The Canned Tuna Cartel

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Note: Our paper must be reviewed by the Kilts marketing center and Nielsen prior to circulation. We anticipate that this will happen well before IIOC. In place of the paper, we include the following extended abstract.

1 Extended Abstract

We develop and apply an econometric test of supra-competitive pricing that is robust to the underlying supergame. Given demand estimates and a transparent identification assumption, the supply-side and extent of above-Nash pricing can be estimated quickly with ordinary least squares regression. We apply the framework to the canned tuna market, which is dominated by three firms: Thai Union, Bumble Bee Foods, and StarKist. In 2015, the US Department of Justice uncovered evidence of price-fixing and has subsequently obtained guilty pleas. Using retail scanner data covering twenty three of the largest metropolitan areas, we estimate the extent to which prices were set above the static Nash level and the magnitude of consumer harm.

More specifically, we derive a regression equation that allows the econometrician to test for supra-competitive pricing behavior given data on prices and market shares. The markets can be conceptualized as geographically or temporally distinct. We develop the model in the context of differentiated-products price competition in order to fit the canned tuna industry. With appropriate adjustments the approach applies equally to other settings. We focus on single-product firms for notational simplicity though generalizing the model to multi-product firms is simple, and we do so in the empirical application.

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Let the profit of firm j $(j = 1, \ldots, J)$ in market t be given by

$$\pi_{jt}(p_{jt}, p_{-jt}) = (p_{jt} - c_{jt}(X_t; \gamma))s_{jt}(p_t, X_t; \theta) \tag{1}$$

where p_{jt} is firm j's price, p_{-jt} and p_t are a vectors of other firms' prices and all prices, respectively, $c_{jt}(X_t; \gamma)$ is firm j's marginal cost, and $s_{jt}(p_t, X_t; \theta)$ is a downward-sloping demand function that, for present purposes, we assume is known by the econometrician. Demand and cost covariates are contained in the matrix X_t and (θ, γ) are structural parameters. We assume the econometrician observes (p_t, s_t, X_t) and has knowledge of θ.

We assume that the competitive benchmark is given by a price vector, p_t^N, that satisfies the first order conditions for static Nash equilibrium:

$$p_t^N - \mu(p_t^N, X_t; \theta) \quad = \quad c_t(X_t; \gamma) \tag{2}$$

$$\mu_t(p_t, X_t; \theta) \quad \equiv \quad -\left[\mathcal{I} \circ \left(\frac{\partial s_t(p_t, X_t; \theta)}{\partial p_t}\right)^T\right]^{-1} s_t(p_t, X_t; \theta) \tag{3}$$

where $\mathcal{I}$ is the identity matrix and $\circ$ is the operator for element-by-element multiplication. Importantly, $\mu_t(\cdot)$ provides the Nash markups in the special case of $p_t = p_t^N$, but the function can be evaluated with any price vector, including the observed prices p_t. As the objective is to determine whether prices exceed the competitive benchmark, we assume that p_t^N is unobserved to the econometrician, subject to a caveat we introduce later.

To obtain a workable regression equation, we first manipulate the static Nash first order conditions such that observed prices rather than Nash prices appear on the left-hand-side:

$$p_t - \mu\left(p_t, X_t; \theta\right) \quad = \quad c_t(X_t; \gamma) + \phi_t \tag{4}$$

$$\phi_t \quad \equiv \quad (p_t - p_t^N) + (\mu(p_t^N, X_t; \theta) - \mu(p_t, X_t; \theta)) \tag{5}$$

where ϕ is characterizes the difference between observed and Nash prices. Further progress is eased with a specification of the cost function. As a linear form is particularly tractable, we assume that $c_t(X_t; \gamma) = \gamma_1 + X_t\gamma_2 + \eta_t$, where η_t is a vector of residual (unobserved) cost factors. Further defining $\overline{\phi} = \frac{1}{T}\frac{1}{J}\sum_t \sum_j \phi_{jt}$, we have

$$p_t - \mu_t\left(p_t, X_t; \theta\right) \quad = \quad \overline{\phi} + \gamma_1 + X_t\gamma_2 + \eta_t^* \tag{6}$$

where $\eta^* \equiv \eta_t + \phi_t - \overline{\phi}$. The $\overline{\phi}$ term is a reasonable object of interest for the econometrician, though its interpretation may not be readily transparent. From equation (5), we can see that the term depends on both the average overcharge (i.e., $p_t - p_t^N$) and the average difference in the markup function (i.e., $\mu(p_t^N) - \mu(p_t)$). We return to interpretation later.

There are two main econometric challenges associated with applying OLS to equation (6). First, the standard condition required for unbiasedness, $E[X_t'\eta_t^*] = 0$, fails if overcharges respond to cost conditions, as they do in many models of collusion. Absent addition structure on the model, there is no obvious econometric solution. Instrumental variable techniques are inapplicable as the endogenous response is in the error term. Instead it can be appropriate to apply engineering estimates of γ_2, as we do in the empirical application, which circumvents the problem but places greater informational demands on the econometrician.

The second econometric challenge is that $\overline{\phi}$ and γ_1 are not separately identified. Absent prior knowledge on the magnitude of marginal costs, this identification problem appears insoluble under the maintained assumptions.[1] One path forward is to assume that there is a set of markets, which we denote $\mathbb{T}$, in which prices are known to satisfy the static Nash equilibrium conditions. The econometrician may remain agnostic as to whether prices in other markets, $t \notin \mathbb{T}$, satisfy the static Nash conditions. This softens our initial assumption that p_t^N is unobserved, as now we have $p_t = p_t^N$ if $t \in \mathbb{T}$.

Applying these modifications yields the OLS regression equation:

$$y_t = \gamma_1 + \overline{\phi}\mathbb{1}\{t \notin \mathbb{T}\} + \eta_t^* \tag{7}$$

where we refer to $y_t \equiv p_t - \mu_t(p_t, X_t; \theta) - X_t\gamma_2$ as adjusted prices. The estimator of $\overline{\phi}$ is $\hat{\phi} = \overline{y}_{t\notin\mathbb{T}} - \overline{y}_{t\in\mathbb{T}}$, where $\overline{y}$ provides the average of firm-market elements. This is a so-called "differences" estimator because inference is based on the difference in adjusted prices between two sets of markets. It is unbiased if $E[\eta_t \mid t \in \mathbb{T}] = E[\eta_t \mid t \notin \mathbb{T}]$, i.e., if unobserved costs are not systematically different in the two sets of markets.[2]

With minor tweaks to the empirical model, a "differences-in-differences" identification strategy can be implemented if some firms are known to set static Nash prices in all markets. Observations from such firms can help account for changes in unobserved marginal costs. Such a strategy requires that competitive firms do not respond to the price changes of other firms, i.e., that they have a flat best-response function. In some consumer products markets, private label brands may satisfy this criteria. With our application, we view the assumptions needed for the differences strategy as more appealing because the branded manufacturers also produce much of the private label product and because the documentary record does not indicate strong trends on cost outside what can be observed in data.

To implement the methodology, we make use of public court filings detailing specific instances of alleged coordination to increase the per-ounce price of tuna. In light of the DOJ investigation, several large grocery store chains and retailers, such as Wal-Mart and Target, filed civil lawsuits against the tuna producers seeking damages. These publicly available complaints include more detailed allegations, as the DOJ does not release details in settled cases. From 2008 through 2012, the three firms are alleged to have coordinated multiple list price increases and agreed to limit the frequency of sales. The complaints also allege that co-packing agreements among the three producers enabled them to monitor and enforce the coordinated price changes. Until 2009, Chicken of the Sea had an agreement to co-pack out of StarKist's American Samoa cannery. Then, in 2011, Chicken of the Sea and Bumble Bee reached a joint co-packing agreement. Chicken of the Sea would focus its West Coast production out of Bumble Bee's facility in California, and, in turn, Bumble Bee would produce its Eastern canned tuna in Chicken of the Sea's cannery in Georgia. Finally, in an

[1] If the econometrician observes the magnitude of marginal costs then other econometric tests become available (e.g., see Nevo (2001)).

[2] Some nuance is required to interpret $\overline{\phi}$ if some but not all of the markets $t \notin \mathbb{T}$ are characterized by supra-competitive pricing. However, if the econometrician benefits from panel data on multiple geographic areas over time, then time-varying estimates of $\overline{\phi}$ can be obtained that have the simple interpretation as being the average difference in adjusted prices across areas for a given time period.

effort to raise the price per-oz., the firms are alleged to have coordinated a can size decrease. Prior to 2009, the most popular tuna can size was 6 oz. In August 2009, Chicken of the Sea and Bumble Bee abruptly decreased their cans from 6 to 5 oz., which brought them in line with StarKist's products.

Using these allegations, we delineate time periods into unique pricing "regimes" to help identify the demand and supply models. Preliminary reduced-form evidence demonstrates that, after controlling for observable costs, prices increased with each instance of alleged collusion. Furthemore, preliminary structural estimates of the model detailed above finds that the three canned-tuna producers successfully implemented price increases above competitive levels, which resulted in consumer harm. Low-income consumers appear to be most harmed from the price increases.

References

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