

Q & A ON ECONOMIC CONCEPTS

Free Lunch



Editor's Note: On October 10, 2005, Robert J. Aumann and Thomas C. Schelling shared the Nobel Prize in Economics "for having enhanced our understanding of conflict and cooperation through game-theory analysis." In this installment of Free Lunch, economists Susan Lee, James Nieberding, and David Weiskopf provide a guide to the ways in which game theory informs antitrust analysis. They discuss how game theory fits into the Chicago School and Post-Chicago paradigms, highlight recent cases using game theory analysis, and explain the relevance for antitrust of two important concepts from game theory: the "Nash Equilibrium" and the "Folk Theorem." Future installments of Free Lunch will discuss additional insights into antitrust analysis offered by game theoretic concepts.

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Game Theory

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QUESTION: How has game theory been applied to analyze oligopoly behavior and market power?

ANSWER: Antitrust practitioners have become increasingly interested in the modeling tools and insights of game theory. Because game theory is used to explain the strategic behavior of firms and to guide business strategy, it has been called "the science of strategy."¹

Game theory provides modern techniques for analyzing and understanding oligopoly behavior but these tools were not widely used in antitrust analysis until relatively recently. The early "structure-conduct-performance" (SCP) paradigm provided a simple analytical framework for antitrust analysis in the post-war period, but it lacked theoretic underpinnings with strong empirical support across many industries. Starting from the presumption that price levels tend to be positively related to seller concentration, the SCP paradigm posited that the structure of a particular industry (e.g., concentration levels) drives firms' conduct (e.g., pricing strategies) which then determines market performance (e.g., prices and profits). The general insight of the SCP approach was that high levels of concentration reflect the ability of firms to exert substantial market power. Consequently, large firms and heavily concentrated industries were believed to

merit heightened scrutiny by antitrust regulators because they were thought to be most likely to depart from the ideal of perfect competition.

However, over time, economists found that more careful empirical analyses called into question the SCP paradigm. Other schools emerged to challenge the presumption that market structure alone could reliably predict the existence and exercise of market power. The "Chicago School" espoused the rigorous application of price theory to analyze market power by stressing the importance of understanding the decision-making process of individual buyers and sellers in a market. This school argued that antitrust enforcers should worry less about firm size per se and focus more on whether a firm could exert power over price. Even if a firm artificially enhanced its market power, the Chicago School argued, the effect usually would be temporary, provided that barriers to rivals' expansions or entry were low, because high profits would attract new competitors. The Chicago School argued that this competitive response usually would curtail market power faster and more effectively than antitrust intervention. In addition, the Chicago School noted that there is another interpretation of the SCP relationship—firms with high market shares could also be the efficient, low-priced sellers in the market.

More recently, the "Post-Chicago School" has applied game theory to investigate oligopoly behavior and market power. Some of the most significant developments in game theory include the modeling of dynamic interactions between competitors and allowing imperfect and incomplete information to shape firms' strategic expectations and competitive behavior. The Post-Chicago School literature has demonstrated how these and other complexities can significantly affect the analysis of market power at the firm or industry-level. By factoring in these complexities,

some results from Post-Chicago analyses challenged conclusions drawn by the Chicago School, most notably in the areas of vertical restraints, market foreclosure, predatory pricing, and “raising rivals’ costs” strategies.²

QUESTION: *How can game theory help us analyze collusion?*

ANSWER: A central role of game theory in antitrust analysis can be seen by comparing and distinguishing express collusion and tacit collusion.

Express collusion involves an explicit agreement and direct communication between rivals to conspire to fix prices or restrain output. In contrast, *tacit collusion* is characterized by the absence of express communication between the parties. Game theory has been useful in showing how and when tacit collusion could lead to market outcomes that resemble the effects of agreements based on express communication (i.e., higher prices and lower market output) even without an explicit agreement among the colluding parties. Due to the lack of direct communication, a closer look at the economic evidence usually is needed in such matters to determine if illegal collusion has occurred. Where such evidence is not readily available or is ambiguous, game theory can play a valuable role in determining whether necessary conditions for tacit collusion have been met.

The U.S. Horizontal Merger Guidelines identify critical conditions required for tacit collusion to be sustainable.³ First, firms must be able to detect significant deviations from the terms of collusion in a timely manner. Detection is more likely to be timely in settings where prices and outputs are relatively transparent and where demand or cost fluctuations are relatively infrequent or small. Second, firms must be able to punish significant deviations, and punishment must be “credible” in the sense that firms must find it more profitable over the long run to carry through with the threatened punishment than to overlook cheating by a rival.

In the *Airtours* case, European antitrust enforcers were concerned that the proposed merger of two holiday tour operators would result in concentration levels sufficient to allow the three remaining companies to attain collective dominance, resulting in a high likelihood of tacit collusion.⁴ The European Commission named two conditions as necessary for the creation of a collectively dominant position, which reflect a game-theoretic approach to tacit collusion.⁵ First, conditions must be sufficiently transparent for all members of the oligopoly to monitor the behavior of their rivals. Second, there must be a mechanism to retaliate against any firm that defects from the agreement. This mechanism could include a relatively simple rule, such as an implicit understanding that other firms will punish a defector who increases output by responding with similar increases in output. The threat of such retaliation helps ensure that honoring the tacit agreement constitutes a “best response” for each member of the oligopoly.

In *Arch Coal*, the U.S. district court used game-theoretic reasoning to evaluate the FTC’s allegations that a merger between two coal suppliers would increase the likelihood of tacit collu-

sion.⁶ The FTC argued: “As producers have consolidated . . . a form of tacit cooperation [is likely] in which the major producers may seek to constrain production so that increases in supply will lag increases in demand, creating upward pressure on price.”⁷ The court determined that while suppliers had the *potential* to implement tacit collusion, firms would face significant practical difficulties with monitoring and punishing cheaters owing to the weak transparency of demand and cost conditions and the confidentiality of bidding. On the basis of these fundamentally game theoretic concepts, the court concluded that Arch Coal’s acquisition of Triton likely would not have an anticompetitive effect.

QUESTION: *What is a “Nash Equilibrium” and how is it relevant to analyzing tacit collusion?*

ANSWER: The “Nash equilibrium” is a central concept in game theory. The concept of an equilibrium focuses on analyzing outcomes after the dust has settled. Thus, it is useful in accounting for strategic responses and in assessing the rationality of the strategic actions and responses at issue. As William J. Kolasky has explained, the Nash equilibrium has become “central to our understanding of coordinated interaction among firms in concentrated markets.”⁸ In *Arch Coal* and the EU *Airtours* decisions, for example, the concept of a Nash equilibrium lay behind the agencies’ assessment of suppliers’ ability to sustain tacit collusion by restricting capacity (*Airtours*) or production (*Arch Coal*) in markets where suppliers interact repeatedly (known to economists as “repeated games”).

Non-cooperative game theory assumes that firms act *independently* to maximize their individual profits, taking into account the *interdependence* of their decisions with actions taken by other firms. That is, when deciding how best to set price or other strategic variables (e.g., output or capacity), game theory assumes that a firm takes into account not only the behavior of its rivals but also how rivals likely will respond over time to the firm’s strategic decisions. Furthermore, it is assumed that each firm is aware of the rationality of the other firms. Given these assumptions, the economist’s concept of a Nash equilibrium is a description of a state of affairs in which each firm’s choice represents its preferred response to the choices of other firms. Stated differently, a Nash equilibrium represents a combination of strategies, one for each firm, such that no firm has an incentive to deviate from its chosen price or output.

The government’s anticompetitive theories in *Airtours* and *Arch Coal* reflect the proposition that cooperation between oligopolists to elevate price by restricting output (or capacity) can be a Nash equilibrium in a repeated game. The transparency and enforcement aspects emphasized by game theory identify the conditions that enable tacit coordination to represent a mutual best response. This is understood by antitrust practitioners: “One of the most important lessons learned from game theory, therefore, is that coordination can be a Nash equilibrium only in multi-period games where there is repeated interaction between the players so that a player who cheats in one period risks punishment in later periods.”⁹

QUESTION: What is the “Folk Theorem” and what does it say about collusion?

ANSWER: The Folk Theorem states that when firms interact repeatedly for an indefinite period of time, and they are sufficiently patient about receiving future profits, a wide range of outcomes can be stable, up to and including perfect collusion. Thus, by providing a theoretical basis to predict that collusion can be one possible outcome in markets where the colluding firms may face obstacles to coordinating, monitoring, and enforcing collusion, the Folk Theorem was an important contribution to the conventional theory of collusion. However, the Folk Theorem does not predict that collusion will always be successful or that if collusion occurs, how closely it will approximate the monopoly outcome.

The Folk Theorem represents a mixed blessing for antitrust practitioners because of the wide variety of possible outcomes that it permits. One way that economists have sought to narrow the range of outcomes in repeated games is by introducing the concept of “equilibrium selection.” When multiple outcomes are possible, it is likely that firms will prefer some of these outcomes over others, and may be able to take actions to narrow the range of outcomes. One way to do this is to develop “focal points” that make particular prices or outputs the natural choice.

When firms interact repeatedly, a focal point might be provided by historical behavior. For example, in some industries, firms quote prices that include transportation costs from one or more “basing points”—locations that are independent of the original locations from which the product is produced or shipped. Such a practice may result in prices being more similar than if each firm’s prices varied by the actual shipping distance to each buyer. If all firms adopt the same basing points, their prices would tend to converge. Even in the face of competitive pressures that otherwise would lead to lower prices, this price coordination can lead to supracompetitive prices. Such issues were at play in *Boise Cascade*, although the court did not find it illegal for plywood suppliers to use a system of basing points.¹⁰

QUESTION: How have the contributions of Thomas C. Schelling and Robert J. Aumann, recipients of the 2005 Nobel Prize in Economics, enhanced our understanding of game-theoretic analysis with applications for antitrust?

ANSWER: In 2005, the Nobel Committee identified the path-breaking contributions of Robert Aumann and Thomas Schelling to game theory as revolutionizing the analysis of economic and social interaction.

While early game theorists focused narrowly on situations of pure conflict (i.e., “zero-sum” games like poker, where one player’s gain corresponds to another’s loss), Schelling demonstrated that game theory can apply more generally to a wide range of situations with elements of both cooperation and conflict. Schelling emphasized that most multi-player decisions (e.g., by firms or countries) contain both common and conflicting interests, and he explained that the interplay between these two elements can be analyzed using non-cooperative game theory.

Schelling also demonstrated that some Nash equilibria are more plausible than others by applying the concept of focal points. As discussed above, the role of focal points in narrowing the possible outcomes that may occur in oligopolistic markets has provided a major step forward to applying game theory concepts to analyze antitrust issues.

Aumann, a mathematician by training, contributed to our understanding of game theory in economics by offering a formal definition of “common knowledge” or firms’ awareness of their mutual interdependence. Another of Aumann’s major contributions was to demonstrate how game theory can be used to study economic and social interactions when parties interact over a substantial period of time. Applying these principles, Aumann showed how tacit coordination could achieve an outcome quite close to the monopoly level of price and output. This insight is implicit in the case *United States v. Airline Tariff Publishing*.¹¹ The DOJ alleged that on a daily basis during 1988 to 1990, eight airlines and American Tariff Publishing (ATP) colluded to raise prices and eliminate discounts on airline routes through use of the ATP fare dissemination system. The success of their collective action was aided by the ability of these airlines not only to monitor each other’s fare changes but also to punish “cheaters” by lowering fares on key routes. ■

¹ See Avinash Dixit & Barry Nalebuff, *Game Theory*, <http://www.econlib.org/library/Enc/GameTheory.html>.

² See, e.g., Herbert Hovenkamp, *Post-Chicago Antitrust: A Review and Critique*, *COLUM. BUS. L. REV.* 257 (2001).

³ U.S. Dep’t of Justice & Federal Trade Comm’n, Horizontal Merger Guidelines § 2.12 (1992, revised 1997), available at <http://www.usdoj.gov/atr/public/guidelines/hmg.htm>.

⁴ The court stated that “the purpose of the tacit coordination likely . . . would be to restrict capacity put onto the market by the three remaining integrated tour operators.” See ¶ 83, *Airtours plc v. Commission*, available at http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexplus!prod!CELEXnumdoc&lg=en&numdoc=61999A0342. The Commission’s decision was later overturned by the European Court of First Instance. *Airtours plc v. Commission*, Case T-342/99, 2002 E.C.R. II-2585 (2002), available at <http://www.europa.eu.int>.

⁵ See ¶ 62, *Airtours plc v. Commission*.

⁶ See *FTC v. Arch Coal, Inc.*, 329 F. Supp. 2d 109 (D.D.C. 2004), appeal dismissed *per curiam*, No. 04-5291 (D.C. Cir. Sept. 15, 2004). For a discussion on this subject in the context of the *Arch Coal* decision, see *Coordinated Effects Analysis: The Arch Coal Decision*, ANTITRUST SOURCE, Mar. 2005, at <http://www.abanet.org/antitrust/source/03-05/04-mar05-coalbag323.pdf>.

⁷ *FTC v. Arch Coal, Inc.*, Emergency Motion of the Federal Trade Commission and Plaintiff States for an Injunction Pending Appeal and to Expedite Appeal, available at <http://www.ftc.gov/os/caselist/0310191/040804emergency-motion0310191.pdf>.

⁸ See William J. Kolasky, Deputy Assistant Attorney General, Antitrust Division, U.S. Dep’t of Justice, Address, Coordinated Effects in Merger Review: From Dead Frenchmen to Beautiful Minds and Mavericks (Apr. 24, 2002), available at <http://www.usdoj.gov/atr/public/speeches/11050.htm>.

⁹ *Id.*

¹⁰ *Boise Cascade Corp. v. FTC*, 637 F.2d 573 (9th Cir. 1980).

¹¹ *United States v. Airline Tariff Publishing Co.*, Competitive Impact Statement (Dec. 21, 1992), available at <http://www.usdoj.gov/atr/cases/f4700/4797.pdf>.