

The Canned Tuna Cartel

Nathan H. Miller

Georgetown University

Marc Remer

Swarthmore College

Matthew C. Weinberg

The Ohio State University

January 5, 2020

Disclaimer: Results are based on data from The Nielsen Company (US), LLC and marketing databases provided by the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the Nielsen data are those of the researchers and do not reflect the views of Nielsen. Nielsen is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

The Canned Tuna Industry

Canned tuna is largely produced by three firms in the United States

- Bumble Bee
- Chicken of the Sea (“CoS”)
- StarKist

Price-setting, differentiated product competition

- Quality of fish - skipjack and albacore
- Canned in oil or water
- Size of can
- Branding (Charlie the Tuna)

Per-capita consumption peaked in 1989 at 3.9 pounds, but declined to 2.3 pounds by 2013.

Revenue Shares and HHI

	Bumble Bee	CoS	StarKist	Private Label	HHI	Total Revenue
2006	0.38	0.16	0.33	0.13	2968.00	359.30
2007	0.40	0.19	0.28	0.13	2922.00	371.46
2008	0.39	0.19	0.27	0.15	2832.00	377.24
2009	0.35	0.21	0.28	0.16	2714.00	412.20
2010	0.35	0.20	0.28	0.16	2708.00	395.50
2011	0.33	0.20	0.30	0.17	2675.00	389.53
2012	0.33	0.20	0.28	0.19	2633.00	377.21
2013	0.33	0.22	0.27	0.18	2624.00	364.92
2014	0.32	0.23	0.28	0.17	2619.00	351.33
2015	0.33	0.22	0.29	0.16	2662.00	332.04
2016	0.33	0.20	0.30	0.17	2678.00	303.35

Note: Total revenue is only for the grocery stores included in the data.

Price-Fixing Discovery and Guilty Plea

In 2014, CoS agreed to purchase Bumble Bee for \$1.5 billion, prompting a standard merger review by the US DOJ.

Evidence of price-fixing between the three main suppliers uncovered during investigation.

CoS applied for Type B leniency. By 2018, Bumble Bee and Starkist plead guilty to price fixing from 2011 through 2013.

Multiple large grocery stores (e.g. Wal-Mar, Target) subsequently filed civil suits seeking damages.

Timeline of Allegations

Few details available in DOJ settlement complaint.

Direct purchaser's class action civil complaint is public and offers detailed allegations.

- June 2008: Reduced can size from 6 to 5 oz. without decreasing prices.
- March 2011: List price increases.
- March 2012: List price increases.
- July 2015: Price-fixing discovered during merger review.

CoS and Bumble Bee merger is abandoned in December, 2015.

This Paper

1. Document price changes before, during, and after alleged instances of price-fixing.
2. We implement a test of supra-competitive pricing that is agnostic about the underlying model of coordination.
3. Estimate the over-charge damages resulting from the alleged coordinated price increases.

Main Empirical Findings

1. Reduced-form evidence of price increases around the time of alleged coordination.
2. Price-cost markups increased by approximately 20 cents, relative to pre-allegation prices of approximately \$1.30.
3. Changes in unobserved marginal costs are unlikely to explain the observed price increases during alleged time of price-fixing.
4. Reducing can size from 6 oz. to 5 oz. resulted in the largest per-oz. price change.

The Data

Sales data obtained from the Nielsen Company through Kilts Center for Marketing at U of Chicago.

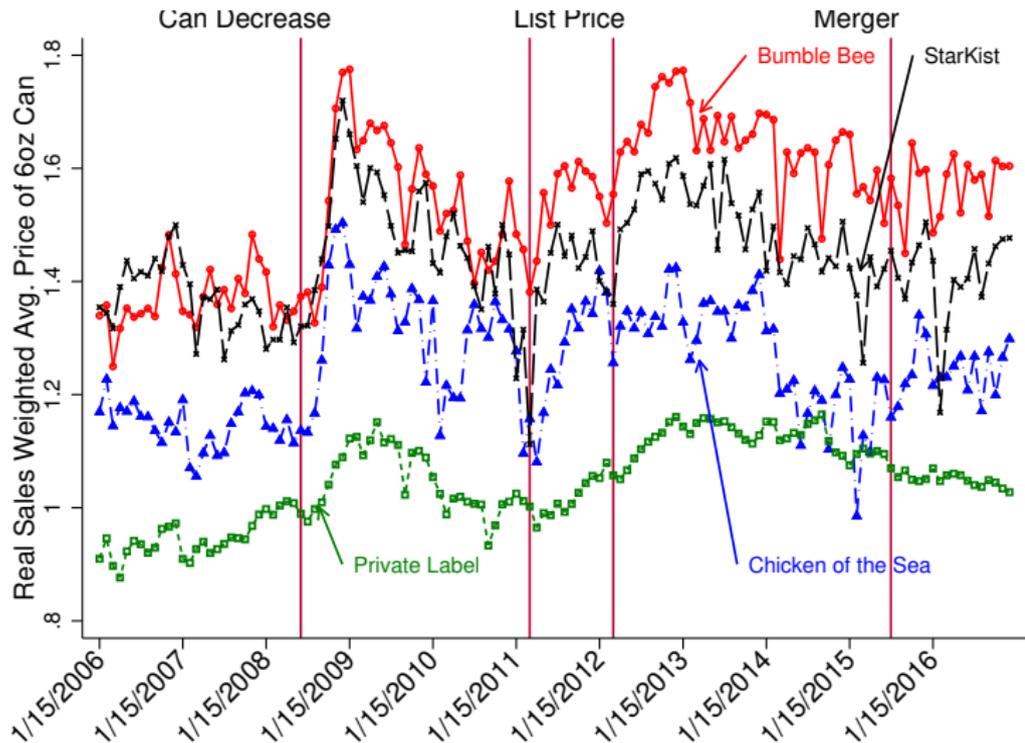
- Weekly revenue and units sold at the store/upc-level.
- Analysis uses top 20 DMAs by total sales revenue.
- Aggregate to product, monthly, DMA-level for demand estimation

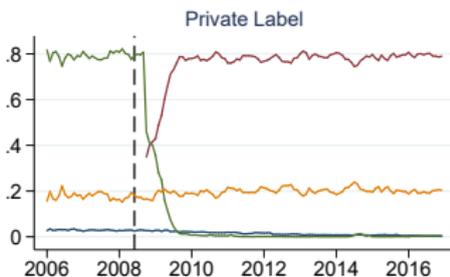
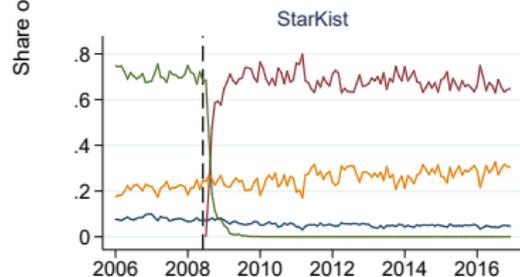
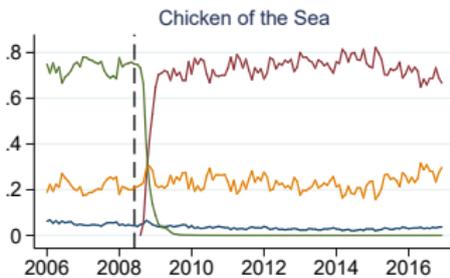
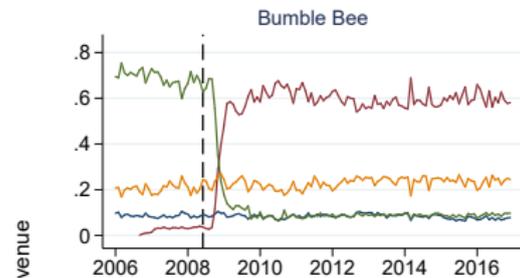
Marginal Cost Data

- Skipjack - monthly price delivered from Bangkok, Thailand (industry benchmark cost).
- Albacore - monthly price of frozen albacore imported into the US.

Data spans from 2006 to 2016. Includes years prior to alleged collusion and after price-fixing was discovered.

Reduced-form Evidence of Price Increases





Price Regressions

	<u>Bumble Bee</u>	<u>Chicken of Sea</u>	<u>StarKist</u>	<u>Private Label</u>
1{date>5/2008}	0.093 (0.005)	0.152 (0.004)	0.235 (0.005)	0.148 (0.004)
1{date>3/2011}	0.004 (0.006)	0.011 (0.005)	0.003 (0.004)	0.022 (0.005)
1{date>3/2012}	0.073 (0.005)	0.020 (0.005)	0.024 (0.006)	0.107 (0.007)
1{date>6/2015}	-0.092 (0.005)	-0.082 (0.004)	-0.114 (0.004)	-0.137 (0.008)
Mean Price	1.52	1.32	1.49	1.05
Observations	222167	217713	257704	145421

Notes: An observation is a brand/type/package size/month/dma. The dependent variable is sales weighted average price. Price is deflated by the CPI with a base year of 2008 and standardized to the price of a 6 oz. can. DMA, month, and type fixed effects are included.

Empirical Model

Empirical Strategy

- 1 Estimate a structural demand model - Nested Logit (for now).
- 2 Assume Nash-Bertrand competition prior to can size decrease.
- 3 Calculate marginal costs implied by Nash-Bertrand competition, assuming average unobserved non-fish costs are unchanged over the data.
- 4 Compare observed prices to prices implied by Nash-Bertrand competition.

Empirical Model

Model Assumptions:

- Static Nash-Bertrand price competition.
- Firms sell differentiated products; may be multi-product firms.
- Standard regularity conditions on demand system

Firms j maximizes profits:

$$\pi_{jt}(p_{jt}, p_{-jt}) = (p_{jt} - c_{jt}(X_t; \gamma))s_{jt}(p_t, X_t; \theta)$$

- p_{jt} is firm j 's price, $c_{jt}(X_t; \gamma)$ is the marginal cost function.
- $s_{jt}(p_t, X_t; \theta)$ is a downward sloping demand function.
- X_t is a matrix of cost and demand covariates.
- (θ, γ) are structural parameters.

Empirical Model

Competitive benchmark is given by the price vector, p_t^N , which solves the static Nash FOC.

$$p_t^N - \mu(p_t^N, X_t; \theta) = c_t(X_t; \gamma) \quad (1)$$
$$\mu_t(p_t, X_t; \theta) \equiv - \left[\mathcal{I} \circ \left(\frac{\partial s_t(p_t, X_t; \theta)}{\partial p_t} \right)^T \right]^{-1} s_t(p_t, X_t; \theta)$$

Here, $\mu_t(p_t, X_t; \theta)$ is the markup function.

If costs are observed then can solve for Nash prices: p_t^N .

If prices are observed then costs implied by Nash competition can be calculated.

Demand Estimation

Nested Logit demand specification (allow for random coefficients in future versions).

$$u_{ijrt} = x_j\beta + \alpha p_{jrt} + \sigma_j^D + \tau_t^D + \xi_{jrt} + \bar{\epsilon}_{ijrt} \quad (2)$$

- $x_j \equiv$ vector of product characteristics.
- $p_{jrt} \equiv$ retail price.
- $\sigma_j^D \equiv$ mean valuation product shifter. Product fixed-effect.
- $\tau_t^D \equiv$ inside good utility may vary over time. Monthly fixed-effect.
- $\xi_{jrt} \equiv$ unobserved product quality
- $\bar{\epsilon}_{ijrt} \equiv$ stochastic logit error.

Demand Estimation - Specifying Nests

Define two groups, $g = 0, 1$, where 1 equals the inside goods and 0 is the outside good.

$$\bar{\epsilon}_{ijrt} = \zeta_{igrt} + (1 - \rho)\epsilon_{ijrt} \quad (3)$$

- $\epsilon_{ijrt} \equiv$ iid extreme value error.
- $\zeta_{igrt} \equiv$ distributed such that $\bar{\epsilon}_{ijrt}$ has extreme value distribution.
- $\rho \in [0, 1] \equiv$ nesting parameter.

Larger ρ corresponds to greater correlation in preferences for inside products.

Inside products \equiv Big 3 and private label products.

Outside good \equiv double maximum observed sales in region.

Demand Estimation - Implementation

Logit error implies the following estimation equation:

$$\log(s_{jrt}) - \log(s_{0rt}) = \mathbf{x}_j\beta + \alpha p_{jrt} + \sigma_j^D + \tau_t^D + \rho \log(\bar{s}_{jrt|g}) + \xi_{jrt}$$

- $\bar{s}_{jrt|g} \equiv$ conditional share of product j among inside goods.
- product characteristics \equiv fish type, oil/water, can size, brand.
- price in 6 oz. equivalents and adjusted for inflation.
- monthly fixed effects for seasonality.
- drop Lent months due to unique customer base.

Demand Estimation - Instruments

Both prices, p_{jrt} , and conditional share, $\bar{s}_{jrt|g}$, are endogenous.

Hausman Instruments

- Average price in other regions
- Proxy for common cost shifters
- Predominantly instruments for price.

BLP and Differentiation Instruments

- Total number of products in a region/month with each characteristic (BLP instruments).
- For a given product, total number of products with the same characteristic (Differentiation instrument).
- Assuming characteristics are exogenous, proxy for the level of competition.
- Predominantly instruments for conditional share

Demand Estimation - Instruments

The 34 BLP and Differentiation instruments are highly collinear.

We implement a principal component routine to address the issue.

The first 18 principal components explain 98% of the variation in the instruments.

We therefore use these 18 principal components, and the Hausman IV's as the demand instruments in the nested-logit regression.

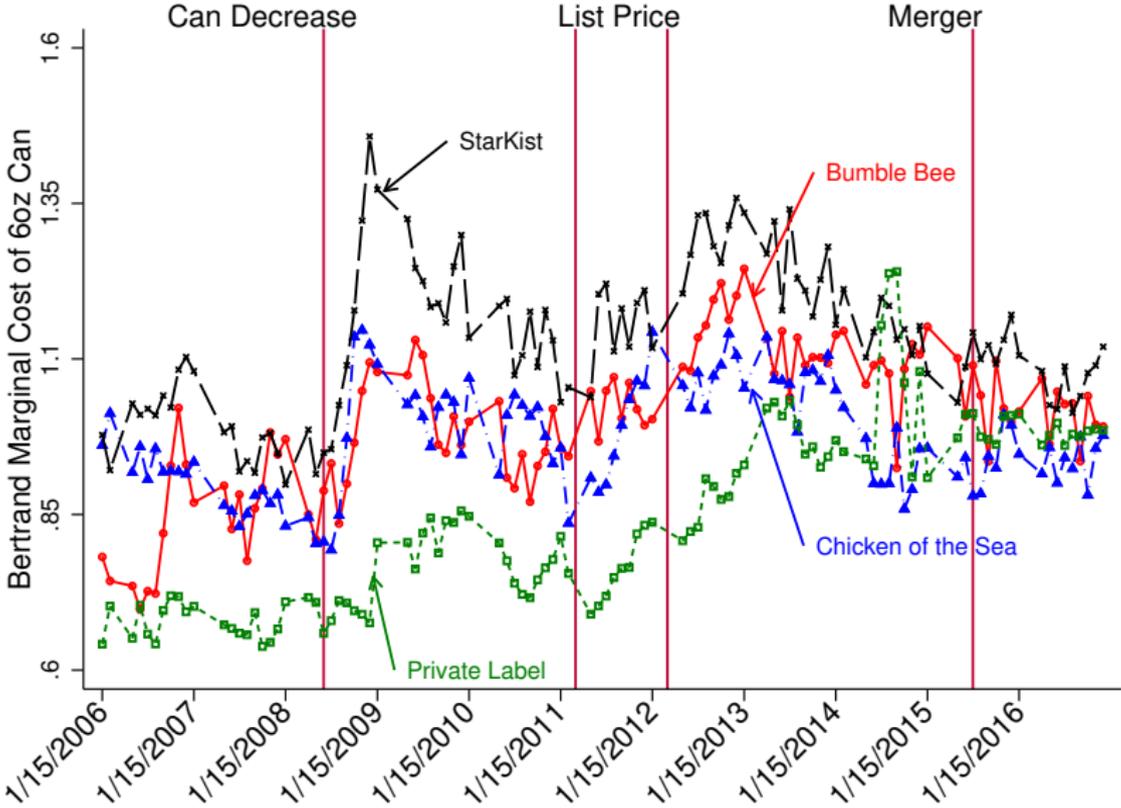
Results

Table: Nested Logit Demand Estimates

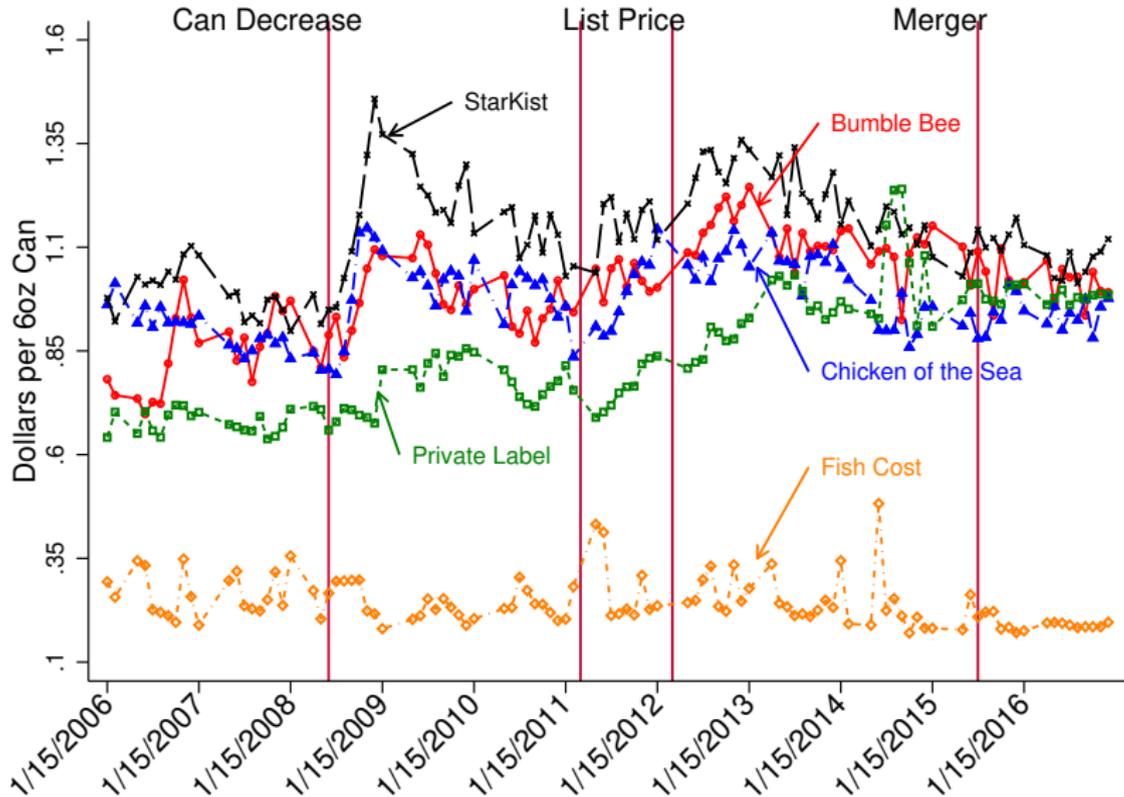
<i>Coefficients and Standard Errors</i>	
Price	-0.060 (0.025)
log(Conditional Share)	0.975 (0.007)
Time Trend	-0.005 (0.001)
<i>Test Statistics</i>	
<i>F</i> -Statistic: Price	1539
<i>F</i> -Statistic: Conditional Share	3329
<i>Economic Statistics</i>	
Median Own Price Elasticity	-3.43
Median Market Price Elasticity	-0.05

Notes: Estimation with 2SLS. Includes product, month, and region fixed effects. Standard errors and test statistics incorporate clustering at the region level. Sanderson-Windmeijer *F*-statistic reported for the first stages. Robust to alternative market size assumptions.

Nash-Bertrand Implied Costs



NB Implied Costs and Actual Fish Costs



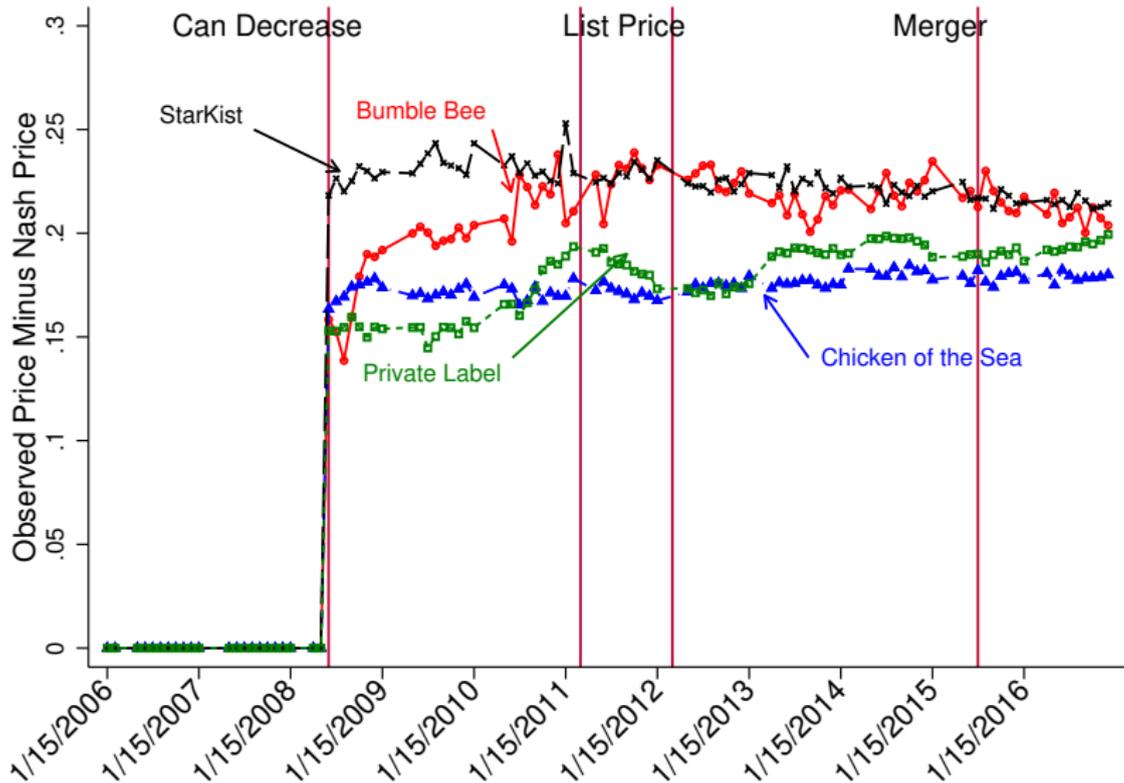
Cost Plot Notes

- Implied MC follow prices, but shifted down by a different amount for each brand.
- Implied MCs do not appear to be driven by changes in the wholesale cost of fish, the predominant cost of production.

Marginal Cost Estimates

- To estimate overcharge, need to take a stance on marginal costs.
 - Solution: Leverage fish wholesale cost data, structure of model, and assumption on unobserved costs.
 - **Assumption:** Non-fish MC in the post periods are, on average, the same as in the pre-period.
- 1 Obtain the implied costs from the Nash FOCs in every period.
 - 2 Subtract fish cost to obtain the non-fish marginal costs implied by Nash.
 - 3 For each product, calculate the mean “pre” non-fish MC and the mean “post” non-fish MC.
 - 4 Subtract mean post non-fish cost from mean pre non-fish cost: $\Delta\bar{w}$.
 - 5 For each product, post non-fish MC \equiv non-fish Nash cost plus $\Delta\bar{w}$.
 - 6 Obtain adjusted MC by adding back in observed fish cost.

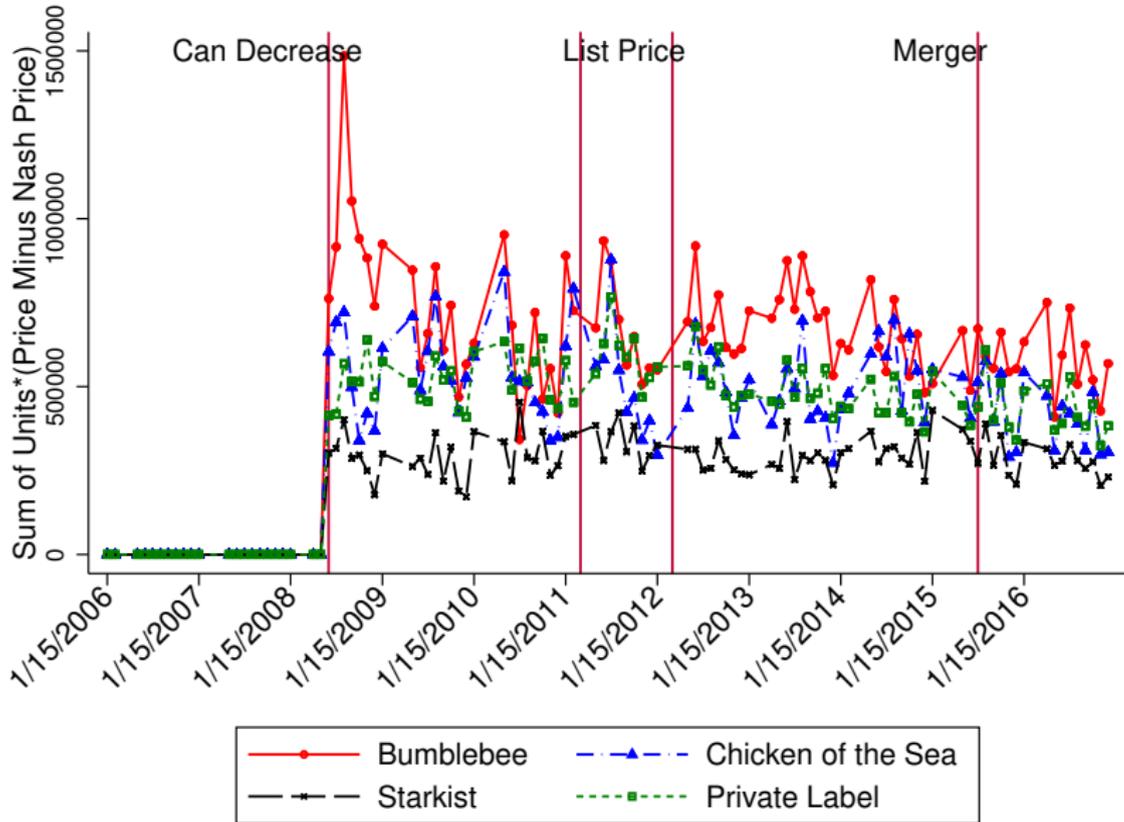
Overcharge Estimates



Overcharge Notes

- StarKist has the largest price increase in response to can size decrease, despite having already having converted their cans
- Bumble Bee's initial increase is in line with CoS, but its price then trends up to StarKist
- Private label also sees a large price increase, and eventually converges to other brands. Private label is supplied, in part, by the Big 3.

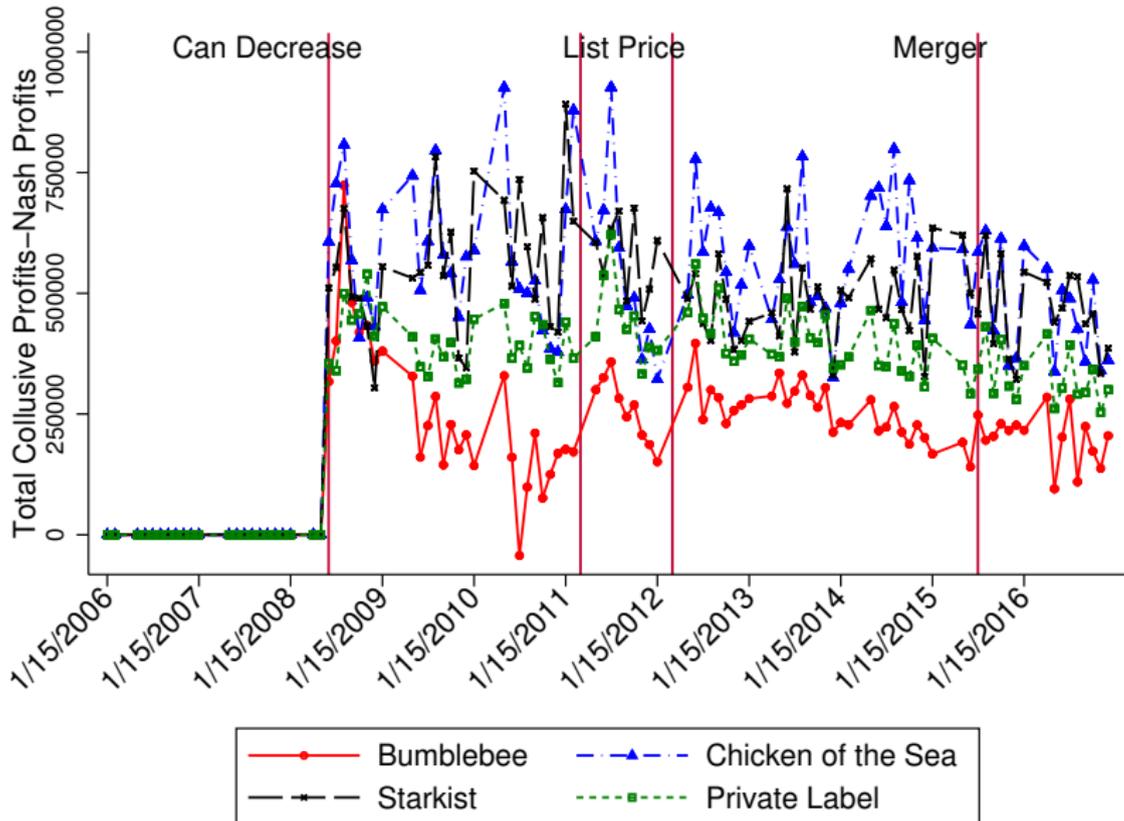
Damages



Damages Notes

- Bumble Bee has the largest damages in the initial periods, as they have a lower markup increase, and enjoy a lot of diverted sales.
- Conversely, Starkest has lower damages because they lost a lot of sales with their higher price increases.
- Damages by firm:
 - Bumblebee = 56.2 million
 - CoS = 41.6 million
 - StarKist = 24.6 million
 - Private Label = 41.3 million

Profits from Collusion



Conclusion

Alleged instances of collusion led to price increases for all three tuna suppliers.

Leverage structural demand estimates to show that prices are inconsistent with Nash-Bertrand competition.

Estimate damages and additional profits from price-fixing to be substantial.