export market context.

In our demand specification, consumer preferences differ based on whether a product is sold by a firm affiliated with the trade union. A positive utility gain for firms with SC membership is consistent with product quality improvements and lower trade frictions in a destination country due to the trade association. We model the supply decisions of the firms as a static two-stage game of complete information.

In the first stage, firms decide whether to join the trade association and simultaneously choose the subset of destination countries where they would plan for shipment. Firms commit to these decisions and simultaneously choose prices for all products supplied to the destination countries in the second stage. Consumers make their decisions at the end of the second stage. We allow for the possibility that firms inside the consortium may partially or fully internalize their pricing externalities on other consortium members and hence test for collusion by introducing a conduct parameter following Miller and Weinberg (2017) and Michel and Weiergraeber (2018). To learn the destination-specific fixed costs associated with planning a shipment, we use a revealed preference argument commonly used in empirical entry literature (Pakes, Porter, Ho, and Ishii (2015), Eizenberg (2014), Fan and Yang (2020), Mohapatra and Chatterjee (2021)). Specifically, we exploit the assumption that a firm chooses to join the consortium and plan a shipment to a destination country only if the variable profit from these actions exceeds the corresponding fixed cost that the firm needs to incur.

Our results suggest that, on average, consumers derive positive utility gains from products exported by firms affiliated with the trade association compared to other products. This is consistent with the hypothesis that firms affiliated with a trade association may supply higher quality fish and provide better ease of business or product availability while exporting the products. Affiliation with the consortium also leads to higher marginal production costs, consistent with more expensive farming and handling processes. Our test of collusion conclusively rejects the hypothesis of Nash-Bertrand competition among the consortium members. In other words, our results support the case of collusion among firms inside the trade association. They suggest that the firms within the consortium internalize roughly 43% of their price effects on the other firm's profits.

To evaluate the welfare consequences of a trade association, we use our estimated model to simulate a counterfactual world where we remove the trade consortium in Chile. We take the utility, marginal cost, and fixed cost parameters as given and solve for the equilibrium set of firms that would plan a shipment to each destination country in a given time and the equilibrium prices that the firms would charge. We compute the consumer and producer surplus with no consortium and compare it with the welfare numbers from the status quo world. Our results from aggregate welfare computations show that the presence of the trade association *SalmonChile* leads to a significant consumer welfare gain. In particular, the elimination of the trade association would lead to 1.7 billion USD, equivalent to a 7% drop in the total consumer welfare compared to the status quo, and hence would lead to a Pareto-inefficient outcome. It is important to emphasize that a trade association is a voluntary organization of firms in a market. Compared to other regulations, infrastructure investment, and large-scale research and development projects that can contribute towards welfare improvements, creating a trade association may require relatively low overhead costs. Therefore, in this context, we consider the trade association's welfare contribution to be of significant value.

We then investigate the relative importance of different channels in the overall welfare effects. First, we remove the parameters that increase consumer utility, but we fix prices and the set of products supplied to different destinations. Our results suggest that a drop in quality due to the consortium's elimination exclusively leads to a significant (0.8 billion USD) drop in consumer welfare. Allowing firms to re-equilibrate their prices without changing the set of suppliers and product mix improves consumer welfare by 0.5 billion USD. Note that consortium membership also increases the marginal cost of production. A counterfactual world with no consortium eliminates the collusive activity among firms and implies a lower marginal cost leading to an increase in consumer welfare. Our results suggest that the loss in consumer welfare due to the quality effects dominates the benefits due to the elimination of collusion. Finally, allowing firms to re-equilibrate their entry decisions with the new price equilibrium leads to a significant drop in consumer welfare by 1.4 billion USD.

In our second counterfactual analysis, we investigate whether a regulation to make the trade association mandatory would benefit consumers. Our results show that the consumer surplus remains roughly unaffected in the counterfactual world, as the effects of increased firms participating in collusion and more products being offered at higher quality roughly balance out. However, due to collusive activity, the producer surplus increases significantly as firms earn higher equilibrium profits in the counterfactual world. Our analysis highlights the trade association's efficiency-enhancing role in facilitating Chile's export industry.

In our third counterfactual analysis, we explore how welfare is affected if we alter the level of collusive conduct among trade association members. To implement this, we change the conduct parameter and simulate the firm-entry and pricing equilibrium for each candidate parameter value. Our results suggest that the presence of a consortium derives higher consumer welfare even with moderate levels of collusion, though it eventually is a net negative for consumers before firms act as a monopoly. This shows that *SalmonChile* represents merely one set of parameter values for collusion, costs, and utilities, that could lead to this outcome. Overall, we show that trade associations can mutually benefit consumers in importing countries and member firms in the exporting country, leading to overall welfare gains.

1.1 Related Literature

Our paper contributes to several strands of literature. It is related to a small but growing literature that provides empirical evidence of collusive behavior and the welfare implications of trade associations. Several theoretical studies highlight the information-sharing role of trade associations (Vives (1990), Kirby (1988), Raith (1996) among others) and their role as lobbyists (Grossman and Helpman (1994), Goldberg and Maggi (1999), Bombardini (2008) and Bombardini and Trebbi (2012) among others). For example, Vives (1990) considers trade associations from an information-sharing perspective and finds that a firm will have incentives to join only if the shared information is exclusive to the association members. However, he identified the welfare implications to be dependent on the nature of the competition among firms. Kirby (1988) examines a particular case of an oligopoly with linear demand and finds that for certain cost functions, trade associations are Pareto-improving and that consumer surplus increases with information sharing. Raith (1996) extends this framework to many different forms of competition and finds that equilibria with information sharing are extremely sensitive to competitive assumptions and the exact information structure of a market.

Empirical studies of trade associations include Ale-Chilet and Atal (2020), which provides a prominent recent case study on the collusive behavior of a trade association comprised of physicians in Chile. Their study provides a detailed empirical characterization of a trade association's collusive strategies while dealing with heterogeneous agents. We contribute to this literature by providing the first evidence of welfare implications due to the trade association in the context of an exporting industry while considering the possibility of collusion among exporting firms.

Trade associations have been of interest to antitrust authorities for possible collusion for many years. Oliphant (1926), for example, discusses the National Association of Hat Manufacturers and the National Wholesale Lumber Dealers' Association in the United States. Carnevali (2011) illustrates that in the 19th century, trade associations were formed that facilitated not only cooperation between economic agents but also boosted industries' political and social standing. Levenstein and Suslow (2006) have documented that collusion among a large number of agents is often due to the involvement of a trade association. Levenstein and Suslow (2011) show that while such cartels attract more antitrust scrutiny, they also tend to be more stable. Symeonidis (2002) documents many examples of trade associations targeted by antitrust authorities in Britain in the 20th Century. McGahan (1995) studies a trade association that involved collusion beyond prices in the brewing market after Prohibition. While focused on a private cartel rather than a trade association, Roller and Steen (2006) provides a critical case study similar to our analysis, where Norwegian cement firms colluded in an export-driven market. Our paper builds on this literature by testing for collusion within the trade association and documenting its welfare implications.

By studying collusion among firms within a consortium, our paper relates to a large literature on collusion in differentiated-product markets. Starting from the pioneering work by Bresnahan (1987), who estimates demand and supply models to test Bertrand-Nash vs. collusive pricing in the US car industry in 1954-1956, this literature includes several studies such as Nevo (2001), Ciliberto and Williams (2014), Miller and Weinberg (2017), Michel and Weiergraeber (2018), Sullivan (2020), Backus, Conlon, and Sinkinson (2021), Alé-Chilet, Chen, Li, and Reynaert (2021), among others.[3] Our paper follows the methodology employed in Miller and Weinberg (2017) and Michel and Weiergraeber (2018) and uses a conduct parameter to test for collusion. Following Berry and Haile (2014) and Michel and Weiergraeber (2018), we construct instruments based on a product's location in the characteristic space to identify the collusive behavior econometrically. This paper is also related to the literature on endogenous firm entry by studying firms' decisions to choose among export destinations. Examples in this literature include Draganska, Mazzeo, and Seim (2009), Fan (2013), Seim (2006), Eizenberg (2014), and Fan and Yang (2022) among others.

Our analysis also relates to the literature in international trade that studies a consortium's role in facilitating trade. For example, using a structural model, Roberts, Xu, Fan, and Zhang (2018) explores the role of firm-level cost and demand heterogeneity in demand, pricing, and market participation in the context of the Chinese footwear export market. Similarly, Gervais (2015) and Hottman, Redding, and Weinstein (2016) explore the role of firm-specific demand factors in export markets using demand models with constant elasticity of substitution. We extend this literature by including a flexible model of product differentiation, collusion, pricing, and firm entry and explore the contribution of a trade association in enhancing efficiency.

The rest of the article is organized as follows: Section 2 provides a brief background of trade association *SalmonChile* in the context of the Chilean fish export industry and describes the data. Section 3 provides reduced form evidence documenting the effects of *SalmonChile*. Section 4 lays out the model. We explain our estimation procedure and present the estimation results in Section 5. The counterfactual simulation results are presented in Section 6. Section 7 concludes.

[3] See Asker and Nocke (2021) for an excellent survey of the literature.

2 Setting and Data

2.1 Trade Association *SalmonChile*

SalmonChile (denoted by *SC*) is a private consortium of fish producers and suppliers in Chile. It was created in 1986 for 17 fish farming firms, a few years after the Chilean Salmon industry began exporting salmon to international markets (Carrera, 2020). *SalmonChile* was part of the effort of the fish producers to maintain quality standards and promote product positioning of the Chilean salmon in the international markets. Around 80% of the total salmon production in Chile is produced by the members of *SalmonChile* (Carrera, 2020; Gallegos, Paulin, Steber, Wolfs, and Van Beukering, 2016). This has entitled the organization to be the leading representative of the fish exporting industry in Chile.

Affiliation with this association benefits the member firms in several ways. First, *SalmonChile* supports and provides defense for its members in the face of any allegations regarding their business practices. For example, in 2002, when the American and European salmon producers accused the Chilean producers of deceitful behavior (ONU, 2006), *SalmonChile* participated in public debates and provided protection for its members.[4] Second, *SalmonChile* plays an essential role in enforcing quality standards through self-regulation among its member firms. For example, it has been an active promoter in reducing the use of antibiotics to reduce the spread of antibiotic resistance (Bachmann-Vargas, van Koppen, and Lamers, 2021). Allegations of overuse of antibiotics have been an important issue that has affected the image of the Chilean Salmon Industry. *SalmonChile*, being a promoter of the "Chilean Salmon Antibiotic Reduction Program" ensures that antibiotic use by its member firms is regulated. *SalmonChile* has participated in several public-private roundtable events to bring together expertise from private and public sectors to implement quality regulations. It has also promoted the implementation of quality certification, "GLOBAL Good Agricultural Practices" among its members, which seeks to implement best practices related to health, safety, and environmental aspects of the fish production (Olson and Criddle, 2008; Vera Garnica, 2009; Little, Felzensztein, Gimmon, and Muñoz, 2015). Similarly, members of *SalmonChile* and companies from Norway and Scotland have created the "Global Salmon Initiative" to promote the industry's

[4] Similarly, during the spread of "Infectious Salmon Anemia" (ISA) among exporting firms in Chile between 2007 and 2009, the association provided collective solutions to prevent the infection spread.

sustainability through integration, cooperation, and transparency (Gallegos et al., 2016). Therefore, when trading with foreign intermediaries, an association member can credibly signal a higher quality than a non-member firm.

2.2 Data Description and Summary Statistics

We obtained our primary data from the Chilean Customs Service. It contains transaction-level information on the universe of salmonid shipments made from Chile between 2009 and 2017. For each shipment package, our data include the total quantity (in tons) and total sales (in USD) of the shipment, date of shipment, exporting firm, mode of transportation, and destination country. The product included in the shipment is identified under the shipped product's International Standard Industrial Classification (ISIC) code. A product is defined as a "fish type-cut type-preserve type" combination. Our sample classifies three fish types—Trout, Atlantic Salmon, and Pacific Salmon.[5] Fish is exported in three different cut types—whole fish, fillet fish, and headless eviscerated. The preserve type for different fish types can be either frozen or fresh. The dataset records each shipment's transportation mode, which can be via air, water, or land. Our dataset also contains detailed cost-side information, including shipping and insurance costs for each shipment.

Figure 1 shows the total exported salmon and trout products from Chile in our sample between 2009 and 2017. As the left panel of the figure shows, the total demand and the average price have grown over time and have significant seasonal variations. The relative importance of each salmon product has changed through the analysis period. Atlantic salmon has been the main cultivated species, followed by the pacific salmon and trout. The right panel of figure 1 shows the evolution of each product in the sample frame. While Atlantic salmon is the most popular product, all three major types of fish also register a significant market share. We also observe a significant variation across destinations over which products are most popular. The United States buys almost entirely Atlantic Salmon, while Japan buys large amounts of Pacific Salmon and Trout. Within each destination, the relative volumes change over time, for example, trout's share in Russia declined over time.

Figure 2 highlights the important role played by the *SalmonChile* consortium. In the left panel, we plot the aggregated total sales of sellers affiliated with *SalmonChile* and other Chilean

[5] We also observe a small share of products under the category "unclassified", which we drop in our analysis.

sellers. As the plot shows, consortium members export a majority of sales by volume in the top five markets every year. The share of sales by consortium members varies significantly over time from under 60% to over 90%. The right panel of figure 2 plots the total sales by consortium status within each destination country. We observe significant variations in terms of sales by consortium members and non-members across different destination countries. Japan and the US are the most important markets for both *SC* and non-*SC* firms. Additionally, *SalmonChile* tends to represent a substantial majority in each destination except for brief periods in Japan. Taken together, the initial evidence shows that many different product and destination combinations will be empirically and economically relevant for explaining the net effects of *SC*.

The left panel of figure 3 plots the number of firms exporting salmon products from Chile by the destination country, consortium status, and year. The right panel plots the average price per kilogram of *Salmonchile* members and other sellers over the sample period. The left panel demonstrates that *Salmonchile* member's sales dominance comes from larger firms, as the number of firms exporting by destination is much more equal between consortium members and non-members. The count of *Salmonchile* suppliers varies within each destination over time, and there is also some cross-sectional variation across destinations. Finally, in the right panel of figure 3, we can see that there are modest price differences at times between *Salmonchile* and non-*Salmonchile* members, though they tend to move together. In total sales, the consortium member prices tend to be modestly higher at most times. These price patterns tell us very little since there are significant volume, destination, and product variety differences by consortium status. Thus, to estimate the effects of the consortium, we conduct reduced-form and structural analyses that simultaneously account for these differences, which we discuss next.

3 Reduced form evidence

We employ a two-way fixed effects model as our first statistical approach to precisely investigate the effects of joining a trade association. This reduced-form model allows us to determine whether key relationships in the data exist independently of our structural model and helps motivate different modeling choices. The primary outcome of interest is the export price of the fish. Note that evidence of price increase in response to a firm's joining *Salmonchile* is consistent with the hypothesis that consortium members offer products with improved quality and/or firms get involved in the collusive activity.

We begin with the following empirical specification:

$$logp_{fjcty} = \beta_p logq_{fjcty} + \gamma_f + \alpha_t + \tau_c + \eta_j + \psi_y + \beta_{SC} SC_{ft} \qquad (1)$$

Observations are at the firm (f) destination (c) product (j) quarter (t) year(y) level. The variable of interest is β_{SC}, which measures the effect that *SalmonChile* membership has on a product's price. We include a range of fixed effects in the specification. We also control for quantity sold in some specifications to control for the differential sales by firms. In specifications with quantity, we estimate both via OLS and using shipping and insurance costs as instruments for quantity.

Table 1 provides the baseline estimates for this model. SC membership is significantly associated with an increase of at least .03 in a product's log price in all specifications, even controlling and instrumenting for quantity. Since prices are, on average higher, even holding quantity fixed, the evidence is consistent with firms being able to price more highly once they are consortium members.

While SC membership affects prices net of all major fixed effects, this regression cannot clearly distinguish whether firms already on a path to higher prices are merely selecting into SC or whether SC membership confers high prices. Checking whether there are parallel trends in firm prices before they join SC compared to non-joiners helps to assess which story is true.

To investigate this, we build an event study model. Event study graphs are easiest to interpret with an absorbing treatment, even though firms can leave and join *SalmonChile* in our data. The following event study equation applies to either, with "joining" or "leaving" being considered the treatment:

$$logp_{ft} = \beta_p logq_{ft} + \gamma_f + \alpha_t + \sum_{\tau \neq 1}^{T} \beta_{SC\tau} \{SC_{i(t+\tau)} = 1\} + \sum_{\tau}^{T} \xi_{SC\tau} \{SC_{i(t-\tau)} = 1\} \qquad (2)$$

As in a classic event study model, we include placebo terms for firms prior to their treatment period and dynamic treatment terms to investigate whether switching into SC has a persistent effect.

Figure 4 shows the graphical results for joining firms. The strongest price effects come roughly 3 quarters and a year after a firm joins SC, and there is little evidence of a pre-trend in their prices.

Many firms also leave SC during our sample, so this estimate represents only a portion of the total effect our two-way fixed effects model estimates.

While our graphs suggest a pre-trend is unlikely, we are interested in ruling out the story that firms who already undergo a series of successful quarters decide to parlay this success into joining SC. We thus follow the procedure in Abadie (2005) where the probability of joining SC based on several sets of variables is estimated, and then treatment effects are weighted by these estimated probabilities. Our results are robust to weighting using the quarter prior to joining's price, the two quarters prior to joining, and full baseline covariates (product type, fish type, destination, cut type). We also include pre-trends explicitly in our regressions as in Dobkin, Finkelstein, Kluender, and Notowidigdo (2018) and employ nearest neighbor matching based on product type, quarter, year, log quantity, and destination. Table 2 documents results on all robustness checks, resulting in positive treatment effects. Only the Dobkin et al. (2018)-style quadratic pre-trend regression is not significant at the 5% level. In the appendix Section 9.1 we present a detailed discussion of the procedure from Abadie (2005) in addition to the other two robustness checks. While our reduced form evidence suggests that firms within a consortium charge higher prices which may happen when consortium members offer products with higher quality, to understand the firm conduct and the welfare implications of the consortium, we resort to a structural model, which we discuss next.

4 Model

To evaluate the welfare implications of the trade association, we model a firm's decision to join the association and supply fish to a specific destination as a two-stage discrete choice game. This section presents a model where every period in stage 1, a firm decides whether to be a member of the trade association and decides on the set of destination countries where it would plan for shipment by incurring the destination-specific fixed cost that varies by firm's affiliation with the consortium. In the second stage, having observed all decisions made by all the firms, every firm decides on the prices of the products, and consumers make the purchase decisions.

4.1 Demand

We follow Berry, Levinsohn, and Pakes (1995) and Nevo (2001) and use a random utility discrete choice model to estimate the demand for fish in the destination countries. Our assumptions on adapting this framework to an export market are largely based on Roberts, Xu, Fan, and Zhang (2018). We define a destination country and quarter pair as a "market". We define an "exporting firm–fish type–cut type–preserve type" pair as a product.[6] At a given time, consumers in a given destination country may buy from one of the products exported from Chile or choose an outside option available in the market. Since we observe data from exporting records of the firms, we do not observe the final set of products that the consumers face in the destination country. Additionally, intermediaries may repackage the exported fish products before reaching consumers in the destination countries. Therefore similar to Roberts et al. (2018), our demand model effectively captures the joint preferences of intermediaries in the supply chain, who in turn represent the preferences of the consumers in the destination country.

Utility derived by a consumer i, in destination country c, at time t, for product j from firm f is given by

$$\begin{gathered} u_{ijct} = X_{jct}\beta + \alpha_i p_{jct} + \theta_i \mathbb{1}_{\{f \text{ in Union}\}} + \lambda_c + \mu_t + \xi_{jct} + \varepsilon_{ijct} \\ \text{where } \alpha_i = \left[-\exp(\alpha + \sigma\nu_i)\right], \text{ and, } \theta_i = \left[\theta + \sigma_\theta \nu_i^\theta\right] \end{gathered} \tag{3}$$

In the above specification, X_{jct} is a K-vector of product characteristics observed by the econometrician. We include a constant term, a consortium dummy indicating whether a firm is a consortium member, dummy variables for the destination countries, and dummy variables for fish types, cut-types, preserve-types, and mode of transportation in the X_{jt} specification. To capture the seasonality in the data, we allow for the year and quarter dummies. The coefficient of the consortium dummy (θ_i) captures the utility gain that a consumer derives from a firm's product that is affiliated with the consortium. We allow a random coefficient (σ_θ)in the coefficient of the consortium dummy that captures the heterogeneity among consumers' valuations of the consortium. In particular, a positive estimate of the mean parameter (θ) would indicate the value derived from a higher quality of products by firms in the consortium. ξ_{jct} captures the shocks to demand that vary by

[6] In our sample, we have three fish types—Trout, Atlantic Salmon, and Pacific Salmon. Fish is exported in three different cut types—whole fish, fillet fish, and headless eviscerated. The preserve type for different fish types can be either frozen or fresh.

product, destination country, and time which is unobserved by the econometrician. ε_{ijct} captures the individual preference heterogeneity that is IID across consumers and products and follows type 1 extreme value distribution. We also allow price sensitivity to vary across consumers. In the specification $[-\exp(\alpha + \sigma\nu_i)]$, α captures the mean price sensitivity, and σ captures the variation in price sensitivity across consumers. We draw ν_i and ν_i^θ from the standard normal distribution.

Following the specification in Berry (1994), Berry, Levinsohn, and Pakes (1995), and Nevo (2001), the indirect utility can be split into two terms.

$$\begin{aligned} \delta_{jct} &= X_{jct}\beta + \theta\mathbb{1}_{\{f \text{ in Union}\}} + \lambda_c + \gamma_t + \xi_{jct} \\ \mu_{ijct} &= [-\exp(\alpha + \sigma\nu_i)]p_{jct} + \sigma_\theta\nu_i^\theta\mathbb{1}_{\{f \text{ in Union}\}} + \varepsilon_{ijct} \end{aligned} \tag{4}$$

The model predicted aggregate market share of product j in destination country c at time t is given by

$$s_{jct} = \int \frac{\exp(\delta_{jct} + \mu_{ijct})}{1 + \sum_k \exp(\delta_{kct} + \mu_{ikct})} dP_\nu \tag{5}$$

4.2 Supply

We model the supply decisions of the firms as a static two-stage game of complete information.[7] In the first stage, firms decide whether to join the trade association and choose the subset of destination countries where they would plan for shipment. Firms commit to these decisions and simultaneously choose prices for all products supplied to the destination countries in the second stage.

4.2.1 Stage 2: Pricing Decision

We follow Miller and Weinberg (2017) and estimate a model of differentiated-products price competition in which firms inside the consortium partially or fully internalize their pricing externalities on other consortium members. We denote the product portfolio of a given firm f inside a shipment

[7] Similar two-stage models to address endogenous characteristics are used in Fan (2013), Fan and Yang (2022), Fan and Yang (2020), Eizenberg (2014), Wollmann (2018), Mohapatra and Chatterjee (2021) among others.

to destination c at time t by $\mathcal{J}_{fct}$. The profit maximization problem of a firm f is given by

$$\max_{\substack{p_{jct} \\ j \in \mathcal{J}_{fct}}} \left\{ \underbrace{\sum_{j \in \mathcal{J}_{fct}} (p_{jct} - mc_{jct}) s_{jct} M_{ct}}_{\text{I}} + \underbrace{\mathbb{1}_{\{f \,\in\, \text{Union}\}} \kappa \left(\sum_{\substack{f' \neq f \\ f' \in\, \text{Union}}} \sum_{k \in \mathcal{J}_{f'ct}} (p_{kct} - mc_{kct}) s_{kct} M_{ct} \right)}_{\text{II}} \right\} \tag{6}$$

In the above expression, M_{ct} denotes the market size in destination c at time t. Part I of the expression in equation (6) refers to the standard multi-product profit maximization problem where firms set prices to maximize their profit by considering their product portfolio. Note that while a price increase for a product j directly raises profits proportional to current demand $s_{jct}(\vec{p})$, it lowers the product's demand, which reduces profits proportional to the current markup. Additionally, it raises the demand for the other products in the firm's portfolio, which partially compensates for its product's reduced demand.

Part II of the expression in equation (6) refers to the potential collusion among consortium members. We do not impose the assumption that the firms are competing with each other; instead, we allow for the possibility that firms within the trade association might collude and hence may set prices by not only taking into account its effects on their own product portfolio but also profits of other firms within the association. The conduct parameter κ takes into account the weight that a firm puts on the profit of rival firms within the consortium.

The vector of equilibrium prices in each destination country–time satisfies the first-order conditions

$$\vec{p}_{ct} = \vec{mc}_{ct} + \left[\Omega_{ct}(\kappa) \circ \left(\frac{\partial \vec{s}_{ct}(\vec{p})}{\partial p_{ct}} \right)^T \right]^{-1} \vec{s}_{ct}(\vec{p}), \tag{7}$$

where Ω_{ct} is the ownership matrix, $\vec{s}_{ct}$ is the vector of market shares, and the operation $\circ$ is element-by-element matrix multiplication. The (j,k) element of the ownership matrix equals 1 if the same firm produces products j and k. The (j,k) element equals κ if products j and k are sold by firms inside the consortium. Otherwise, the (j,k) element equals zero. This expression generates Nash–Bertrand competition among firms in the union under $\kappa = 0$ and joint profit maximization among firms within the union under $\kappa = 1$.

To complete the supply-side model, we parameterize the marginal cost of product j in destination country c and period t as follows:

$$\log(mc_{jct}) = w_{jct}\gamma + \theta^{mc}\mathbb{1}_{\{f \text{ in Union}\}} + \mu_t^{mc} + \omega_{jct} \tag{8}$$

where γ is the parameter vector to be estimated. In the above specification, w_{jct} is a set of product characteristics that includes a constant term, a consortium dummy indicating whether a firm is a consortium member, dummy variables for destination countries that receive the export, dummy variables for exporting firms, and dummy variables for fish types, cut-types, preserve-types and modes of transportation in the w_{jct} specification. We add the year and quarter dummies (μ_t^{mc}) in the marginal cost specification. In the marginal cost specification, the coefficient of the consortium dummy θ^{mc} captures the differential marginal cost that the firms within the consortium have to bear. In particular, if affiliation with a consortium also implies a higher quality of products, then we expect the estimate of θ^{mc} to be positive.

4.2.2 Stage 1: Joining Consortium and Supplying to a Destination

At the beginning of every period, each firm observes the realizations of fixed costs, decides whether to join the trade association, and chooses the subset of destination countries where it would plan for shipment with the understanding that its actions and its rival's actions will affect the variable profit in the pricing stage.

A firm's decision to supply a shipment to a destination country incurs a fixed cost. We allow the fixed cost of shipment for a given exporting firm at a point in time to vary by the destination country and by consortium status; that is, we allow for the possibility that a firm's shipment cost to a destination country when it is affiliated to the association can be different from the case when it is not a trade association member. This is consistent with the existing literature where firms operating through intermediaries or trade associations may have differential market access in the destination country and hence may have to incur different fixed costs (Atkin, Khandelwal, and Osman (2017)). For example, affiliation with an association may increase the credibility of an exporting firm in the destination country and hence may affect the fixed cost of entry. Note that we do not specify any separate fixed cost for entering the trade association. The differential fixed cost structure that varies with a firm's affiliation with the trade association effectively captures the joint fixed cost of entry into the consortium and the shipment cost conditional on union membership. We assume that firms have complete information regarding the fixed cost structure of all firms.

In our analysis, we consider five destination countries; hence the total number of subsets that a firm may consider for supplying its shipment is given by $2^5 = 32$. We define the subset of destinations to which a firm f decides to plan a shipment at time t by $\mathbb{C}_{ft}$. The fixed cost specification of supplying to a subset of destinations is given by

$$\begin{cases} \sum_{c \in \mathbb{C}_{ft}} F_{fct}^{f \in \text{Union}} & ; \text{ if } f \in \text{ Union} \\ \sum_{c \in \mathbb{C}_{ft}} F_{fct}^{f \notin \text{Union}} & ; \text{ if } f \notin \text{ Union} \end{cases} \tag{9}$$

In equation 9, we allow fixed cost of a given firm f to a destination c at time t to vary by consortium status denoted by $F_{fct}^{f \in \text{Union}}$ if it is a part of the consortium, and $F_{fct}^{f \notin \text{Union}}$ otherwise. Additionally, we assume that the joint fixed cost of supplying to multiple destinations is additive across destinations.

Following Eizenberg (2014), we further assume that

$$\begin{aligned} F_{fct}^{f \in \text{Union}} &= F_c^{\text{Union}} + \nu_{fct}^{f \in \text{Union}} \\ F_{fct}^{f \notin \text{Union}} &= F_c^{\text{NoUnion}} + \nu_{fct}^{f \notin \text{Union}} \end{aligned} \tag{10}$$

where F_c^{Union} denotes the *average* fixed cost a firm faces to prepare a shipment to destination c when it is affiliated with the trade association. Similarly, F_c^{NoUnion} denote the *average* fixed cost for a shipment to destination c when it is not a part of the consortium. $\nu_{fct}^{f \in \text{Union}}$ and $\nu_{fct}^{f \notin \text{Union}}$ denote the fixed cost shocks that a firm faces depending on the firm's affiliation status. Given that we consider five different destination countries in our estimation, we have ten fixed cost parameters to be estimated.

5 Identification, Estimation, and Results

5.1 Demand

We denote the demand parameters to be estimated by θ^D. The identification and estimation of the demand model closely resemble Berry, Levinsohn, and Pakes (1995), Nevo (2001), and Gandhi and

Houde (2022). We estimate demand parameters by minimizing the generalized method of moments objective function based on the conditional independence of demand shocks (ξ) with respect to the instruments, that is, $E(\xi|X, Z) = 0$, where X denotes the vector of product characteristics excluding price and Z denotes the excluded instruments. Note that we do not make an *assumption* on firm conduct, i.e., whether firms are competing or colluding, and instead, test for collusion. Therefore, our estimation of utility parameters does not rely on supply-side moments. Endogeneity of price arises in this framework as the firm observes ξ_{jct} while deciding on prices. Hence, specifying a reasonable set of instruments to estimate the model is necessary. We use destination country-specific exchange rates as an instrument for the price. Note that the fluctuations in the exchange rates between Chile and the destination country affect the cost of import and hence are correlated with the prices of the imported fish products in the destination country. Under the exclusion restriction that the shocks in the fish market are independent of exchange rate fluctuations, the exchange rate is a valid instrument for the price. We include other observable cost-shifters, such as insurance costs and shipping costs associated with each shipment, as instruments. We also include the number of rival products by consortium status and the number of rival products by fish type in the set of demand instruments.

Table 3 summarizes our parameter estimates from the BLP model. Our results suggest that the mean (α) and the standard deviation (σ) of the log-normal price sensitivity are precisely estimated. It reveals that price sensitivity is heterogeneous across consumers. Our key parameter of interest, the dummy (θ) associated with trade association membership, is positive and significant. This suggests that, on average, consumers derive utility gain from products exported by firms affiliated with the trade association. This is consistent with the hypothesis that firms affiliated with a trade association may supply higher quality fish and provide better ease of doing business while exporting the fish products. The estimate of σ_θ (coefficient of Consortium Dummy $\times$ Normal Draw) is statistically significant, suggesting that this effect is heterogeneous among consumers.

5.2 Marginal Costs and Conduct Parameter

We estimate the marginal costs and the conduct parameter, taking the demand results ($\hat{\theta}^D$) as given. The supply side parameters to be estimated (θ^S) include the conduct parameter (κ) and the parameters included in the equation (8) (i.e., $\theta^S = (\kappa, \gamma, \theta^{mc}, \mu_t^{mc})$). For each candidate parameter vector $\tilde{\theta}^S$, we calculate the markups and observed marginal costs and obtain the structural error as a function of the parameters:

$$\omega^*_{jct}(\tilde{\theta}^S, \hat{\theta}^D) = \vec{p}_{ct} - (w_{jct}\gamma + \theta^{mc}\mathbb{1}_{\{f \text{ in Union}\}} + \mu^{mc}_t) - \left[\Omega_{ct}(\kappa) \circ \left(\frac{\partial \vec{s}_{ct}(\vec{p})}{\partial p_{ct}}\right)^T\right]^{-1} \vec{s}_{ct}(\vec{p}) \tag{11}$$

Identification of the parameters included in θ^S rests on the population moment condition $E[z^{mc'} \cdot \omega^*_{jct}] = 0$, where ω^*_{jct} is a stacked vector of structural errors obtained from equation (11), and z^{mc} is a conformable vector of instruments. In the equation 11, the markup term is endogenous because the unobserved cost shocks enter implicitly through price, which poses a challenge to the identification. Our approach to identifying the conduct parameter follows closely that of Michel and Weiergraeber (2018) and Backus, Conlon, and Sinkinson (2021). As pointed out in both these papers, the key challenge on the supply side is to separately identify manufacturer markups from unobserved marginal cost shocks. Put another way, it is difficult empirically to determine whether observed pricing patterns across firms are truly due to non-competitive conduct vs. misspecification or a series of shocks to marginal costs that produce a "false positive" for collusion.

To address this, we use instruments; a valid instrument should be correlated with the endogenous variable, i.e., a firm's markup, and uncorrelated with marginal cost shocks. We follow Michel and Weiergraeber (2018) and Gandhi and Houde (2022) and construct instruments based on a product's location in the characteristic space. In particular, we count the number of rival products within consortium status, the number of rival products by fish type, cut type, and preserve type and use those as instruments. These instruments are correlated with markup as how many rival products have similar characteristics affects the competitive pressure exerted on a product, affecting the markup that a firm can charge. The exogeneity argument follows from the timing assumption, i.e., the firms do not observe the product-destination-quarter specific marginal cost shocks while deciding to join the consortium or deciding on other product characteristics. In our marginal cost specification, we control for any time-invariant product-specific effects through a wide range of covariates and time-varying factors using various fixed effect controls. Hence, it seems reasonable to assume that any product-time-specific marginal cost shocks are uncorrelated with contemporaneous product characteristics. In Appendix Section 9.2, we provide further reduced form evidence about the validity of those instruments. In particular, our reduced form regressions provide evidence that consortium status interacted with product characteristics capture relevant shifters of manufacturers' markups and can therefore constitute strong instruments for industry conduct.

The method-of-moments estimate is given by

$$\hat{\theta}^S = \arg\min_{\theta} \omega^*(\theta, \hat{\theta}^D)' z^{mc} z^{mc\prime} \omega^*(\theta, \hat{\theta}^D) \tag{12}$$

We concentrate the fixed effects and the marginal cost parameters out of the optimization problem using OLS to reduce the dimensionality of the nonlinear search. The results from marginal cost estimation are reported in table 4. The conduct parameter is positive and statistically significant, suggesting that the null of Nash-Bertrand competition among the consortium members is easily rejected. In other words, our results support the case of collusion among firms inside the trade association. They suggest that the firms within the consortium internalize roughly 43% of their price effects on the other firm's profits. Our second parameter of interest, the coefficient of consortium dummy, picks a positive value and is statistically significant. This is consistent with the hypothesis that a firm within the consortium may supply better quality products and hence incurs a higher cost of production.

5.3 Fixed costs of joining the consortium and supplying to a destination

In our model, firms observe the realizations of fixed costs, decide whether to join the trade association, and choose the subset of destination countries where they would plan for a shipment. As specified in equation 9, firms incur fixed costs to plan shipments for specific destinations that vary by whether a firm is affiliated with the consortium. Given our information structure, firms have complete information regarding fixed costs for each potential choice.

While the demand and marginal cost shocks (ξ and ω) are realized at the beginning of every period, we assume that firms know the distribution of these shocks. Hence, firms can compute the expected period profit when making the shipment decisions. A Subgame Perfect Nash Equilibrium consists of choices made by the firms in the first stage and pricing decisions in the second stage, constituting a Nash equilibrium in every subgame. However, given that this is a game of complete information, we might end up with a multiplicity of equilibria. To address this, we follow Pakes, Porter, Ho, and Ishii (2015) and Fan and Yang (2020) and use necessary conditions for equilibrium decisions to estimate fixed costs. These conditions lead to inequalities, and hence, we estimate bounds for fixed costs. Our estimation closely follows that of Eizenberg (2014). Nash equilibrium implies that given competitors' decisions to enter into the trade association and supply to a specific destination, any deviation from an exporting firm's equilibrium decisions should not lead to a higher expected profit for this firm, where the expectation is taken over demand and marginal cost shocks (ξ and ω).[8]

Suppose, for a given destination country, we observe a firm supplying to a specific destination country at a given time. Then, the necessary condition for a Nash equilibrium implies that, given the decisions (consortium status and supply decisions to destination countries) made by all rival firms, and conditional on a firm's consortium status, a unilateral deviation by a firm of not supplying to the destination country can not lead to a higher expected profit. In particular, if a firm is a part of the consortium and supplies to a specific destination $c^* \in \mathbb{C}_{ft}$, then

$$\begin{aligned} &\sum_{c \in \mathbb{C}_{ft}} \left(E_{\xi,\omega} \pi_{fct}^{f \in \text{Union}}(\mathcal{J}_{f,ct}, \mathcal{J}_{-f,ct}) - F_{fct}^{f \in \text{Union}} \right) \geq \sum_{c \in \{\mathbb{C}_{ft} \backslash c^*\}} \left(E_{\xi,\omega} \pi_{fct}(\mathcal{J}_{f,ct}, \mathcal{J}_{-f,ct}) - F_{fct}^{f \in \text{Union}} \right) \\ &\implies F_{fc^*t}^{f \in \text{Union}} \leq E_{\xi,\omega} \pi_{fc^*t}^{f \in \text{Union}}(\mathcal{J}_{f,c^*t}, \mathcal{J}_{-f,c^*t}) \\ &\implies F_{c^*}^{\text{Union}} + \nu_{fc^*t}^{f \in \text{Union}} \leq E_{\xi,\omega} \pi_{fc^*t}^{f \in \text{Union}}(\mathcal{J}_{f,c^*t}, \mathcal{J}_{-f,c^*t}) \end{aligned} \tag{13}$$

Similarly, if a firm is not a part of the trade association and supplies to a specific destination $c^* \in \mathbb{C}_{ft}$, then

$$\begin{aligned} &\sum_{c \in \mathbb{C}_{ft}} \left(E_{\xi,\omega} \pi_{fct}^{f \notin \text{Union}}(\mathcal{J}_{f,ct}, \mathcal{J}_{-f,ct}) - F_{fct}^{f \notin \text{Union}} \right) \geq \sum_{c \in \{\mathbb{C}_{ft} \backslash c^*\}} \left(E_{\xi,\omega} \pi_{fct}^{f \notin \text{Union}}(\mathcal{J}_{f,ct}, \mathcal{J}_{-f,ct}) - F_{fct}^{f \notin \text{Union}} \right) \\ &\implies F_{fc^*t}^{f \notin \text{Union}} \leq E_{\xi,\omega} \pi_{fc^*t}^{f \notin \text{Union}}(\mathcal{J}_{f,c^*t}, \mathcal{J}_{-f,c^*t}) \\ &\implies F_{c^*}^{\text{NoUnion}} + \nu_{fc^*t}^{f \notin \text{Union}} \leq E_{\xi,\omega} \pi_{fc^*t}^{f \notin \text{Union}}(\mathcal{J}_{f,c^*t}, \mathcal{J}_{-f,c^*t}) \end{aligned} \tag{14}$$

Inequalities 13, and 14 suggest that if a firm supplies to a destination country at time t, then the firm's destination-specific fixed cost conditional on its affiliation with a trade association must be dominated by the expected profit that the firm gains from planning a shipment to the destination

[8] In practice, we fit an empirical distribution for ξ and ω from estimated values, randomly draw 500 vectors of demand and mc shocks from the fitted empirical distribution, and solve price equilibrium for each of those shocks given the estimated demand and marginal cost parameters. We compute the expected variable profit by taking the average across those random draws.

given the consortium status when the choices made by the rival firms are given.

If a firm does not supply to a specific destination $\tilde{c}$, then conditional on the firm's affiliation with the trade association following inequalities must hold.

$$
\begin{aligned}
&\sum_{c\in\mathbb{C}_{ft}}\Big(E_{\xi,\omega}\pi_{fct}^{f\in\text{Union}}(\mathcal{J}_{f,ct},\mathcal{J}_{-f,ct})-F_{fct}^{f\in\text{Union}}\Big)\geq\sum_{c\in\{\mathbb{C}_{ft}\cup\tilde{c}\}}\Big(E_{\xi,\omega}\pi_{fct}^{f\in\text{Union}}(\mathcal{J}_{f,ct},\mathcal{J}_{-f,ct})-F_{fct}^{f\in\text{Union}}\Big)\\
&\implies F_{f\tilde{c}t}^{f\in\text{Union}}\geq E_{\xi,\omega}\pi_{f\tilde{c}t}^{f\in\text{Union}}(\mathcal{J}_{f,\tilde{c}t},\mathcal{J}_{-f,\tilde{c}t})\\
&\implies F_{\tilde{c}}^{\text{Union}}+\nu_{f\tilde{c}t}^{f\in\text{Union}}\geq E_{\xi,\omega}\pi_{f\tilde{c}t}^{f\in\text{Union}}(\mathcal{J}_{f,\tilde{c}t},\mathcal{J}_{-f,\tilde{c}t})
\end{aligned}
\tag{15}
$$

$$
\begin{aligned}
&\sum_{c\in\mathbb{C}_{ft}}\Big(E_{\xi,\omega}\pi_{fct}^{f\notin\text{Union}}(\mathcal{J}_{f,ct},\mathcal{J}_{-f,ct})-F_{fct}^{f\notin\text{Union}}\Big)\geq\sum_{c\in\{\mathbb{C}_{ft}\cup\tilde{c}\}}\Big(E_{\xi,\omega}\pi_{fct}^{f\notin\text{Union}}(\mathcal{J}_{f,ct},\mathcal{J}_{-f,ct})-F_{fct}^{f\notin\text{Union}}\Big)\\
&\implies F_{f\tilde{c}t}^{f\notin\text{Union}}\geq E_{\xi,\omega}\pi_{f\tilde{c}t}^{f\notin\text{Union}}(\mathcal{J}_{f,\tilde{c}t},\mathcal{J}_{-f,\tilde{c}t})\\
&\implies F_{\tilde{c}}^{\text{NoUnion}}+\nu_{f\tilde{c}t}^{f\notin\text{Union}}\geq E_{\xi,\omega}\pi_{f\tilde{c}t}^{f\notin\text{Union}}(\mathcal{J}_{f,\tilde{c}t},\mathcal{J}_{-f,\tilde{c}t})
\end{aligned}
\tag{16}
$$

Inequalities 15, and 16 suggest that if a firm decides not to supply to a destination country at time t, then the firm's destination-specific fixed cost conditional on its affiliation with a trade association must dominate the expected profit that the firm gains from planning a shipment to the destination given the consortium status when the choices made by the rival firms are given.

In the above expressions, equations 13 and 14 define the upper bounds for a firm's destination-specific fixed costs. Important to note here that we obtain these inequalities only for the time period-destination pairs for which a firm plans for a shipment, conditional on the affiliation of a firm with the trade association. Therefore, since a firm observes the destination-time specific fixed cost shocks, it may decide to supply *only* to the subset of destinations with favorable fixed cost shocks at a time t. As highlighted in Eizenberg (2014), this leads to a selection problem. To put it another way, conditional on supplying (or not supplying) to a destination, the expectation of fixed cost error terms is not equal to zero; this implies

$$\begin{aligned}
&E\left(\nu_{fct}^{f\in TA}|f \text{ supplies to } c \text{ at time } t\right) \neq 0\\
&E\left(\nu_{fct}^{f\notin TA}|f \text{ supplies to } c \text{ at time } t\right) \neq 0\\
&E\left(\nu_{fct}^{f\in TA}|f \text{ does not supply to } c \text{ at time } t\right) \neq 0\\
&E\left(\nu_{fct}^{f\notin TA}|f \text{ does not supply to } c \text{ at time } t\right) \neq 0
\end{aligned} \tag{17}$$

To address this, we follow the approach developed in Eizenberg (2014) and replace the missing lower and upper bounds with reasonable bounds. In particular, we only obtain the lower bounds for the firm-destination pair where we observe that the firm does not plan for a shipment at time t. It is reasonable to assume that fixed costs are non-negative. Therefore, we replace the missing lower bounds with 0. Similarly, for a firm-destination pair, if we observe that the firm supplies a shipment at time t, then we obtain the upper bounds only following equations 13, and 14. For those cases, we need to construct the missing upper bounds. We compute the maximum variable profit that any firm may earn across all periods for a specific destination.

$$\max_{f,t} \{E_{\xi,\omega}\pi_{fct}\}_{c=\text{Brazil, US, China, Russia, and Japan}} \tag{18}$$

We replace the destination-specific missing upper bounds with their corresponding values from equation (18).

The estimated sets for destination-specific fixed costs that vary by trade association affiliation are given by

$$F_c^s \in \left[\frac{1}{n_c^s}\sum L_{cft}^s,\ \frac{1}{n_c^s}\sum U_{cft}^s\right], \quad s = \{\text{Union}, \text{NoUnion}\} \tag{19}$$

$$\text{where } L_{cft}^s = \begin{cases} E_{\xi,\omega}\pi_{fct}^s, & \text{if } f \text{ does not supply to } c \text{ at time } t\\ 0, & \text{if } f \text{ supplies to } c \text{ at time } t \end{cases}$$

$$
\text{and, } U^s_{cft} = \begin{cases} E_{\xi,\omega}\pi^s_{fct}, & \text{if } f \text{ does not supply to } c \text{ at time } t \\ \max_{f,t}\left\{E_{\xi,\omega}\pi_{fct}\right\}, & \text{if } f \text{ supplies to } c \text{ at time } t \end{cases}
$$

$$
n_c^{\text{Union}} = \#\text{ firm-time pairs given destination } c\text{, and } f \in \text{Union}
$$

$$
n_c^{\text{NoUnion}} = \#\text{ firm-time pairs given destination } c\text{, and } f \notin \text{Union}
$$

We report the results from fixed cost estimation in table 5. The bounds are reported in millions of USD. For every destination, the estimated fixed cost bounds when a firm is affiliated with the trade association overlap with the estimated bounds when the firm is not a part of the trade association. Therefore, given the estimates, we cannot infer whether the fixed costs when a firm is affiliated with a trade association differ from the case where the firm is not a part of the trade association. Nevertheless, we use these estimated bounds to run multiple counterfactual analyses, which we will describe next.

6 Counterfactual Analysis

Using the estimates from the structural model, we first evaluate the welfare effects of the presence of the trade association SalmonChile. We show that even though the trade association may lead to collusion among consortium members, getting rid of the Consortium significantly lowers consumer welfare in the countries that receive the exports. In our second counterfactual, we evaluate the welfare consequences of making trade associations mandatory for exporting firms. Finally, we vary the *level* of collusive activity among firms within the consortium and explore its effects on consumer welfare.

6.1 Welfare Effects of *SalmonChile*

How does a trade association in the exporting country affect consumer welfare in the destination country? To evaluate the welfare consequences of a trade association, we use our estimated model, simulate a counterfactual world where we remove the trade consortium in Chile, compute the consumer's surplus and the producer's surplus, and compare it with the welfare numbers from the status quo world. Eliminating the trade association in the exporting country affects our model's demand and supply side. On the demand side (as highlighted in section 5.1, and table 3), a firm's affiliation with the trade association also derives higher indirect utility for consumers. Similarly, on the supply side, affiliation with the trade association also implies a higher marginal cost of production. Finally, we estimate fixed cost bounds allowing those to vary by destination and trade association affiliation status.

In the counterfactual world with no consortium, we take the utility, marginal cost, and fixed cost parameters as given and solve for the equilibrium set of firms that would plan a shipment to a destination country in a given time and the equilibrium prices that the firms would charge.[9] Solving for the counterfactual equilibrium, however, is a computationally challenging task. Given that we consider five destination countries, with around 60 firms as potential entrants for each destination, we end up with extremely large ($2^{60\times5}$) potential choices for every period. Moreover, to compute the profit of each firm for a given set of choices, we need to compute the corresponding pricing equilibrium, making the computational burden prohibitively high.[10]

To deal with the computational challenge, we use the heuristic algorithm developed in Fan and Yang (2020) to solve for the equilibrium set of firms that would supply to a destination country. The algorithm uses one-step deviations to compute the equilibrium response of each firm and computes the equilibrium destination-specific firm choices for every period from 2009 to 2017. Regarding fixed costs, since we observe the upper and lower bounds, we uniformly draw five fixed cost values from the fixed cost bounds for each parameter (reported in table 5), solve for the counterfactual world for each of those five draws, and report the average in our results.[11] We report the results from the counterfactual exercise in table 6. Panel I of the table reports results from aggregate welfare effects. Panel II reports the differences in the consumer surplus by different destination countries. Our results from aggregate welfare computations show that the presence of the trade association *SalmonChile* derives significant consumer welfare gain. In particular, the elimination of

[9] In the counterfactual exercise, we allow a firm conditional on planning a shipment offers the entire set of firm-destination-specific products that we observe in the data. We consider this a reasonable assumption, as the set of products for a firm destination remains stable over time. In other words, we only focus on the firm's decisions on whether to plan a shipment to a destination country rather than the products that the firm plans to include in the shipment. This also makes the computations of counterfactual equilibrium feasible by restricting the choice sets of the firms.

[10] This step requires the computation of expectation of variable profits for every combination of potential firms, which involves solving for pricing equilibrium for several random draws of ξ and ω, which adds to the computational burden.

[11] Similar approach is used in Fan and Yang (2020) while simulating the counterfactual world.

the trade association would lead to a 7% drop in the total consumer welfare compared to the status quo world. As Panel II of the table shows, this pattern is consistent across different destination countries. On the producer's side, eliminating the trade association leads to a higher producer's surplus than the status quo world. Removing the trade association also eliminates the possibility of collusion among firms through the consortium. It also lowers the utility gain derived to the consumers due to the firm joining the consortium, negatively affecting firm profit. On the other hand, it leads to a lower cost of production. Our results suggest that compared to the status quo world, the effect of lower cost of production in the counterfactual world with no consortium dominates other effects leading to a higher overall producer surplus. Overall, the results indicate that eliminating the trade association would lead to a Pareto-inefficient outcome. This is consistent with the existing literature where trade associations, by removing information frictions and trade frictions, lead to higher total overall welfare (Kirby (1988)).

To further understand the effects of trade associations on consumer welfare in the US, we decompose the gains in consumer welfare. Eliminating the consortium affects consumer welfare through four channels — (i) it eliminates the indirect utility gain derived from a firm's affiliation with the consortium (captured by θ_i in equation 3), (ii) it removes the collusive arrangement among consortium members (captured by the conduct parameter κ), (iii) it leads to a lower marginal cost of production (as captured by θ^{mc} in equation 8), (iv) it affects the equilibrium prices through channels (i), (ii), and (iii) and hence, depending on the fixed cost of planning a shipment, affects the equilibrium entry and exit decisions of the firms affecting the supply patterns to different destination countries.

Therefore to tease apart these effects, we first consider the world where trade association is eliminated. At the same time, the same set of firms keeps supplying the bundle of products to the destination countries and charges prices identical to the status quo world. By keeping the product assortment and prices identical to the status quo world, this exercise captures the drop in consumer welfare exclusively due to the indirect utility from channel (i) above. We report our results in table 7. Our results show that in a counterfactual world with no consortium, keeping the set of suppliers and export prices at the status quo level leads to a significant drop in consumer welfare from 23.8 Billion USD to 23.0 Billion USD. We label this as the "quality effect" as it captures the associated potential quality gain due to the consortium's presence.

Next, we consider the world where there is no trade association, the same set of firms keeps supplying the bundle of products to the destination countries but charges new equilibrium prices. As highlighted in channels (ii) and (iii) above, without consortium, the firms face a lower marginal cost of production. Similarly, the collusive arrangement among consortium members is also eliminated. These two effects imply that compared to channel (i) alone, allowing a new price equilibrium improves consumer welfare by 0.5 Billion USD. Finally, allowing firms to re-equilibrate their entry decisions with the new price equilibrium leads to a significant drop in consumer welfare by 1.4 Billion USD. Our decomposition results highlight the role of quality effects, collusion, and price and entry effects on consumer welfare. It also highlights the benefits of flexibly modeling price effects and firms' entry and exit decisions. In other words, ignoring the entry and exit effects would lead to misleading conclusions while simulating the welfare effects of the consortium.

The aggregate consumer welfare loss from banning the consortium is roughly 1.7 billion USD or 7% of the total consumer surplus generated by the market. We consider this to be quite large, as this is ultimately a voluntary organization of firms in a market that could still function without it. A trade association likely has small overhead costs compared to sweeping regulations, infrastructure investment, large-scale research and development, or other ways of increasing consumer surplus. Therefore, in this context, we consider the trade association's welfare contribution to be of significant value.

6.2 Making the Trade Association Mandatory

Our discussions so far highlight that the presence of *SalmonChile* in the exporting country also leads to a higher consumer surplus in the destination country. Given this, we investigate whether a regulation to make the trade association mandatory would benefit consumers. If intermediaries in the destination countries conduct trade with the set of suppliers that are affiliated with *SalmonChile*, on the one hand, the quality of imports will go up. On the other hand, it would limit the competition among exporting firms as the firms without affiliation with the consortium would not qualify for trade with the destination countries. Further, we assume that the collusive conduct of the firms also holds under the new counterfactual world.[12] Therefore, the overall welfare effects of making the

[12]Note that making trade associations mandatory for participating in trades may also change firms' incentives to participate in the collusive activity. In Section 6.3, we investigate this case in more detail.

trade association mandatory depend on the equilibrium set of firms that would join the consortium and the equilibrium prices, which is an empirical question.

The results from making the consortium mandatory are reported in table 8. Our results show that, compared to the status quo where affiliation with the consortium is not required for conducting trade with Chilean suppliers, making consortium mandatory does not significantly alter consumer surplus. In the new equilibrium, the set of exporting firms and equilibrium prices get affected, leading to a different assortment of products and potentially higher prices. This, along with the collusive conduct of the firms, would negatively affect consumer welfare. However, making consortium mandatory also implies higher quality products and lower trade frictions, positively impacting the welfare gain to the consumers. Our results suggest that these two effects cancel each other, and consumer welfare remains unaffected in the new counterfactual world. On the other hand, the producer surplus increases significantly as firms earn higher equilibrium profits in the counterfactual world. Our paper highlights the efficiency-enhancing role a trade association like *SalmonChile* plays in augmenting the trade of fish-related products between Chile and other destination countries.

6.3 Effect of Collusion due to Trade Association

How is welfare affected if we alter the *level* of collusive conduct among trade association members? As highlighted in the existing literature, trade associations raise antitrust concerns as they may facilitate coordination on prices, establish barriers to entry, or undertake other activities that diminish competition (FTC (2022); OECD (2007); Kühn (2001)). As existing literature points out, the cases of successful collusion with a large number of agents typically involved the presence of a trade association, especially in differentiated product industries (Ale-Chilet and Atal (2020)).

In our setting, we find strong evidence of collusion among members of *SalmonChile*. In particular, our results suggest that the firms within the consortium internalize roughly 43% of their price effects on the other firm's profits. To investigate how variations in collusive activity may affect consumer and producer surplus, we implement different levels of collusion among members of the association by altering the conduct parameter (κ – as defined in equation 6) and compute new firm-entry as well as pricing equilibrium for each of those counterfactual κ values. For each of the candidate κ values, we compute the corresponding consumer surplus and producer surplus by considering three alternative scenarios - (i) the status quo world, where firms can plan a shipment to a destination irrespective of their consortium affiliation by paying destination-consortium affiliation-specific fixed costs; (ii) a counterfactual world where there is no consortium; (iii) a counterfactual world where affiliation with the consortium is mandatory for planning a shipment to a destination country. We compute the results for $\kappa = 0, 0.1, 0.2, 0.3, \cdots, 0.9$. While $\kappa = 0$ represents no collusion, higher values of κ represent better coordination among firms within the consortium.

We plot the results from consumer surplus calculations in left panel of figure 5. Our results suggest that, presence of a consortium derives higher consumer welfare even with moderate levels of collusion. In particular, for κ less than 0.5, making consortium mandatory derives overall higher consumer welfare than the status quo world. Similarly, making consortium mandatory dominates the counterfactual world of no consortium for even wider range of κ values. In other words, our results suggest that, while potential collusive activity may lead to anti-competitive outcomes affecting consumer welfare negatively, the positive efficiency gains outweighs such negative effects even for moderate levels of collusion. At high levels, however, the consortium's presence can eventually become a net negative for consumers.

The corresponding producer surplus values for different levels of conduct parameter is reported in the right panel of figure 5. As expected, higher collusion among members within a consortium also increases overall producer's surplus. Exporting firms derive highest surplus when all firms join consortium and engage in collusive activity.

7 Conclusion

Trade associations may have ambiguous welfare implications for consumers and producers. While they may improve product attributes and increase availability for consumers, they may also lead to higher prices and potentially facilitate collusion. Similarly, while producers stand to profit from selling higher quality products, non-member firms may lose out from the distortion to competition that occurs from firms coordinating on quality standards. Member firms may also alter their market entry patterns in response to their consortium affiliation. All of these effects are especially relevant in export markets, where branding may not be as salient to international consumers and small firms may need extra resources to sell their goods.

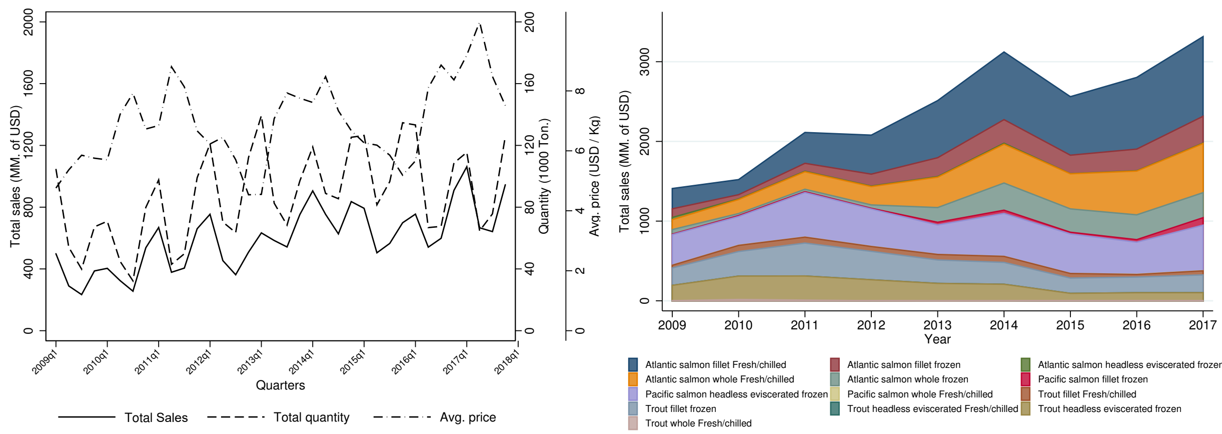
Using detailed data on prices, sales, association membership, and product variety, this paper provides the first welfare analysis of trade associations by measuring the costs and benefits of an association's existence in the context of the Chilean fish export industry. Our results show that the trade association has a strong positive effect on consumer utility and requires higher marginal costs of production, which is consistent with mechanisms of higher quality products and reduced trade frictions. We also document robust evidence of collusive activity among trade association members. However, overall, the trade association *SalmonChile* benefits member producers in exporting countries and consumers in importing countries, leading to net efficiency gain. Our counterfactual exercises show that the quality and ease of trade effects due to the existence of a consortium exceed the adverse effects due to the collusive conduct of the firms. In addition to these key policy findings, our paper contributes by advancing the methodology of modeling differentiated good markets in the international trade literature, using the methods in Roberts et al. (2018) and Michel and Weiergraeber (2018) as starting points. Using recent insights in the demand estimation literature, we use a novel series of instruments to identify the conduct parameter for firms in a trade association. Our work presents the first fixed cost estimates for planning a shipment to a destination country conditional on consortium membership.

While this paper focuses on a particular case study, it is relevant in many different contexts. Trade associations exist in many industries in Chile and international trade more broadly. They are also plentiful in domestic markets across the world. In total, our results show that trade associations play an important role in determining the welfare of producers and consumers alike. Given their prevalence in many different forms of trade and production, determining the benefits and costs of trade associations across various industries will be important in deciding welfare-maximizing policies.

8 Tables and Graphs

Figure 1: Total sales of exported salmon products

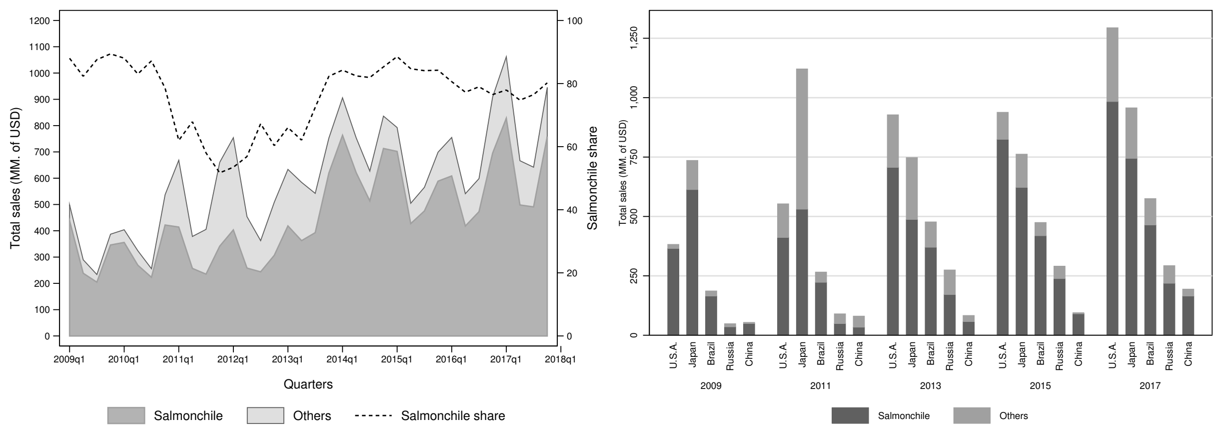
(a) Total Sales, Quantity and Avg price (b) Total sales of exported product by year



Source: Chilean National Customs Service.
Notes: The left panel plots the total Sales (in USD) of exported salmon products from Chile to the rest of the world, total quantity (in tons) and average price per kilogram (in USD). In the right panel, we plot the total sales of exported salmon products from Chile to the rest of the world by product and year.

Figure 2: Sales of exported salmon products by Consortium Status

(a) Total Sales and Sales Share by consortium status (b) Total Sales by destination country and consortium status

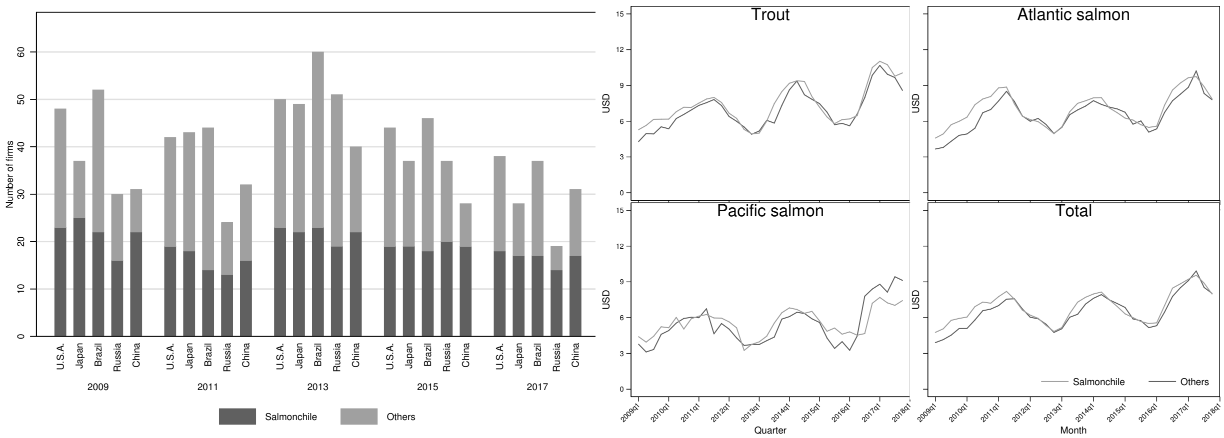


Source: Chilean National Customs Service.
Notes: The left panel plots the total Sales (in USD) made by *SalmonChile* members and other firms. It also plots *SalmonChile*'s sale share from 2009 to 2017. In the right panel, we plot the total sales of exported salmon products from Chile to the rest of the world by the destination country and consortium status.

Figure 3: Number of firms and Avg price by Consortium Status

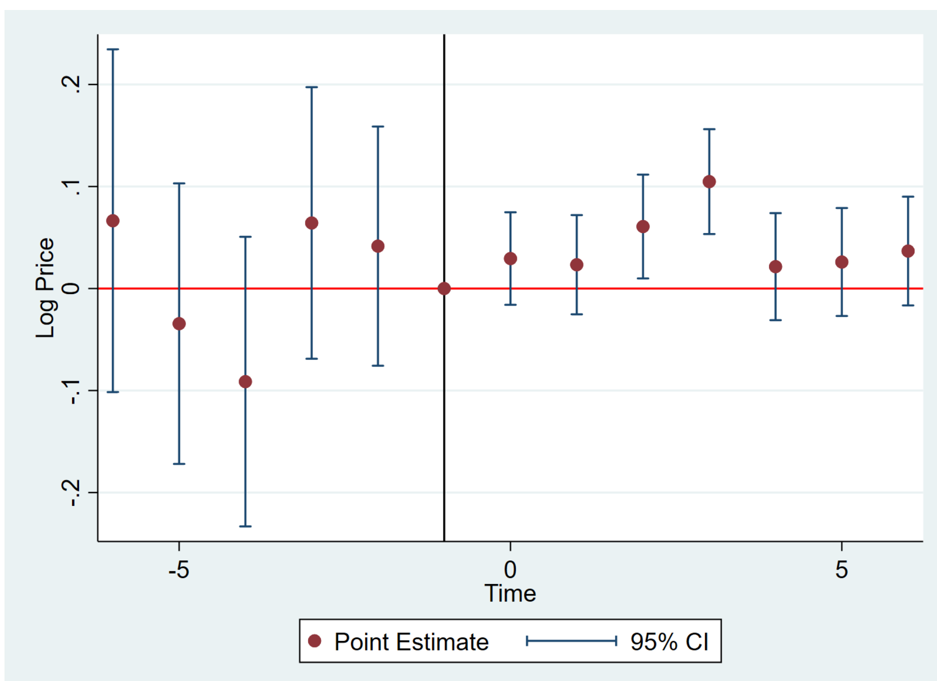
(a) No. of Firms by destination and consortium status

(b) Avg. price per kilogram by consortium status



Source: Chilean National Customs Service.
Notes: The left panel plots the number of firms exporting salmon products from Chile by the destination country, consortium status, and year. In the right panel, we plot the Average price per kilogram of *Salmonchile* members and other sellers over the sample period.

Figure 4: Quarterly Event Study Graph, Joining Firms Only (6 quarters)

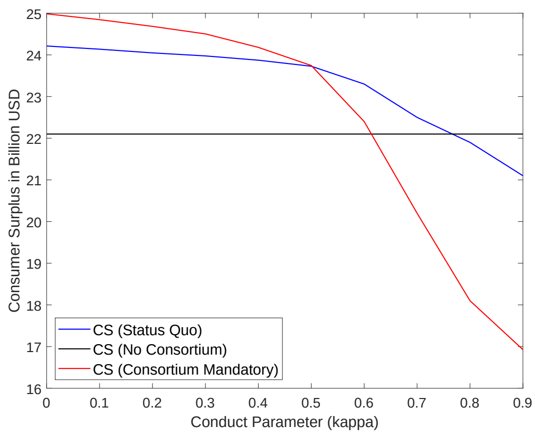


Source: Chilean National Customs Service.

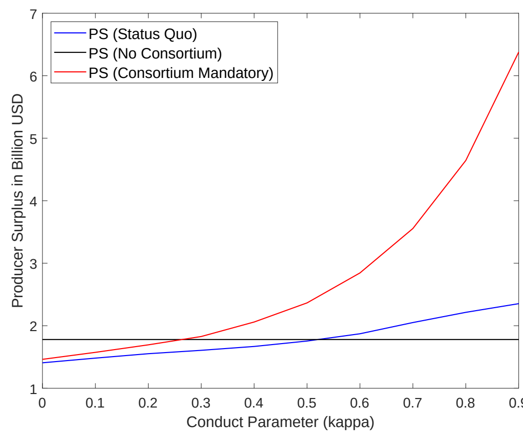
Notes: The sample period is between 2009 and 2017. Price and quantity are quarterly averages at the firm-product-destination level. We omit the accumulated endpoints.

Figure 5: Consumer Surplus and Producer Surplus at Different Levels of Conduct Parameter (κ)

(a) Consumer Surplus



(b) Producer Surplus



Notes: The left panel plots Consumer Surplus at Different Levels of Conduct Parameter (κ). In the right panel, we plot the Producer Surplus at Different Levels of Conduct Parameter (κ).

Table 1: Two Way Fixed Effects Models: Price

VARIABLES	(1) Log Price	(2) Log Price	(3) Log Price	(4) Log Price	(5) Log Price	(6) Log Price
SC Status	.079***	.069***	.056***	.030**	.030**	.030**
	(0.013)	(.013)	(.009)	(.007)	(.013)	(.007)
Log Quantity		.016**			.011***	.009***
		(.004)			(.003)	(.003)
Instruments for Quantity	No	No	No	No	No	Yes
Year FEs	No	No	Yes	Yes	Yes	Yes
Quarter FEs	No	No	Yes	Yes	Yes	Yes
Destination FEs	No	No	Yes	Yes	Yes	Yes
Product Type FEs	No	No	No	Yes	Yes	Yes
Firm FEs	No	No	No	Yes	Yes	Yes
N	10,540	10,540	10,540	10,503	10,503	8,916

Notes: Sample covers 2009-2017. Price and quantity are quarterly averages at the firm-product-destination level. The number of distinct panel units is 1,248. Includes trout, Atlantic salmon, and Pacific salmon. Instruments for quantity include shipping costs and exchange rates. Standard errors are clustered at the market (destination-quarter-year) level. Observations differ by specification due to missing data in instruments and singleton observations.

Table 2: Two Way Fixed Effects: Price Robustness Checks

Method	Estimated Treatment Effect
Linear Trend Control, Joining Firms Only	.051
	(0.025)**
Quadratic Trend Control, Joining Firms Only	.041
	(.030)
Abadie (2005) Using Previous Price	.015
	(.005)***
Abadie (2005) with Two Previous Prices	.016
	(.006)***
Abadie (2005) Using Full Baseline Covariates	.054
	(.011)***
Nearest Neighbor Matching	.045
	(.006)***

Notes: "Trend control" specifications explicitly include pre-trend terms for treated observations in OLS regressions. "Abadie (2005)" specifications implement Abadie (2005) two-step method for controlling for pre-trends that arise due to observables. "Nearest neighbor matching" matches observations on product type, quarter, year, log quantity, and destination.

Table 3: Results from BLP Demand Estimation

Price Sensitivity	0.82***
	(0.15)
Price x Normal Draw	0.55***
	(0.15)
Consortium Dummy x Normal Draw	0.36***
	(0.13)
Constant	22.4***
	(5.32)
Consortium Dummy	0.94***
	(0.21)
Brazil Dummy	-2.50***
	(0.53)
USA Dummy	2.99*
	(1.72)
Japan Dummy	-1.54***
	(0.51)
China Dummy	-0.47*
	(0.24)
Year Dummy	Yes
Quarter Dummy	Yes
Fish Type Dummy	Yes
Cut Type Dummy	Yes
Preserve Type Dummy	Yes
Transportation Mode Dummy	Yes
No. of Obs	10,540

For Destination dummies, Russia Dummy is excluded as the base
For Fish-type dummies, Pacific Salmon Dummy is excluded as the base

Table 4: Results from MC Estimation

Conduct parameter (κ)	0.43***
	(0.02)
Constant	1.89***
	(0.24)
Consortium Dummy	0.04***
	(0.01)
Destination Dummy	Yes
Year Dummy	Yes
Quarter Dummy	Yes
Firm Dummy	Yes
Fish Type Dummy	Yes
Cut Type Dummy	Yes
Preserve Type Dummy	Yes
Transportation Mode Dummy	Yes
No. Of Obs	10,540

For Destination dummies, Russia Dummy is excluded as the base
For Fish-type dummies, Pacific Salmon Dummy is excluded as the base

Table 5: Results from Fixed Cost Estimation

$F_{\text{USA}}^{\text{Union}}$	[0.2, 1.4]	$F_{\text{USA}}^{\text{NoUnion}}$	[0.3, 2.9]
$F_{\text{Brazil}}^{\text{Union}}$	[0.4, 1.3]	$F_{\text{Brazil}}^{\text{NoUnion}}$	[0.4, 1.5]
$F_{\text{Japan}}^{\text{Union}}$	[0.8, 5.2]	$F_{\text{Japan}}^{\text{NoUnion}}$	[0.6, 19.0]
$F_{\text{China}}^{\text{Union}}$	[0.3, 1.3]	$F_{\text{China}}^{\text{NoUnion}}$	[0.4, 0.6]
$F_{\text{Russia}}^{\text{Union}}$	[0.8, 2.1]	$F_{\text{Russia}}^{\text{NoUnion}}$	[0.4, 3.7]

Fixed cost bounds are reported in million USD

Table 6: Welfare Effects of Trade Association

	Status Quo	No Consortium
I. Aggregate Welfare Effects		
Aggregate Consumer Surplus	23.8	22.1
Aggregate Producer Surplus	1.70	1.78
II. Consumer Surplus by Destination Countries		
US	7.4	7.0
Brazil	4.6	4.2
Japan	8.3	7.6
China	1.2	1.1
Russia	2.3	2.2

The values are reported in Billion USD

Table 7: Decomposition of Consumer Welfare effects in the USA

Consortium Status	Price	Firm Entry	Consumer Welfare
Status Quo	Status Quo	Status Quo	23.8
No Consortium	Status Quo	Status Quo	23.0
No Consortium	New Equilibrium	Status Quo	23.5
No Consortium	New Equilibrium	New Equilibrium	22.1

The values are reported in Billion USD

Table 8: Welfare Effects of Making the Trade Association Mandatory

I. Aggregate Welfare Effects		
	Status Quo	Consortium Mandatory
Aggregate Consumer Surplus	23.8	24.0
Aggregate Producer Surplus	1.70	2.15
II. Consumer Surplus by Destination Countries		
US	7.4	7.4
Brazil	4.6	4.5
Japan	8.3	8.6
China	1.2	1.2
Russia	2.3	2.3
The values are reported in Billion USD		

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9 Appendix

9.1 Discussion of Reduced-Form Robustness Checks

Section 9.1 features an explanation of the three major types of robustness checks used to check Table 1. We include pre-trend terms directly in our regressions, use the semiparametric estimator from Abadie (2005), and use nearest neighbor matching. The full results are previously featured in Table 2 in the text.

Approach 1: Include the potential pre-trend in the event study regression. Following, for example, Dobkin, Finkelstein, Kluender, and Notowidigdo (2018), we simply include the estimated trend for treated observations as part of the regression, and estimate the treatment effect on top of that. This leads to the following slight modification of our original event study model:

$$logp_{ft} = \beta_p logq_{ft} + \gamma_f + \alpha_t + \sum_{\tau \neq 1}^{T} \beta_{SC\tau}\{SC_{i(t+\tau)} = 1\} + \sum_{\tau}^{T} \xi_{SC\tau}\{SC_{i(t-\tau)} = 1\} + \gamma_1 \tau + \gamma_2 \tau^2 + \epsilon_{ft} \quad (20)$$

All terms are the same as before, but now the γ parameters represent a quadratic (or linear with the quadratic term dropped) pre-trend on time to treatment τ that the results now condition on. Table 2 shows us that netting out this trend leaves our empirical results intact, but it is well known that this approach may still lead to bias, as recalled in Abadie (2005).

Approach 2: Abadie (2005)'s semiparametric estimator. Abadie (2005) provides a direct way to control for selection on unobserved shocks. In our case, we are interested in controlling for the possibility that firms choose to join SC in response to negative price shocks. Rather than a pure parallel trends assumption, this estimator allows for conditional parallel trends, where the variables being conditioned on can include past outcomes. The researcher must also assume that all firms have some probability of being treated, and that firms do not have a 100% chance of being treated either. Given our setting of costly but voluntary entry and exit into SC, these are fair assumptions in this case.

For estimation, it is necessary to specify treatment selection variables and then to first estimate the probability of treatment as a function of these variables X. In our case, the relevant variables are either the firm's last price, p_{t^*-1}, or their last two prices, p_{t^*-1} and p_{t^*-2}, where t^* is their treatment period. We use a linear approximation and also include year and quarter fixed effects. We label this first stage approximation $\hat{\pi}(X)$.

Abadie (2005) shows that $\hat{\beta} = ((1/n)\sum_{i=1}^{n} X_{ki}\hat{\pi}(X_i)X'_{ki})^{-1}((1/n)\sum_{i=1}^{n} X_{ki}\hat{\pi}(X_i)\hat{\phi}_i Y_i)$ is consistent for the true treatment effect. In this case, without individual fixed effects, $\hat{\phi}_i = \frac{T_i-\lambda}{\lambda(1-\lambda)}\frac{D_i-\hat{\pi}(X_i)}{\hat{\pi}(X_i)(1-\hat{\pi}(X_i))}$. λ represents the proportion of treated observations, k is the size of X, D_i is treatment status, and T_i represents pre- or post-treatment period. A fuller explanation of the estimator and its variance are available in the paper.

Approach 3: Nearest neighbor matching. For nearest neighbor matching, we take each treated observation and "pair" it with the closest observation based on log quantity, quarter, year, destination, cut type, preserve type, and fish type. We specify exact matches for cut type, preserve type, and fish type. The effect of the treatment is then determined by comparing the two groups.

9.2 Validity of supply side instruments

Key to the arguments of both Michel and Weiergraeber (2018) and Berry and Haile (2014) is that instruments used to identify a conduct parameter must cause variation in demand that is different than the actual sale prices. Table 9 demonstrates that this is true for our choice of instruments. Holding log price fixed, 9 of our 10 chosen instruments still significantly vary the level of quantity that a product sells for in their individual regressions. Even all jointly in the same regression, 6 instruments are individually significant in addition to log price, and the F test on all of them together results in a highly significant result. We can thus think of SC membership as providing extra promotion or salience for a given product, given that it empirically shifts the demand curve independent from prices.

Table 9: Collusion Instrument Verification Regressions - Quantity

	(1)	(2)	(3)	(4)	(5)
SC Status	.412	.155	.113	.539	.005
	(0.101)***	(.102)	(.101)**	(.169)***	(.189)
Log price	.626	.586	.626	.594	.686
	(.170)***	(.167)***	(.165)***	(.169)***	(.151)***
Total products in market	.017				.010
	(.005)***				(.004)***
Count of Products in SC:					
At other firms	-.021				-.102
	(.008)***				(.008)***
At the same firm	-.178				-.123
	(.021)***				(.066)*
Count of products by fish type in SC:					
At other firms		.062			.061
		(.003)***			(.047)***
At the same firm:		-.090			.112
		(.032)***			(.051)**
Count of products by cut type in SC:					
At other firms			.087		.083
			(.004)***		(.007)***
At the same firm:			-.083		.084
			(.036)**		(.061)
Count of products by preserve type in SC:					
At other firms				.037	.060
				(.006)***	(.05)***
At the same firm:				-.261	-.030
				(.029)***	(.062)
F Statistic on All Instruments	24.35***	162.6***	215.62***	71.29***	39.13***
N	10,540	10,540	10,540	10,540	10,540

Notes: Dependent variable is log quantity. Sample covers 2009-2017. Price and quantity are quarterly averages at the firm-product-destination level. Includes trout, Atlantic salmon, and Pacific salmon. Standard errors are clustered at the market (quarter-destination-year) level. All regressions include year, quarter, destination, product type, and firm fixed effects.