Economics at the FTC: Quantitative Analyses of Two Chemical Manufacturing Mergers

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Abstract: Economists at the Federal Trade Commission support the agency's competition and consumer protection missions in numerous ways. In this article, we discuss the economic analyses that were conducted in connection with two Commission antitrust investigations: The first involved a merger of manufacturers of titanium dioxide, which is an intermediate good used in the manufacture of paints, plastics, and other final goods. This article highlights the analysis that the FTC economists performed relating to techniques used to define the relevant product market as well as to analyze the impact of the merger with a Cournot model. The second investigation also involved a merger of manufacturers of an intermediate product -- polyethylene terephthalate (PET) resin -- which is a plastic that is used to manufacture bottles and food packaging. We highlight here the consideration that FTC economists gave to an argument that one of the manufacturers was a failing firm -- which, if true, may imply that the merger would not reduce competition relative to the counterfactual in which one firm would exit the market.

Keywords: Antitrust, Failing Firm, FTC, Market Definition, Mergers

I. Introduction

Roughly 75 Ph.D. economists comprise the bulk of the staff of the Federal Trade Commission's Bureau of Economics (BE). They are joined by a few financial analysts, roughly a dozen research analysts, and a handful of administrative staff. BE supports the FTC's two primary missions: competition (antitrust), and consumer protection. The main capacity in which BE serves the Commission is the performance of economic analysis in connection with the Commission's law enforcement activities (i.e., investigations and litigation).

BE's staff also conduct economic research aimed at refining FTC enforcement decisions and policies, as well as topics that more generally address competition or consumer protection issues. In addition, FTC economists interact with other state and federal government agencies to help provide feedback about laws and regulations that may relate to the FTC's two missions.

Merger review is the modal activity in which BE economists assist in the pursuit of the FTC's competition mission. In 2018, the FTC entered into consent orders for ten mergers and filed suit in three; and seven transactions that were investigated by the FTC staff were abandoned. The FTC also brought actions in three non-merger antitrust matters in 2018. Consumer protection actions were taken by the Commission in 66 cases that represented a great variety of frauds, privacy violations, and false or deceptive advertising (to name a few).[1] FTC actions can have significant economic impact -- especially for the consumers who have been harmed. For example, in an FTC monopolization case that alleged an abuse of government processes, a federal district court awarded $448 million in consumer monetary relief after finding that drug maker AbbVie

[1] See FTC Annual Highlights 2018, Stats & Data at https://www.ftc.gov/reports/annual-highlights-2018/stats-and-data, last visited July 24, 2019.

illegally used sham litigation to maintain its Androgel monopoly.[2] And on the consumer protection side, the FTC required that refunds of over $505 million be sent to people who were deceived in the AMG Services/Tucker payday lending scam.[3]

BE economists also participate in and contribute to the larger economics community by regularly publishing original research articles in academic journals, participating in and hosting conferences, and maintaining an active seminar series. In November of 2018, BE hosted the eleventh FTC Microeconomics Conference.[4] Paper sessions, panel discussions, and keynote addresses focused on topics such as the estimation of markups, strategic supply reduction, extended warranties, consumer protection via occupational licensing, and online privacy. The next FTC Microeconomics Conference will be co-sponsored by Yale University's Tobin Center for Economic Policy and will be held on November 14-15, 2019 in Washington, DC.[5]

This article discusses the analyses that were performed by BE economists in connection with two FTC merger investigations -- both of which involved chemicals but presented quite different economic issues: Section II considers an FTC investigation of a merger of manufacturers of chloride process rutile titanium dioxide. This is a chemical that is used in paints, plastics, and

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[2] See https://www.ftc.gov/news-events/press-releases/2018/06/statement-ftc-chairman-joe-simons-regarding-federal-court-ruling, last visited July 24, 2019.

[3] See https://www.consumer.ftc.gov/blog/2018/09/505-million-refunds-sent-payday-loan-customers, last visited July 24, 2019.

[4] The conference website is located at https://www.ftc.gov/news-events/events-calendar/2018/11/eleventh-annual-federal-trade-commission-microeconomics, last visited July 24, 2019.

[5] Details are available at: https://www.ftc.gov/news-events/events-calendar/twelfth-annual-federal-trade-commission-microeconomics-conference, last visited July 24, 2019.

other final goods. Two aspects of this case that required particularly detailed analysis by economists included market definition -- in particular, the determination of whether a different type of titanium dioxide would be a close substitute -- and the use of a Cournot oligopoly model to analyze the likely competitive effects of the transaction.

Section III turns to an action that the Commission took to preserve competition for polyethylene terephthalate (PET) resin that is used to make plastic bottles and other products. The Commission required three PET resin producers to restructure their transaction and agree to other conditions to settle charges that their proposed $1.1 billion joint acquisition of an under-construction PET production facility would violate federal antitrust law. This section discusses the evaluation of potential price effects from a proposed acquisition of a partially constructed plastics plant. This evaluation required a comparison of the possible anticompetitive harms from alternative ownership structures, while accounting for differences in the likelihood and timeliness with which alternative purchasers might finish construction and open the plant.

II. Market Definition and Competitive Effects in a Titanium Dioxide Merger

In December 2017, the Federal Trade Commission (FTC) issued an administrative complaint that challenged the proposed merger of Tronox Limited (Tronox) and the National Titanium Dioxide Company's titanium dioxide assets (Cristal).[6] The complaint charged that the transaction would violate the antitrust laws by substantially reducing competition in the North American market for

[6] For details, see https://www.ftc.gov/enforcement/cases-proceedings/171-0085/tronoxcristal-usa, last visited July 24, 2019.

chloride process rutile titanium dioxide (TiO2).[7] The complaint alleged that -- if consummated -- the deal would threaten consumer welfare by increasing the likelihood of unilateral anticompetitive output reductions by Tronox.[8] Because the administrative court's opinion would not be released before the parties were able to consummate their deal, FTC also petitioned the D.C. District Court to issue a preliminary injunction to prevent Tronox from closing the proposed acquisition before the administrative court could issue its decision. BE economists worked in support of an expert witness to help develop the economic theories of harm that were presented to both courts, and to help defend these theories against attacks by the defendants.

In September 2018, the District Court granted a preliminary injunction. In December 2018, the administrative law judge upheld the allegations in the FTC complaint. Subsequently, the parties and the FTC negotiated a divestiture that resulted in Cristal's North American TiO2 assets being sold to a third party.

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[7] Rutile TiO2 is used to whiten or opacinate paints, plastics, and other final goods. It can be produced by interacting titanium feedstocks with either sulfuric acid or chlorine. Within the industry, these approaches are known as the chloride process and the sulfate process, respectively. In general, TiO2 produced via the chloride process tends to be brighter, more durable, and bluer in hue than sulfate process TiO2. See discussion in McFadden Opinion, page 3. Available at https://www.ftc.gov/system/files/documents/cases/tronox_pi_opinion_redacted.pdf, last visited July 24, 2019. The FTC has previously analyzed the titanium dioxide market. In 1980, the Commission concluded that DuPont was not guilty of illegally dominating the industry (Dobson, Shepherd, & Stoner, 1994). The industry was separately the subject of several academic studies (Ghemawat, 1984; Hall, 1990; Schumann, Rogers, & Reitzes, 1992).

[8] In addition, the complaint raised the possibility that the transaction would increase the likelihood of coordinated action among the remaining competitors. For more details on the connection between the case and coordinated effects theories, see the recap of the Tronox-Cristal litigation by Hill, Vote, and Wilson (2019).

Economic modeling played a substantial role in several elements of the investigation and subsequent litigation. Below, we discuss two areas where FTC economists and the parties disagreed over the appropriateness of different analytical methods. First, we describe the dispute between the parties and FTC economists over the appropriateness of using price co-movement (Davis & Garces, 2010, p. 182) analyses to delineate the contours of the relevant antitrust market. Second, we consider the relevance and application of the workhorse Cournot model of oligopolistic competition to commodity mergers.

A. The Use of Co-Movement Analyses to Define the Relevant Market

As laid out in the *Horizontal Merger Guidelines (Guidelines)* (2010), a key part of a horizontal merger investigation is defining the relevant market(s). The *Guidelines* state that this serves to "specify the line of commerce and section of the country" that may be affected by a given transaction or practice (§ 4). Moreover, it enables one "to identify market participants and measure market shares and market concentration" (§ 4). Though such measures are not ideal predictors of potential merger consequences, case law and custom afford them great weight.[9] Consequently, in almost all investigations, both the plaintiffs (i.e., the FTC) and the defendants (i.e., the merging parties) devote considerable attention to the question.

The *Guidelines* advise that antitrust markets are defined by engaging in a thought exercise known as the "Hypothetical Monopolist Test" (HMT). This involves asking whether or not a hypothetical monopolist in control of a given set of products could profitably implement a "small

[9] For details on the relative performance of market-definition-based predictors, see Loudermilk and Taragin (2019). For details on the importance of market definition in litigation, see some of the citations in footnote 4 of Baker (2007).

but significant and non-transitory increase in price" (SSNIP). Typically, a SSNIP is defined as a 5-10% increase in price. In practice, the parties and antitrust agencies rarely can use (quasi-) experimental variation in product ownership and pricing to identify precisely the relevant market. Instead, depending on the context, standard econometric tools for analyzing observational data are combined with qualitative insights from market participants to assess the plausibility of different definitions.

In the case of Tronox-Cristal, the FTC complaint specified that the relevant market was chloride process TiO2 sold to North American customers. The FTC's market would not be valid if North American customers could defeat the SSNIP by buying alternatives to chloride TiO2 or through engaging in geographic arbitrage: procuring chloride TiO2 in other regions and importing it to be used in North America. To support its market definition, the FTC relied on a combination of qualitative and quantitative evidence. The qualitative evidence included direct testimony from customers about their preferences and purchase patterns.[10] Quantitatively, market definition was addressed with a variety of analyses, including econometric analyses whose outputs were used in critical-loss tests that were specifically designed to address the question at the heart of the SSNIP test.[11]

[10] Chappell Opinion, pages 13-14. Available at https://www.ftc.gov/system/files/documents/cases/docket_9377_tronox_et_al_initial_decision_redacted_public_version_0.pdf, last visited July 24, 2019.

[11] McFadden Opinion, pages 12-14. See also Chappell Opinion, pages 29-30. For details on critical loss tests, see, inter alia, Katz and Shapiro (2003).

The parties maintained both that North American customers could and would switch to sulfate TiO2 and that international arbitrage was feasible. To support this proposition, they too relied on a mix of qualitative and quantitative evidence: On the qualitative side, the parties emphasized documents and testimony that suggested that sulfate TiO2 could technically be used in many applications for which North American customers currently used chloride TiO2. On the quantitative side, rather than consider actual purchase patterns, the parties used co-movement analyses to support their wider market definition. By co-movement, we refer to types of analysis that consider how different variables change in relationship to each other over time.

The idea of using co-movement analyses to inform market definition has a lengthy pedigree. It dates at least to Stigler and Sherwin (1985), who suggested using correlations among product prices to identify products within a relevant market. Since then, other writers have focused on establishing that price series are cointegrated.[12] In one form or another, the idea of examining the co-movement of price series has regularly been applied to commodity market mergers in the United States and other countries.[13] The sustained appeal of the approach stems from the fairly intuitive idea that the prices of goods in the same market should behave in similar ways.

Notwithstanding the intuition that underpins their use, the reliability of using statistical co-movement analyses to define markets credibly is far from assured. Moreover, despite many

[12] See, for example, Forni (2004). Two non-stationary variables are said to be cointegrated when there exists a linear combination of the two variables that is stationary. This relationship implies that shocks to one variable that cause it to increase or decrease will tend to also affect the other so that the two variables do not drift too far apart. Thus, the relationship involves more of a causal connection than correlation implies.

[13] For example, Hayes, Shapiro, and Town (2007).

practitioners' continued use of them, the antitrust literature has recognized their flaws almost from the moment the possibility of using co-movement to define markets was first proposed.[14]

The argument against relying on correlation analysis is straightforward: Correlation does not provide insight into causality. There are many reasons why two price series might move together. In the case of TiO2, one might well expect the prices of chloride TiO2 to be correlated with the prices for other forms of TiO2 due to both being affected by common cost (i.e., feedstock prices) and common demand (i.e., economic growth) factors. Similarly, one might also expect TiO2 prices to be correlated across regions because of similar underlying demand or cost conditions. Notwithstanding these correlations, however, a monopolist of a particular product or in a particular region might be able profitably to impose a SSNIP.

Cointegration tests also fail to establish relevant markets. The general idea is to test whether or not one can reject the null hypothesis that there is no cointegrating relationship between two products' prices. If one can reject the null, then proponents of this approach to defining markets argue that the projects must be in the same antitrust market. However, while more sophisticated than correlation analyses, cointegration tests of product prices share the problem of not fundamentally addressing the question of demand substitutability that is the focus of market definition. As noted in Davis and Garces (2010, p. 182), the results of the test do not in and of themselves indicate whether the relationship exists for demand or supply reasons. Moreover, cointegration tests possess their own weaknesses: In particular, the existing economic literature has documented substantial problems with the accuracy of cointegration tests in small samples. This is because cointegration is about a long-term equilibrium relationship, and many factors may

[14] See, for example, Baker (1987) or Werden and Froeb (1993).

complicate the relationship between two series in the short run. The sensitivity of cointegration tests to sample size will typically be a problem in contexts such as Cristal-Tronox -- where only a limited time series of data are available. Problematically, at least from the point of view of the FTC staff, the papers that have documented the weaknesses of cointegration tests in small samples have found that the tests are unreliable and may generate high rates of false positives: In small samples, these tests too readily lead the analyst to infer incorrectly the presence of co-integration.[15]

Consistent with these results, the studies that have used publicly available data have shown that correlation and cointegration tests would misleadingly suggest products that are in separate relevant markets are in the same product market. This is true even with much longer time series of data than were available in Tronox-Cristal. For example, data from the Federal Reserve Economic Data (FRED) series show that the prices of crude oil and propane gas are highly correlated and

[15] For example, Cheung and Lai (1993) conclude that Johansen tests are biased toward rejecting the null of no cointegration too often in finite samples compared to the asymptotic distribution of the test statistics. Similarly, Toda (1995) found that one needs 300 observations for the test to perform well uniformly over the range of finite sample scenarios that he considers, while Mallory and Lence (2012) showed that cointegration tests are severely affected by negative moving-average errors, which are common in U.S. commodity price series. Using Monte Carlo simulations to study specifically the performance of cointegration in defining antitrust markets, Coe and Krause (2008) concluded that the performance of cointegration analysis of small samples "provide little economically meaningful information to antitrust practitioners." In particular, their results found "a tendency to over-reject the null hypothesis [of no cointegration] when it is true and only slightly higher rejection rates when the null hypothesis is false, even for the case where T=2600 [observations]."

cointegrated.[16] However, it would be the rare -- and foolish -- consumer who would elect to power a barbeque with crude oil in the event of a SSNIP of propane gas.

The problems that were identified above undermine the validity of the parties' use of cointegration analysis to define antitrust markets and thereby to argue for a broad antitrust market definition in the Tronox-Cristal litigation. The shortcomings of the analysis were also illustrated by the direct evidence that TiO2 customers did not respond to price variation by switching from chloride process material to sulfate process material or by importing TiO2 purchased overseas.

However, despite the economic literature's long awareness of the shortcomings of using co-movement measures to define antitrust markets, we are not aware of any US court having ruled on their (in)validity prior to the Tronox-Cristal litigation. Going forward, this will not be true as both the district and administrative court judges specifically noted in their opinions that such relationships do not speak to the question at the heart of market definition: Would a SSNIP in one set of products' prices lead to significant substitution to products outside the market?[17]

B. Modeling Unilateral Effects Using the Cournot Model

A merger is said to produce "unilateral effects" if it would incentivize the merging parties to increase price or reduce output, even if the merging firms' competitors did not change their price or output. Unilateral effects stem from internalizing the (pre-merger) externality that results from each firm's choice of price or quantity. In quantity-setting models, when one firm decreases its output,

[16] The FRED series used are Crude Oil Prices: West Texas Intermediate – Cushing, Oklahoma (DCOILWTICO) and Propane Prices: Mont Belvieu, Texas (DPROPANEMBTX). We used daily price data for the period between April 30, 2008 and April 30, 2018.

[17] McFadden Opinion, page 15; Chappell opinion, page 21.

the market price increases, which thereby increases the profits of competing firms. An independent firm ignores this externality when choosing its output, whereas a merger causes each merging firm to internalize the externality of its output decision on its former rival. This internalization incentivizes each merging firm to reduce quantity, which thereby results in higher prices.[18]

Quantitative evidence about the magnitude of unilateral effects commonly consists of a merger simulation, which involves assumptions about systems of demand and cost curves that are calibrated to match observed pre-merger pricing. These calibrated demand and cost curves are used to generate predictions of optimal post-merger pricing. Since mergers often produce both marginal cost savings and incentives for higher pricing, merger simulation may be used to calculate the implied marginal cost reduction that is needed to offset the merging firms' incentives to increase price.

A limitation of merger simulation is that the results may not be robust with respect to the specification of the demand or cost system, so what seems to be compelling proof of unilateral effects under (for example) a logit demand system may evaporate under a linear system that rationalizes pre-merger data equally well.[19] Further, while the magnitude of the price increase that is predicted by a merger simulation may have some probative value, the goal of an antitrust agency is to determine whether the combination of unilateral effects and efficiencies will, on net, increase

[18] This reduction in quantity by merging firms incentivizes non-merging firms to increase their quantity as a new equilibrium is reached. Under standard assumptions on demand, the total effect of the merging firms' reduction in quantity and the non-merging firms' increase in quantity is to raise prices. See Farrell and Shapiro (1990) for a general treatment of mergers of Cournot oligopolists.

[19] See Crooke et al. (1999) for a discussion of the relationship between the form of demand and simulated merger price effects.

or decrease price, and thus harm or improve consumer welfare. In this sense, merger simulation goes farther than is necessary in determining not only the sign but also the magnitude of merger price effects.[20]

Methods that trade off weaker assumptions for results that are still sufficient to predict the sign of merger price effects have thus generated considerable interest among antitrust practitioners. One such method -- the compensating marginal cost reduction (CMCR) -- was applied in the Tronox-Cristal litigation.[21] The CMCR is the percentage reduction in marginal cost that would be needed at both merging firms for the merger to result in no price change. It follows from standard assumptions that cost decreases greater than (less than) the CMCR will result in a price decrease (increase).

In the Tronox litigation, the CMCR calculation of the FTC expert witness assumed that producers of TiO2 compete in quantity *a la* Cournot, with each firm's TiO2 a perfect substitute for any other firm's product. Importantly, it did not assume anything about the form of demand or cost curves. This is because only two inputs are needed to calculate the CMCR: the merging firms' pre-merger market shares; and the elasticity of demand.[22] With these inputs, the CMCR is derived by manipulating the merging firms' pre- and post-merger first-order conditions to determine the percentage price reduction such that if both firms' marginal costs decreased by that amount, post-

[20] Magnitude – whether a merger to monopoly would result in a SSNIP -- matters for market definition. But once the relevant market has been delineated, the direction of the welfare change gains in prominence.

[21] CMCR is developed for differentiated products in Werden (1996) and for homogenous products in Froeb and Werden (1998). The FTC applied the latter model in the Tronox-Cristal litigation.

[22] Market shares, of course, depend on which firms are included and excluded from the market, and thus a market definition exercise is also a necessary input into a CMCR calculation. An additional advantage of CMCR over merger simulation is that the latter requires inputs related to non-merging firms, including, at a minimum, market shares.

merger pricing would coincide with pre-merger pricing.[23] In the Tronox-Cristal litigation, the estimated CMCR was well in excess of any cost efficiencies claimed by the parties, and was thus an important component of the argument that the merger would likely result in unilateral price effects that would harm consumers.

The parties contested the appropriateness of the Cournot model that underlay this CMCR calculation along two fronts: First, they claimed that the model implied unrealistic marginal costs for TiO2 producers. Second, they claimed that the model implied that the Tronox-Cristal merger would be unprofitable for the parties. In their view, both of these flaws rendered the Cournot model unsuitable for modeling the TiO2 market. FTC economists disagreed with the premise and/or the validity of both of the parties' claims.

First, the parties correctly pointed out that a Cournot oligopolist chooses quantity q_i to satisfy the first order condition $\frac{p-c_i}{p} = \frac{q_i}{\epsilon * Q}$, where p is the market price, c_i is firm i's marginal cost, ϵ is the market elasticity of demand, and Q is the total quantity sold by all firms, including firm i. Recall that the FTC's CMCR calculation used two inputs: the market shares for Tronox and Cristal ($^{q_i}/_{Q}$); and the market elasticity of demand (ϵ). It follows that these inputs -- together with market shares for non-merging firms and the assumption of Cournot oligopoly -- imply values for each firm's margin ($\frac{p-c_i}{p}$). The parties contended that these implied margins differed significantly from observed margins, particularly for those Ti02 producers with large shares.

FTC economists did not dispute that a poor fit to pre-merger observables -- including pre-merger margins -- could disqualify the Cournot model. As Werden (2010) notes, "the key test of a

[23] Specifically, $CMCR = \frac{2s_1 s_2}{\epsilon(s_1+s_2)-(s_1^2+s_2^2)}$, where s_i is firm i's market share, and ϵ is the market elasticity of demand.

model used to predict the likely unilateral price effects of a merger is how well the model explains premerger pricing." Werden points to a non-merger case in which expert testimony was excluded because of a Cournot model that was inconsistent with observed margins.

However, FTC economists disagreed with the parties with regard to their factual claim that observed margins clearly did not match those predicted by the Cournot model: First, FTC economists claimed that the parties' measure of marginal cost inappropriately included some fixed costs. After accounting only for variable costs, the best available evidence suggested that observed margins coincided fairly closely with predicted margins. Second, it is notoriously difficult to infer economic marginal cost from accounting data,[24] and economists frequently disagree about which costs are marginal and which are fixed. Thus, FTC economists had the view that small differences between observed and implied marginal costs did not invalidate the Cournot model, as such differences are to be expected when using accounting data to measure marginal cost.

Next, the parties used a linear demand model, calibrated to be consistent with observed pre-merger shares, to simulate the effect of the merger on the combined profits of Tronox and Cristal. They concluded that -- as is often the case with Cournot models[25] -- the merger would have decreased the total profits of Tronox and Cristal. The parties claimed that this implies that the

[24] See, for example, Fisher and McGowan (1982), arguing that "accounting rates of return, even if properly measured, provide almost no information about economic rates of return."

[25] Salant et al. (1983) -- which prompted a large literature on the profitability of mergers -- was among the first to conclude that Cournot mergers often appear to be unprofitable. Perry and Porter (1985) showed that a refinement to Salant et al. that allows both firms to continue to exist as separate entities post-merger makes mergers relatively more profitable. Farrell and Shapiro (1990) assume that only mergers that increase variable profits would occur endogenously.

Cournot model is an inappropriate modeling choice, as clearly Tronox and Cristal would not have agreed to merge had they expected their profits to decrease. FTC economists responded by noting that the Cournot model that was used measured only variable profits in North America, and that fixed cost savings and/or savings outside of North America may well have motivated the deal. Since neither of these sources of profitability were measured, nothing could be inferred about the overall profitability of the transaction from the Cournot result.[26]

Ultimately, the district court judge ruled that the FTC's economic analyses of unilateral effects was more consistent with the business realities that were described in the record than was the economic analysis that was offered by the parties.[27]

C. Discussion

Market definition and Cournot modeling in Tronox-Cristal both reflect a common dynamic in merger litigation: The plaintiff first puts forward an affirmative case -- in the form of a complaint and an expert report -- about the harm that would result from the merger. The defendants then often proceed largely by attempting to poke holes in the plaintiff's case. Here, two areas on which the parties focused were their claim that the cointegration of chloride TiO2 and sulfate TiO2 implied a broader market than the FTC complaint alleged, and that the Cournot model behind the CMCR calculation had implications that were inconsistent with reality. In this case, neither critique was sufficient to sway a court opinion.

[26] Fixed cost savings are not typically measured in merger review, as they are irrelevant to consumer welfare. See Wilson et al. (2019) for a discussion of measuring fixed costs under a total welfare standard.

[27] McFadden Opinion, p. 34.

III. Price Effects of Acquisition of a Polyethylene Terephthalate Plant by a Joint Venture

A. Introduction

Corpus Christi Polymers LLC (CCP) is a joint venture formed by: Alfa, S.A.B. de C.V. (DAK); Indorama Ventures Plc (Indorama); and Far Eastern New Century Corporation (FENC). The joint venture members formed CCP to purchase, complete the construction of, and then operate a partially constructed plastic plant in Corpus Christi, Texas, which was being sold pursuant to the bankruptcy of Mossi and Ghisolfi (M&G). In contrast to the analysis of the titanium dioxide merger investigation of the previous section, the FTC staff's analysis of CCP's proposed acquisition presented a number of unusual issues that do not arise in a typical merger investigation.

In a typical merger investigation, we compare our expectation of how the market would evolve after the proposed transaction to a counterfactual, or 'but for' world, where the merging parties would continue to operate independently. In the investigation of CCP's proposed acquisition of M&G's Corpus Christi plant, it was unclear who would purchase and eventually operate M&G's plant but for the proposed acquisition. In addition, we needed to account for the fact that an alternative purchaser might be slower or less likely to complete construction and open the plant. The likelihood and timeliness of the plant opening were important issues because the plant would increase North American capacity by approximately 20 percent, which would likely lead to a significant price reduction.[28] Before discussing the alternative counterfactuals and timing issues, it is important to summarize the bankruptcy process that led to the proposed transaction.

[28] See the FTC Complaint, December 21, 2018, in the Matter of Corpus Christi Polymers LLC, a limited liability company; Alfa, S.A.B. de C.V., a corporation; Indorama Ventures Plc, a corporation; Aloke Lohia and Suchitra Lohia,

In 2011, M&G decided to build one of the world's largest polyethylene terephthalate (PET) and purified terephthalic acid (PTA) plants in Corpus Christi, Texas. PET is a plastic that is used to make soda bottles and other types of packaging. PTA is a chemical precursor to PET, and most of the PTA production at the Corpus Christi plant would be converted into PET within the integrated facility. M&G initially projected that the plant would cost $1.1 billion to build. Construction began in April 2013 and was supposed to be completed in late 2015.[29]

By October 2017, M&G had spent nearly $1.9 billion, and the plant was less than 85 percent complete. At that time, M&G and several of its subsidiaries filed for Chapter 11 bankruptcy protection. The bankruptcy court established requirements for the sale of M&G's assets and scheduled a March 2018 auction for the Corpus Christi plant. M&G received three final bids for the Corpus Christi plant: a bid from CCP, which at the time was a two-firm joint venture between DAK and Indorama; a bid from FENC; and a bid from a subsidiary of Grupo Financiero Inbursa, S.A.B. de C.V. (Inbursa), which is a bank and the plant's largest lienholder.

In evaluating the final bids, M&G had concerns that the bids did not comply with the bankruptcy court's requirements. M&G allowed negotiations among DAK, Indorama, and FENC to create a trilateral bid that would meet the bankruptcy court's requirements. The three firms ultimately agreed to form a trilateral joint venture. The resulting joint venture -- CCP -- submitted a

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natural persons; and Far Eastern New Century Corporation, a corporation, https://www.ftc.gov/enforcement/cases-proceedings/corpus-christi-polymers-llc-et-al-matter, last visited July 24, 2019.

[29] See Katherine Blunt, "Complex bankruptcy leaves potential of plastics plant unmet", *Houston Chronicle*, July 12, 2018.

$1.1 billion bid for the Corpus Christi plant.[30] By the end of March, the court approved the sale of the assets to the three-party joint venture and appointed Inbursa as the backup buyer.[31]

The three owners structured CCP to act as a toll manufacturer. Toll manufacturing, where one company outsources a specific manufacturing process to another in return for a set fee or toll, is quite common in chemical industries. Chemical companies often use toll agreements when their own manufacturing equipment breaks down or when they need to service a distant customer or to service new geographical markets.

Each CCP owner will have access to one-third of the plant's capacity and will independently procure raw materials and independently sell the output. The tolling fee charged to each member is designed to cover the joint venture's costs rather than generate an economic profit. If a joint venture partner fails to utilize all of its tolling rights in a given month, the other two firms will have access to use the spare capacity. If none of the joint venture partners use the spare capacity, CCP will make the capacity available to third parties. The joint venture agreement -- as incorporated in the FTC consent decree -- also prohibits each joint venture member from owning more than a one-third equity interest in CCP and from owning tolling rights to more than one-third of the plant's capacity without prior approval of the Commission.

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[30] See FTC Analysis of Agreement Containing Consent Order to Aid Public Comment, December 21, 2018, in the Matter of Corpus Christi Polymers LLC, a limited liability company; Alfa, S.A.B. de C.V., a corporation; Indorama Ventures Plc, a corporation; Aloke Lohia and Suchitra Lohia, natural persons; and Far Eastern New Century Corporation, a corporation, https://www.ftc.gov/enforcement/cases-proceedings/corpus-christi-polymers-llc-et-al-matter, last visited July 24, 2019.

[31] *See* Order Approving Stipulation Regarding Settlement and Agreement with Respect to Sale of Corpus Christi Assets and Related Matters, *In re M&G USA Corp.*, Case No. 17-12307 (Bankr. D. Del. Mar. 29, 2018).

B. Product and Geographic Market

PET is a plastic polymer that is primarily used to make plastic water and soda bottles and packaging for consumer goods. Consumer goods manufacturers generally cannot switch away from PET without incurring significant costs. Thus, customer substitution to other materials -- such as glass, aluminum, and polypropylene -- is low enough for PET to constitute its own product market.

The Commission determined that North America was the relevant geographic market in which to analyze the effects of the transaction. Imported PET accounts for approximately 15% of North American sales, but primarily serves customers that are located close to the coasts.[32] The Commission's Complaint alleges that imports do not constrain prices throughout North America. More important, if the Corpus Christi plant opened, North American capacity would likely be greater than North American demand, and the North American plants would thereby satisfy all demand.

The North American PET market is highly concentrated: CCP joint venture members -- DAK, Indorama, and FENC -- are three of only four North American PET producers.[33] The joint venture partners together control nearly 90 percent of North American PET capacity. Ownership of North American PTA capacity is also highly concentrated: DAK and Indorama are two of only

[32] See the FTC Complaint, December 21, 2018, in the Matter of Corpus Christi Polymers LLC, a limited liability company; Alfa, S.A.B. de C.V., a corporation; Indorama Ventures Plc, a corporation; Aloke Lohia and Suchitra Lohia, natural persons; and Far Eastern New Century Corporation, a corporation, https://www.ftc.gov/enforcement/cases-proceedings/corpus-christi-polymers-llc-et-al-matter, last visited July 24, 2019.

[33] Before the bankruptcy court auction of the Corpus Christie plant, M&G's PET plant in Apple Grove, WV, was sold to FENC. Since prior to this sale FENC owned no plants in North America, there was no antitrust concerns with that purchase in isolation.

three significant producers. Not every PET plant is integrated with a PTA production facility; however, almost all of the PTA that is produced in North America is used to make PET.

C. Evaluation of a Transaction under Uncertainty

Analyzing CPP's proposed transaction was a challenge primarily because the 'but for' world was unclear. The FTC had to compare the three-firm joint venture to a range of possible alternative buyers. In addition, there was the added uncertainty of which purchaser(s) would have the greatest potential for finishing the construction of the plant as well as the possible delay of completion if someone other than the three-firm joint venture was the buyer. Once the Corpus Christi plant was completed, there would be a sizeable increase in North American capacity and potential downward pressure on prices. From a consumer perspective, the worst outcome of this process would be if the plant never reached completion, and the next worse outcome was a substantial delay.

If the FTC had challenged the three-way joint venture, it is not clear what would have happened to the Corpus Christi plant. Inbursa -- a Mexican bank and the senior creditor -- was the backup bidder in the bankruptcy auction. Presumably, Inbursa could have auctioned the plant again if the FTC blocked the three-party joint venture; but the outcome of that potential sale was unclear. After all, M&G could have pursued an alternative buyer during the initial auction. In light of the considerable uncertainty with regard to the 'but for' world, the FTC evaluated the proposed transaction relative to a set of counterfactuals.

The purchasers that we considered included: 1) the proposed three-party joint venture; 2) a two-party joint venture between DAK and FENC; 3) a two-party joint venture between DAK and an entrant; 4) FENC alone; 5) an entrant alone; 6) DAK; alone; 7) Indorama alone; and 8) a two-

party joint venture between DAK and Indorama.[34] We used a Cournot model to predict how the alternative ownership scenarios would change firm output choices and (as a result) change the overall market price level. More concentrated ownership of production capacity would lead to lower overall output and a higher market price level in this model.[35] While the joint venture technically owned the Corpus Christi capacity, the tolling agreement granted each member control over its share of the plant's capacity. Thus, we set up the model so that each joint venture member owns a share of the Corpus Christi capacity.

We simulated the proposed transaction's effect with the assumptions of linear demand and quadratic costs. In this model, a firm's marginal costs increased at a constant rate with additional output. The slope was inversely proportional to a constant that is representative of the firm's capital investment. Acquisitions redistribute a fixed stock of capital amongst firms in this model. When a firm acquires additional capital (production capacity), its returns to variable factors of production diminish more slowly.[36]

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[34] We assumed that joint-venture partners would have access to equal shares of the capacity.

[35] Werden (1991) shows this result.

[36] A number of scholars have studied this special case of the Cournot model with linear demand and quadratic costs. The cost function is the dual of the Cobb Douglas production function $Q = \sqrt{LK}$ (there is technically no restriction on K's exponent as capital is fixed and fixed costs are not part of the merger simulation model). Perry and Porter (1985) use it to show that there is much greater scope for profitable mergers than is suggested by Salant, Switzer, and Reynolds (1983), who use a Cournot model with constant marginal costs and no capacity constraints. Farrell and Shapiro (1990) and McAfee and Williams (1992) also use the linear demand quadratic cost Cournot model to study the welfare effects of horizontal mergers. Finally, Werden and Froeb (2006) discuss the model as it relates to merger simulation.

We calibrated the model under a range of assumed demand elasticities and assumed that output shares would be proportional to capacity shares after the plant opened. The baseline price level was that which would arise in Cournot equilibrium if the proposed three-firm joint venture owned the Corpus Christi plant. We compared that baseline equilibrium to the equilibria that would occur under the alternative ownership scenarios that were described above.

The model predicted essentially the same price level whether a DAK/FENC partnership controlled Corpus Christi or the proposed three-party joint venture controlled Corpus Christi. Under a DAK/FENC partnership, Indorama would have a stronger incentive to expand output at the margin because it would have a smaller share of the market, but DAK and FENC would have larger shares and would operate less competitively.

Not surprisingly, the model predicted that having DAK or Indorama -- the two largest North American producers -- as the owners of the plant separately or jointly would lead to higher prices than would the three-firm joint venture. The predicted changes in output were large enough to suggest that DAK or Indorama might close one of their smaller and less efficient plants in the long run. This was consistent with commentary in the PET trade press that predicted that DAK or Indorama would likely rationalize capacity if either purchased the Corpus Christi plant on their own or if they purchased it jointly, but not rationalize capacity if they each acquired only one-third of the capacity.

The only two ‘but for’ worlds that were simulated that would lead to lower prices than the proposed transaction were the scenarios where a new entrant bought the plant or where FENC bought the plant. Both of these scenarios showed price decreases of less than one percent. This raised the issue, however, of whether a new entrant or FENC would be able to complete the plant and more importantly how quickly.

If the FTC challenged the proposed transaction, this would inevitably delay the addition of the Corpus Christi capacity to the North American PET market. If the parties decided to fight an FTC challenge, the resulting litigation would also add delay. If the parties abandoned the proposed deal or the FTC won the litigation, then the M&G estate (or Inbursa) would again attempt to sell the assets -- a process that took more than four months in the first instance.

The Cournot model predicted that prices would fall by 4 to 7 percent after the Corpus Christi capacity entered the market. Thus, delaying construction by a year would result in PET customer harm of approximately 4 to 7 percent of annual North American PET revenue.[37] We calculated the net present value of consumer surplus that would be generated by not challenging the proposed transaction by summing the consumer surplus change from a year of delay and the consumer surplus change from the proposed transaction relative to a specific counterfactual transaction in each year thereafter.

For example, transactions such as a new entrant or FENC buying the plant alone would have led to a slightly lower price level than the three-firm joint venture; but with the assumption of one year of delay, the present discounted value of the consumer benefit from accepting the three-party joint venture was greater than the alternative. There was also less uncertainty about whether the three-firm joint venture would finish the plant. Finally, if the plant were put up for bid again, the market could end up more concentrated and with higher prices -- for example, if DAK or Indorama were the only interested bidders.

[37] This approximation ignores the lost sales from the reduction in quantity when price increases.

D. Coordinated Effects and the Consent Agreement

By having all three major U.S. producers of PET in a new business venture, it was possible that the proposed transaction could facilitate communication among the parties. The parties signed a consent agreement with the FTC that addressed the Commission's competition concerns about the transaction by restricting DAK and Indorama's ability to exercise control over CCP and by limiting information exchange among the parties.[38] The FTC consent order was designed to minimize unneeded communication among the parties by restricting the flow of confidential information among them.

The FTC consent order requires that the parties not receive, or attempt to receive, any confidential information from CPP. Confidential information comprises all non-public information that relates to the operation of CCP: including information that is related to customers, pricing, production, costs, and marketing. The only exception is that employees of the parties may receive summary aged and aggregated information and other information that is necessary for reporting obligations and material decisions that affect CCP; and an FTC appointed monitor would oversee the exchange of such information.

In addition, each member would retain, identify, and describe in a log all communications with any other member with respect to the operation and management, or any other aspect of CCP.

[38] See FTC Agreement Containing Consent Order, December 21, 2018, in the Matter of Corpus Christi Polymers LLC, a limited liability company; Alfa, S.A.B. de C.V., a corporation; Indorama Ventures Plc, a corporation; Aloke Lohia and Suchitra Lohia, natural persons; and Far Eastern New Century Corporation, a corporation, https://www.ftc.gov/enforcement/cases-proceedings/corpus-christi-polymers-llc-et-al-matter, last visited July 24, 2019.

The proposed order also restricts the parties from hiring CPP employees with sales, marketing, pricing, or production decision-making authority until a year after their departure from CCP.

E. Discussion

This proposed three-way joint venture presented a number of unique circumstances. The basic question in this case, however, remained the same as in any merger investigation. We evaluated the transaction relative to the other likely outcomes in order to assess the consumer welfare effects.

IV. Conclusion

Even though the transactions that were discussed above involved seemingly similar products -- industrial chemicals -- and were best modeled with the use of one of the most common oligopoly models known to the economics profession -- the Cournot model -- the discussion above highlights how BE economists must tailor their analysis to the specifics of a given investigation. Some of that customization may be required as a way to evaluate arguments that are made by the merging parties -- such as the use of price-correlation studies for market definition in the titanium dioxide case. Or it may be to account for unique aspects of a particular transaction -- such as the three-way joint venture in the PET investigation.

FTC economists must be prepared to utilize the most informative tools that are available to them based on the facts of the matter at hand in order to help decision makers -- including the Commission and the courts -- to be well-informed about the economic consequences of their potential actions.

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