

Summer 1-1-2012

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Recommended Citation

William Bradford, *The Creation and Destruction of Price Cartels: An Evolutionary Theory*, 8 *Hastings Bus. L.J.* 285 (2012).
Available at: https://repository.uchastings.edu/hastings_business_law_journal/vol8/iss2/2

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The Creation and Destruction of Price Cartels: An Evolutionary Theory

*William Bradford**

I. INTRODUCTION

Imagine a motorist, I. Ned Gass, who has lost his bearings and is sputtering down a dirt road toward the tiny town of Utopia, desperate to find a gas station as the fuel gauge on his rented car dips below empty and the engine begins knocking. As he approaches the sole intersection, elation surges as through the dust the shapes of not one but two gas stations identical in all apparent respects and located directly across the road from each other come into view. He scans back and forth between the signs for each station. The first—operated by DeweyCheatham Oil—is charging \$7.99 per gallon of regular unleaded. The second—operated by EnHowe Oil—is charging the identical price. His elation fades as he recalls that gas sells for \$3.99 per gallon back in Big City. Angry at this “price gouging” but bereft of options, I. Ned Gass wrestles the wheel toward the DeweyCheatham station and shudders to a stop at the first pump. After he fills the tank and studies a map he speeds back out onto the road, retracing his route toward the interstate highway, muttering about “breaking up OPEC” and “Big Oil” and vowing to “throw the bums out” of Congress and the White House in the next election.

* * *

The preceding scenario¹ raises a number of questions. Clearly, the two gas stations in Utopia are charging a significant price premium above the competitive price, but why are they able to do so? How did they both arrive at the identical supracompetitive price? Why doesn't each station

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1. A scenario—a detailed hypothetical account of a sequence of fictional political, economic, and legal events—is used to generate data and create a natural context for the heuristic analysis of theories, particularly in the field of law and economics. See Carol Rose, *Game Stories*, 22 YALE J.L. & HUMAN. 369, 369–70 (2010).

lower its price in order to attract all the business in Utopia? Is it legal to charge a supracompetitive price? If not, can supracompetitive pricing be remedied through law? If it is legal, what if anything can and should the law do in response? Whether it is legal or not, what entities—firms, consumers, government regulators, or others—are part of the optimal solution to the failure of a competitive market for gas in Utopia, and what rules, processes, and instrumentalities can they wield by way of a remedy?

Part II of this Article will sketch the goals of antitrust law, describe the causes and effects of anticompetitive pricing generally and supracompetitive pricing specifically, explain the inability of antitrust law to suppress some instances of supracompetitive pricing, establish the importance of trust between firms as a necessary condition for supracompetitive pricing, and illustrate how the strategic exchange of information is crucial to the creation and destruction of trust and thus to the evolution and devolution of price cartels. Part III will develop a positive theory² that explains and predicts the evolution and devolution of price cartels as a function of the ability of rival firms to exchange information and, in turn, to enable the generation and sustenance of trust that cooperation in supracompetitive pricing decisions will be reciprocated. Part IV, followed by a Conclusion, extends the scenario *supra* and uses game theory as a heuristic to develop and test the proffered theory, posit working answers to and hypotheses regarding the questions *supra*, and discuss the implications for the creation, interpretation, and adjudication of antitrust law in the context of price cartels.

II. INFORMATION, TRUST, AND THE CREATION AND DESTRUCTION OF PRICE CARTELS

A. THE RELATIONSHIPS BETWEEN MARKET STRUCTURE, COMPETITION, AND SOCIAL WELFARE

Earning a profit is not *ipso facto* a violation of law; quite the contrary: each firm is a legal fiction created by the state for the purpose of maximizing profits, and its continued existence depends upon how well it performs this function.³ To earn profit, a firm combines capital and labor to produce goods or services demanded by consumers and offers them for

2. A “positive” theory is distinct from a normative theory in that it attempts to state what is, and not what ought to be, and thus is falsifiable. JAMES N. ROSENAU, *COMPARING FOREIGN POLICIES: THEORIES, FINDINGS, AND METHODS* 17 (1972). A positive theory includes a specification of constructs or concepts, a set of hypotheses, and criteria for explanation of behavior.

3. See, e.g., Milton Friedman, *The Social Responsibility of Business Is to Increase Its Profits*, N.Y. TIMES MAGAZINE, Sept. 13, 1970, at 126.

sale at the greatest price the market will bear—ideally, from the perspective of the profit-maximizing firm, as close to an infinite sum as possible. In turn, consumers demand these goods and services to satisfy their needs and wants, but want to pay as little as possible—ideally, zero. Where the market is characterized by many firms supplying a particular good or service, competition drives price down, expands output, and maximizes consumer surplus and social welfare.⁴ However, where only a single firm produces a given good or service, that firm is a natural monopoly that, “by keeping the market under-stocked, by never fully supplying the effectual demand, sell[s] [its] commodities above the natural price, and raise[s] [its] emoluments, whether they consist in wages or profit, greatly above their natural rate.”⁵ Thus consumers, as well as market regulators and public officials, have common interests not in suppressing profit *per se* but in preventing monopolization and its effects, which include diminished consumer surplus and social welfare resulting from reduced supply, supracompetitive prices, and supracompetitive profits.⁶

B. ORIGINS OF ANTICOMPETITIVE PRACTICES

Elimination of monopolies does not guarantee competitive prices, however. Multiple producers can also engage in self-interested cooperation that has anticompetitive effects. Indeed, the intensity of competitive behavior in an industry is not fixed but “ranges from peaceful coexistence to all-out combat situations.”⁷ Because competition can trigger price wars that destroy producer surplus, many firms have evolved a “more dynamic relationship than the words ‘competition’ and ‘cooperation’ suggest individually.”⁸ Rather than accept mutually destructive competition as ordained, some rivals—particularly large duopolists⁹—have evolved

4. Tay-Cheng Ma, *Bank-Firm Relationship as a Strategic Commitment in a Duopolistic Environment*, 3 J. COMPETITION, L. & ECON. 233, 241 (2007). “Consumer surplus” is the product of (1) the difference between the maximum price consumers are willing to pay and the price they actually pay and (2) the total quantity purchased. A detailed definition of “social welfare” is beyond the scope of this Article; it suffices to define the term as the aggregate or total wealth or income of a society, with maximization of social welfare implying the form of market that produces and allocates goods and services so as to maximize the real utility to the society it serves. See, e.g., KENNETH J. ARROW, *SOCIAL CHOICE AND INDIVIDUAL VALUES* 1 (2d ed. 1951).

5. ADAM SMITH, *THE WEALTH OF NATIONS* 66 (1776).

6. See AVINDASH DIXIT & SUSAN SKEATH, *GAMES OF STRATEGY* 358–59 (2d ed. 2001) (detailing the common interest of consumers and regulators in competitive prices that resulted in antitrust legislation).

7. Oliver P. Heil, George S. Day & David J. Reibstein, *Signaling to Competitors*, in *WHARTON ON DYNAMIC STRATEGY* 280 (George S. Day, David J. Ribstein, & Robert E. Gunther ed., 2005).

8. ADAM M. BRANDENBURGER & BARRY J. NALEBUFF, *CO-OPERATION* 4 (1996).

9. See IRA WINKLER, *CORPORATE ESPIONAGE* 50 (1997) (noting that cooperation and market partitioning behavior correlates with firm size and is greatest in the case of large duopolists).

relationships of leader-follower behavior, collusion, and even “*de facto* partitioning of the market” to ensure their peaceful coexistence.¹⁰ Under these arrangements, even the most self-interested rivals recognize that, by jointly setting prices higher than would obtain under competition, the welfare of each producer can be maximized, albeit at the expense of consumers.¹¹

C. ORIGINS OF ANTITRUST LAW

Antitrust laws such as the Sherman Act are designed to deter and punish monopolies as well as other anticompetitive practices such as collusive agreements to restrain output, fix prices, or allocate markets.¹² Accordingly, the legal regime governing antitrust has been designed to undo collusion and preserve for consumers the benefits of competitive markets—greater choice, more innovation, higher quality, and above all lower prices—by promoting competition.¹³ When impediments to competition are created by the coordinated strategies of firms, the state has the power and duty to intervene. Antitrust analysis identifies and addresses anticompetitive practices by predicting the behavior of firm combinations under various market characteristics that bear upon the ability to charge higher prices than would prevail absent these combinations and characteristics, and by deterring or punishing predicted or observed behavior.¹⁴ In theory, antitrust laws increase production and lower prices.¹⁵ In practice, antitrust laws are effective in proscribing mergers of rival firms that would otherwise create (quasi)monopoly power. However, deterring and punishing anticompetitive practices, and in particular the apparently collusive pricing observed in duopoly¹⁶ markets in general and by the hypothetical motorist in Utopia in particular, is more difficult.

10. Heil et al., *supra* note 7, at 280. Although in some industries competition is intensifying, in others more extensive collaboration is *en vogue* due to the need for quick responses to rapid market and technological changes. *Id.* at 281.

11. See Jagmohan S. Raju & Abhik Roy, *Understanding Competitive Relationships*, in WHARTON ON DYNAMIC STRATEGY 222.

12. Sherman Act, 15 U.S.C. §§ 1-7 (2000). The Sherman Act proscribes “contracts, combinations, or conspiracies in restraint of trade.” *Id.* at § 1.

13. Dennis A. Yao, *Antitrust Constraints to Competitive Strategy*, in WHARTON ON DYNAMIC STRATEGY 316.

14. Joseph Kattan & William R. Vigdor, *Game Theory and the Analysis of Collusion in Conspiracy and Merger Cases*, 5 GEO. MASON. L. REV. 441, 442 (1997).

15. Yao, *supra* note 13, at 317.

16. A duopoly is a market structure in which only two producers supply the market and by virtue of this have the capacity to exercise market power over price and output.

D. LIMITATIONS OF ANTITRUST LAW

1. *Explicit Price-Fixing*

Explicit price-fixing schemes, along with boycotts and market allocation agreements, where there is evidence of direct communication between firms in establishing the conspiracy to restrain trade, are “naked” cartels that have a “pernicious effect on competition”¹⁷ and are regarded as *per se* violations of the Sherman Act with no further analysis of the intent of the individuals who engaged in these practices or their effects on the market.¹⁸ As recent scholarship underscores, antitrust law can deter and punish explicit agreement price cartels by exploiting distrust between cartel members and incentivizing rivals to be the first to confess their existence to state regulators in exchange for immunity and other side benefits.¹⁹ However, direct evidence of agreements as to price or output is rare—duopolists conspiring to create cartels rarely create paper trails documenting collusive agreements²⁰—and the mere fact that duopolists charge parallel and supracompetitive prices without evidence of direct communication and an agreement to restrain trade is not a *per se* violation that the state can readily enjoin via antitrust law.²¹

17. *Cont'l T.V., Inc., v. GTE Sylvania, Inc.*, 433 U.S. 36, 58 (1977) (quoting *N. Pac. R.R. v. United States*, 356 U.S. 1, 5 (1958)).

18. *See* *Jefferson Parish Hosp. Dist. No. 2 v. Hyde*, 466 U.S. 2, 9 (1984); *United States v. Container Corp. of Am.*, 393 U.S. 333, 335 (1969) (holding illegal an agreement to exchange price information).

19. *See, e.g.*, Christopher R. Leslie, *Trust, Distrust, and Antitrust*, 82 *TEX. L. REV.* 515 (2004); Christopher R. Leslie, *Antitrust Amnesty, Game Theory, and Cartel Stability*, 31 *J. CORP. L.* 453, 455 (2006).

20. Cases where duopolists reach express agreements to fix prices but are sufficiently careful to not allow prosecutors to charge antitrust violations present a distinct category. For a discussion of how antitrust law can nonetheless be used to destroy “naked cartels” even in the absence of evidence establishing an explicit agreement, *see, e.g.*, Dennis W. Carlton, Robert H. Gertner, & Andrew M. Rosenfield, *Communications Among Competitors: Game Theory and Antitrust*, 5 *GEO. MASON L. REV.* 423, 424 (1997).

21. Firms can “openly and fairly gather and disseminate information” regarding the conduct of their businesses and even “meet and discuss such information” without violating the Sherman Act so long as they do not reach a specific agreement or take any “concerted action with respect to prices or production or restraining competition.” *Maple Flooring Mfr. Ass’n v. United States*, 268 U.S. 563, 586 (1925). In fact, the reciprocal gathering of information regarding prices in order to discover and match lower prices charged by rivals promotes the competitive objectives of antitrust law. DOUGLAS G BAIRD, ROBERT H. GERTNER & RANDALL C. PICKER, *GAME THEORY AND THE LAW* 177 (2d ed. 2003). Whether information is exchanged directly or through indirect “signaling” is of less concern to antitrust regulators and consumer welfare advocates than whether the information “makes it easier for parties to coordinate price or other behavior in an anticompetitive way.” PHILIP AREEDA & HERBERT HOVENKAMP, *ANTITRUST LAW: AN ANALYSIS OF ANTITRUST PRINCIPLES AND THEIR APPLICATION* § 1407b (3d ed. 2004).

2. Rule of Reason Cases

Allegations of antitrust violations in cases where no direct evidence of conspiracy exists but conscious parallelism of conduct is evident are subject to a “rule of reason” in which the lawfulness of the conduct is dependent upon an inquiry into the totality of the circumstances, with a focus upon “the facts peculiar to the business, the history of the restraining [of competition], and the reason why it was imposed[.]”²²

3. Proving Violations

In rule of reason cases, defendants’ intent and conduct and the characteristics of the market are critical inquiries,²³ for government prosecutors and civil plaintiffs must prove Section One violations circumstantially through evidence of conscious parallelism²⁴ as well as various “plus factors”—in particular the existence of opportunities for rivals to meet,²⁵ to signal their intentions,²⁶ or otherwise to exchange information—that support an inference of an agreement to fix prices.²⁷ Provided defendant firms can offer explanations based in rationality,

22. *Nat’l Soc’y of Prof’l Eng’rs v. United States*, 435 U.S. 679, 692 (1978). However, convictions in rule-of-reason cases are still possible even with no direct evidence of conspiracy. *See, e.g.*, *Am. Column & Lumber Co. v. United States*, 257 U.S. 377, 409 (1921) (finding, despite no direct evidence of agreements to fix prices, an unlawful restraint of trade because a trade association, in allowing its members to meet and discuss prices, had “contributed greatly” to an increase in prices and that an agreement was highly probable). In recent decades, courts have been more chary of lightly inferring illegality in rule-of-reason cases. *See infra* at notes 27–29 and accompanying text.

23. *See Poller v. CBS*, 368 U.S. 464, 473 (1962) (holding that “in complex antitrust litigation[.] . . . motive and intent play leading roles . . . [and] the proof is largely in the hands of the alleged conspirators . . .”)

24. Conscious parallelism is the behavioral pattern whereby duopolists charge supracompetitive prices in anticipation of rivals pursuing a similar strategy. *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 227 (1993). Conscious parallelism is not illegal *per se* but becomes unlawful price-fixing when conducted pursuant to an express agreement. *See, e.g.*, *Todorov v. DCH Healthcare Auth.*, 921 F.2d 1438, 1456 (11th Cir. 1991).

25. *See, e.g.*, *Pittsburgh Plate Glass Co. v. United States*, 260 F.2d 397, 400–01 (4th Cir. 1958) (holding that conspirators’ opportunity to meet is an important plus factor), *aff’d*, 360 U.S. 395 (1959).

26. *See Yao, supra* note 13, at 323–24 (noting that additional “plus factors” include opportunities to “signal” intentions regarding price such as reporting clearinghouse, licensing agreements involving patented products, and exchange of advertising and marketing plans through industry trade associations and proposed mergers and acquisitions).

27. *See Blomkest Fertilizer, Inc. v. Potash Corp.* 203 F.3d 1028, 1033 (8th Cir. 2000) (“An agreement is properly inferred from conscious parallelism only when certain ‘plus factors’ exist.”); *Wallace v. Bank of Bartlett*, 55 F.3d 1166, 1168 (6th Cir. 1995) (“[P]arallel pricing, without more, does not itself establish a violation Courts require additional evidence which they have described as ‘plus factors.’”). *See generally* William E. Kovacic, *The Identification and Proof of Horizontal Agreements Under the Antitrust Laws*, 38 ANTITRUST BULL. 5 (1993); Reza Dibadj, *Conscious Parallelism Revisited*, 47 SAN DIEGO L. REV. 589 (2010).

efficiency, or prevailing market characteristics for parallel pricing that make “economic sense,”²⁸ the inference of an agreement is rebutted and antitrust law will not permit the punishment of supracompetitive outcomes *post facto* nor require firms to behave irrationally by cutting prices.²⁹ In other words, parallel pricing, which is not only lawful but rational under certain market conditions, is difficult to distinguish from unlawful price-fixing,³⁰ and attempts to do so are dependent upon inquiries into whether information regarding price is exchanged between rival firms, and upon the sensitivity of regulatory agencies and courts to error. Although a noncompetitive outcome is not an inevitable consequence of duopoly, failing proof of express price-fixing agreements between rivals, agencies and courts, averse to false positives, tolerate many facilitative practices that create anticompetitive outcomes, thereby rendering what some suggest is the underenforcement of antitrust law rather than indulging in potentially mistaken inferences of unlawful conduct.³¹

28. *Matsushita Indus. Co. v. Zenith Radio Corp.*, 475 U.S. 574, 587 (1986) (holding that to meet the rule of reason test, a firm’s explanation for anticompetitive outcomes must not be “implausible” or “make no economic sense.”).

29. *See Theatre Enter., Inc. v. Paramount Film Distrib. Corp.*, 346 U.S. 537, 541 (1954) (holding, under a rule of reason, that evidence of parallel conduct alone is insufficient to violate the antitrust prohibition against agreements in restraint of trade). *See also United States v. Int’l Harvester Co.*, 274 U.S. 693, 693 (1927). *See generally* Jonathan Baker, *Two Sherman Act Section 1 Dilemmas: Parallel Pricing, the Oligopoly Problem, and Contemporary Economic Theory*, 38 ANTITRUST BULL. 143 (1993).

30. Kattan & Vigdor, *supra* note 14, at 443 (“[I]f the same firms independently charge the same price because each rationally recognizes that it is in its best interest to match the price charged by its rivals, there is no avoidable conduct that the law can punish, even if the price on which all firms settle is higher than what would prevail in a competitive market.”).

31. Courts and agencies are increasingly aware of and interested in avoiding “false positives,” defined as rulings that pricing decisions violate antitrust laws when they are in fact merely rational and lawful responses to market conditions and rival decisions, on the theory that market competition will eventually correct false negatives whereas the value created by false positives will be lost to the market forever. *See* Michael D. Guttentag, *An Argument for Imposing Disclosure Requirements on Public Companies*, 32 FLA. ST. L. REV. 123, 147 (2004) (describing the judicial preference for “false negatives,” or rulings that pricing decisions do not violate antitrust laws when in fact they should be deemed instances of price-fixing, over false negatives. False positives and false negatives are also described in the literature at Type I and Type II errors respectively. *See generally* Alan Devlin & Michael Jacobs, *Antitrust Error*, 52 WM. & MARY L. REV. 75 (2010). Concern over the possibility of error—both Types I and II—imposes limits on the reach and effectiveness of antitrust law. *See* Frank H. Easterbrook, *The Limits of Antitrust*, 63 TEX. L. REV. 1 (1984) (developing this analysis). Some fault the judicial preference for Type II over Type I errors as resulting in the systematic underenforcement of antitrust law, even if this preference preserves competitive and innovative behavior in general. *See, e.g.*, Frank Meier-Rigaud & Kay Parplies, *EU Merger Control Five Years After the Introduction of the SIEC Test: What Explains the Drop in Enforcement Activity?*, 11 EUR. J. COMPETITION L. 565 (2009); Devlin & Jacobs, *supra*, at 79, 131 (describing antitrust law as “seek[ing] to err on the side of underenforcement” but noting that underenforcement is necessary to avoid “reduced levels of static and dynamic efficiency”); Lawrence M. Frankel, *The Flawed Institutional Design of U.S. Merger Review: Stacking the Deck Against Enforcement*, UTAH L. REV. 159, 159 (2008) (noting that the “institutional design” [of antitrust law] is structured so as to lead to systematic

4. Theoretical Divisions

The Sherman Act was predicated upon the assumption that market concentration correlates with the increased probability of parallel pricing, but subsequent generations of economists and law-and-economics scholars “savaged this conventional economic learning . . . as vague, illogical, and essentially empty.”³² These rational choice theorists³³ suggested that the difficulties firms experience in developing the trust and exchanging the information necessary to achieve and maintain cooperation—a burden termed “transaction costs” that subtract from the benefits incurred through cartelization³⁴—should call into question whether concerted action without explicit collusion is likely to occur frequently or to enhance profits in the long run.³⁵ According to these “cooperation skeptics,” given the fragility of price cartels and the costliness in forming and preserving them, any alleged underenforcement of antitrust law against firms that engage in parallel pricing will not seriously harm social welfare because “successful and prolonged cooperation [between firms] is virtually impossible.”³⁶ However, empirical research by a number of “cooperation optimists” challenged the skeptics and concluded that, although it is not inevitable, cooperation between rational and mistrustful rivals can emerge and

underenforcement, resulting in a significantly greater number of false negatives than false positives[.]” in order to not undermine competition and innovation). However, the rationale for avoiding Type I errors is ultimately pro-competitive and supportive of social welfare as well: if a more prohibitive *per se* rule applied to cooperative pricing based solely on mutual interdependence and collateral interest and did not require evidence of express agreements, firms would be loathe to enter into the market for fear of potential criminal and civil liability, and fewer producers would result in fewer products at higher prices. Dennis W. Carlton, Robert H. Gertner & Andrew M. Rosenfeld, *Communication Among Competitors: Game Theory and Antitrust*, 5 GEO. MASON L. REV. 423, 429 (1997).

32. John Wiley, *Reciprocal Altruism as a Felony: Antitrust and the Prisoner's Dilemma*, 86 MICH. L. REV. 1906, 1913–14 (1988) (citing J. MCGEE IN DEFENSE OF INDUSTRIAL CONCENTRATION (1971)); HAROLD DEMSMETZ, *Two Systems of Belief About Monopoly*, in INDUSTRIAL CONCENTRATION: THE NEW LEARNING 164, 165 (H. Goldschmid, H. Mann & J. Weston eds., 1974).

33. “Rational choice theory”—the most frequent source of explanations and predictions of behavior in the fields of law and economics and antitrust—is a general term for theories that maintain that decisionmakers make decisions to maximize their individual welfare by the means they calculate most likely to do so at the lowest costs. For a general discussion of the origins of rational choice theory, *see generally*, HERBERT SIMON, MODELS OF MAN (1957). For an elaboration of rational choice theory as it is applied within the field of law-and-economics scholarship, *see* RICHARD POSNER, ECONOMIC ANALYSIS OF LAW (Wolters Kluwer Law & Business eds., 6th ed. 1998).

34. *See* Darren Filson, Edward Keen, Eric Fruits & Thomas Borchering, *Market Power and Cartel Formation: Theory and an Empirical Test*, 44 J. L. & ECON. 465, 465 (2001) (elaborating the concept of transaction costs and their inhibition of cartel formation).

35. ROBERT BORK, THE ANTITRUST PARADOX 1754 (Basic Books 1978).

36. Wiley, *supra* note 32, at 1914 (citing Hotelling, *Stability in Competition*, 39 ECON. J. 41, 48 (1929)). So strong is the disbelief of some cooperation skeptics in the threat of parallel pricing that several suggest the Sherman Act be repealed as useless or even counterproductive. *See, e.g.*, D. ARMENTANO, ANTITRUST POLICY: THE CASE FOR REPEAL (1986).

stabilize, leading to increased producer surplus and decreased social welfare, provided rivals learn to communicate, engage in correct strategies, and evolve towards trust and cooperation.³⁷

E. PRICE CARTEL FORMATION AND DESTRUCTION

1. *General Conditions*

Notwithstanding an ongoing lack of theoretical consensus as to whether firms in concentrated markets are likely to engage in parallel pricing and whether antitrust laws should be enacted, interpreted, and enforced to suppress the practice, there is broad agreement in support of the following two postulates: (1) it is difficult to prosecute price cartels under antitrust laws without evidence of an express agreement, and (2) duopolists want very much to cooperate to achieve supracompetitive prices and profits, and benefit greatly from doing so.³⁸ As empirical observation, economic analysis, and, in particular, the use of game theory reveals,³⁹ rational duopolists, acting in their own self-interests, and in consideration of the self-interests of their rivals, can and under certain conditions do form cartels, often without creating any evidence of express exchanges of information that could be judicially construed as agreements to fix prices.⁴⁰ Among these conditions, five are of utmost importance: (a) rivals recognize their mutual interdependence and the desirability of cooperation; (b) rivals capitalize upon opportunities for mutual gains by evolving tacit agreements to engage in supracompetitive, parallel pricing; (c) rivals generate and sustain trust that their opposite numbers will not act upon incentives to “cheat” on cooperative agreements by charging a lower price in order to reap the short-term gains of larger market shares that result from competitive pricing; (d) rivals generate and sustain trust that their opposite numbers will not act upon incentives to “cheat” on cooperative agreements by confessing the existence of such agreements to the state; and (e) rivals develop a method of detecting and punishing cheating.⁴¹ Failure to satisfy

37. See, e.g., ROBERT AXELROD, *THE EVOLUTION OF COOPERATION* (1984).

38. See SMITH, *supra* note 5 (concluding that it is in the nature of producers that they invariably conspire in attempts to transfer wealth from consumers to firms).

39. For a discussion of game theory and its application to analysis of the creation and destruction of cartels, see *generally infra* Part III.

40. See Carlton et al., *supra* note 31, at 424 (noting that parallel pricing arrangements are achieved by rational duopolists even in the absence of any direct information exchange).

41. See *generally* George Stigler, *A Theory of Oligopoly*, 72 J. POL. ECON. 44 (1964) (enumerating the second, third, and fourth of these conditions as the “three problems” that must be solved before a price cartel can be formed and sustained). Absent trust, potential cartel members must rely on contract or force. See Leslie, *Antitrust, Amnesty, Game Theory, and Cartel Stability*, *supra* note 19, at 461–62

these five conditions results either in the failure to create cartels or the failure to sustain them.

2. *The Centrality of Trust*

Of these five conditions, the latter three are most difficult to satisfy. Recognizing mutual interdependence and discerning the benefits of agreements to cooperate in order to achieve supracompetitive pricing in parallel with rivals requires only that firms think and behave strategically.⁴² Developing trust and discovering and punishing its breach are much more difficult tasks for entities that rarely intrinsically trust one another.⁴³ Self-interest analysis, after all, coupled with a presumption against altruism, yields the conclusion that cartel members will cheat on agreements if the net benefits of doing so are greater than the net benefits of compliance. Thus whatever trust cartels can muster is in part a function of the continued self-interested preference in cooperation over cheating, as well as the capacity to monitor, which permits discovery of whether cartel members are cheating by charging competitive prices, and, in turn, the application of sanctions to deter future cheating.⁴⁴ Given the legal prohibition against

(identifying trust, contract, and force as the three mechanisms whereby firms can create and sustain cartels). However, any contracts to engage in anticompetitive pricing would be unenforceable in the courts of the state as a matter of law, and thus any penalties agreed to by the parties for breach of a cartel agreement would be ineffective. See Leslie, *Antitrust, Amnesty, Game Theory, and Cartel Stability*, *supra* note 19, at 461–62. Similarly, the use of force is inefficient and unlikely to yield the desired result of mutually high prices. *Id.*

42. See Leslie, *Trust, Distrust and Antitrust*, *supra* note 19, at 610 (“When they recognize the benefits of long-term cooperation, rational firms will agree to enter mutually coercive, cartel-enforcement mechanisms.”).

43. For a theoretical discussion of the meaning of “trust” and an examination of the process whereby trust is established and maintained through communication, reputational development, identification with groups, and commitments to social norms, see Leslie, *Antitrust, Amnesty, Game Theory, and Cartel Stability*, *supra* note 19, at 528–46. For purposes of this Article, “trust” is defined as a “calculated decision . . . to engage in a transaction with another based on a probability assessment attached to the other person’s likely cooperation[,]” recognizing that the decision to engage in the transaction creates vulnerability due to the possibility of betrayal but recognizing also that cooperation and the solutions to collective action problems are impossible without accepting this vulnerability. Oliver E. Williamson, *Comparative Economic Organization: The Analysis of Discrete Structural Alternatives*, 36 ADMIN. SCI. Q. 269 (1991).

44. In some industries it is not always possible to determine with rapidity and precision whether rivals are pricing supracompetitively or are cheating and charging competitive prices. See generally Carlton et al., *supra* note 31. However, the knowledge that cheating will be sanctioned reduces the incentive to cheat and reinforces trust within cartels. See, e.g., Philip B. Heymann, *The Problem of Coordination: Bargaining and Rules*, 86 HARV. L. REV. 797, 822 (1973) (“The benefits of coordination frequently depend upon trust that agreed sacrifices of freedom of action will be honored despite conflicting temptations.”). However, if detection of cheating is rendered difficult by the capacity to discount secretly or the lack of price transparency, trust is harder to monitor and the incentive to cheat is greater. Leslie, *Antitrust, Amnesty, Game Theory, and Cartel Stability*, *supra* note 19, at 573. Moreover, the need for information regarding pricing decisions of rivals becomes more valuable. See

direct exchange of information in establishing and maintaining pricing agreements, monitoring—which includes practices such as the public reporting of business information, the employment of independent auditors and administrators, and other methods of gathering and analyzing information about rival firms—serves, in effect, as an alternative and permissible information exchange that facilitates, or stands in as proxy for trust.⁴⁵

3. *Facilitating and Compromising Trust through Information Exchange*

In practice, rivals must exchange information that communicates their intention to cooperate and, through repeated interactions and the tolerance of a certain amount of information “leakage,”⁴⁶ build mutual reputations for fairness, honesty, and reliability such that each individual high-pricing decision has a high probability of reciprocation.⁴⁷ In such a relationship, independent efforts to acquire information about a rival’s pricing intentions and decisions, and even to some extent about core competencies—which would otherwise be viewed as hostile and destructive of cooperation—can be analogized to the regime of mutual inspection and verification established between the Soviet Union and the United States to manage the process of disarmament.⁴⁸ Information and trust are both imperfect, but inspection and verification of a tacit cooperative regime exchanges information between rivals that allows them to ascertain if and when cheating has occurred and to respond accordingly, reinforces and rewards cooperative behavior, and thereby increases trust in the stability of the high-price and high-profit arrangement.⁴⁹ Through information exchange, rivals learn to revise their strategies regarding conflict and cooperation on the basis of new knowledge about each other and to signal that they have

Irwin Greenberg, *The Role of Deception in Decision Theory*, 26 J. CONFL. RES. 139, 149–150 (1982) (explaining effects of rivals’ strategies and the transparency of pricing decisions on the value of information).

45. See Leslie, *Trust, Distrust and Antitrust*, *supra* note 19, at 611–12 (describing monitoring as a “trust-facilitating device and a trust substitute.”). The courts have monitored various modalities in regard to their antitrust implications. Disclosure of business information to the general public under Securities and Exchange Commission regulations and the use of lawful competitive intelligence methods are exemplars of permissible methods, whereas agreements to use delivered prices, adhere to announced prices, and standardize product content and credit have been found to violate the rule of reason. See, e.g., Kattan & Vigdor, *supra* note 14, at 454 (discussing cases).

46. See A. Matsui, *Information Leakage Forces Cooperation*, 1 GAMES & ECON. BEHAVIOR 94, 94–96 (1989) (describing the unintentional transfer of information between cooperating rivals as “leakage”).

47. See DIXIT & SKEATH, *supra* note 6, at 23–24.

48. STEVEN J. BRAMS, *SUPERPOWER GAMES: APPLYING GAME THEORY TO SUPERPOWER CONFLICT* 100 (1985).

49. See *infra* at Part V.C. and notes.

acquired such knowledge, enabling steerage of mutual behavior toward desired outcomes.⁵⁰ In short, monitoring leads to information exchange, and information exchange, so long as it does not constitute a proscribed express agreement, can render cooperation rational because it promotes the trust, or creates the trust-substitute, without which cartels cannot endure.⁵¹

4. *Cartel Destruction*

Information exchange, while it is vital to creating the trust necessary to create and sustain cooperation, poses risks to the firms that engage in it. The difficulty firms face in generating trust, the monitoring cartel members employ to enhance or substitute for trust, and the potential gains for members and third parties in exploiting that trust, present opportunities to consumers and regulators frustrated by supracompetitive pricing and antitrust law's seeming "inability to do much about it."⁵² If cartels cannot form or survive absent trust, and if information exchange is necessary to creating and sustaining trust, the mission for consumers and regulators is clear: disrupt or corrupt the information exchange before cooperation occurs, if possible, so that cartels do not form—but afterward if necessary, so that trust collapses and cartels cannot arise or endure.

a. Disruption of Information Exchange

i. *Between Firms*

The first such opportunity to disrupt the information exchange that supports the trust necessary to create and sustain price cartels arises in the issue area of intellectual property. Firms cannot survive the misappropriation of their intellectual property, and in particular their trade secrets⁵³ (which create competitive advantage) are costly and time-

50. Matsui, *supra* note 46, at 98.

51. Leslie, *Trust, Distrust and Antitrust*, *supra* note 19, at 527. Cooperation requires trust, which is difficult to muster, particularly when firms have incentives not to cooperate and when the only way to secure mutually optimal outcomes is for each firm to render itself vulnerable to duplicity at the hands of a rival. When insufficient trust exists, distrust can "block even the attempt at cooperation" among potential cartel members. *Antitrust Amnesty, Game Theory, and Cartel Stability*, *supra* note 19, at 463–64. By contrast, when trust exists, cooperation becomes possible because the expected gains for each firm are greater in the long run than the gains from cheating. For a discussion of the dilemma firms face in determining whether to cooperate, and of the importance of trust to the resolution of this dilemma, see *infra* at Part II.A.

52. BAIRD, GERTNER, & PICKER, *supra* note 21, at 178.

53. A trade secret is any undisclosed information that can be used in the operation of a business or other enterprise and that is sufficiently valuable to afford actual or potential economic advantage over others. The Economic Espionage Act of 1996 defines a trade secret as follows:

consuming to develop, and form the majority of their value.⁵⁴ Although firms routinely gather publicly available or “open source” information about rivals⁵⁵—a lawful practice known as “competitive intelligence”

[A]ll forms and types of financial, business, scientific, technical, economic, or engineering information including patterns, plans, compilations, program devices, formulas, designs, prototypes, methods, techniques, processes, procedures, programs, or codes, whether tangible or intangible, and whether or how stored, compiled or memorialized physically, electronically, graphically, photographically, or in writing if (A) the owner thereof has taken reasonable measures to keep such information secret; and (B) the information derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable through proper means by, the public.

See Economic Espionage Act, 18 U.S.C. § 1839 (1996) [hereinafter “EEA”]. Virtually any information, whether or not recorded, qualifies for trade secret protection if its exclusivity affords it economic value and it is reasonably guarded. RESTATEMENT OF TORTS § 757 cmt. B (1939). Trade secrets are not limited to scientific or technological information; they may include information regarding formulas, recipes, materials specifications, means of manufacturing, computer programs, costs, price information, vendor and customer lists. Trade secrets are distinct from patents, copyrights, and trademarks in that unlike these other three species of intellectual property they are required to be kept secret from rivals as well as from the general public and are not required to be registered with the state to be enforceable. See Kenneth A. Kovach, Mark Pruett, Linda B. Smith, & Christopher Duvall, *Protecting Trade Secrets During Employee Migration: What You Don’t Know Can Hurt You*, 55 LAB. L.J. 69, 73 (2004) (differentiating trade secrets from other forms of intellectual property). Firms may elect not to patent innovations either because they fall outside the scope of patent law, because trade secrets are subject to protection for unlimited duration whereas patents are time limited. See Andrew Beckerman-Rodau, *The Choice Between Patent Protection and Trade Secret Protection: A Legal and Business Decision*, 84 J. PAT. & TRADEMARK OFF. SOC’Y 371, 380–406 (2002) (listing factors that firms consider in choosing between patent and trade secret protection). Trade secret protections endure so long as the trade secrets are properly guarded and not developed independently or reverse engineered by a rival firm.

54. See generally Don Weisner & Anita Cava, *Stealing Trade Secrets Ethically*, 47 MD. L. REV. 1076 (1988) (describing the importance of trade secrets to firms); John Brandt, *Theft in (Your) Office*, INDUSTRY WEEK, June 17, 1996, at 6. The average modern firm may derive seventy percent or more of its value from its intellectual property, to include trade secrets. See Kurt M. Saudners, *The Law Ethics of Trade Secrets: A Case Study*, 42 CAL. W. L. REV. 209, 210–11 (2006) (citing studies). Firms in high-tech manufacturing, computer technology, genetics, and pharmaceutical industries among others may derive nearly all their market value from trade secrets. Kovach et al., *supra* note 53, at 71–72. Rather than expending years and large sums of money to bring competing products to market, firms that steal trade secrets bring equivalent products to market by copying a proven design or process and thereby enhance market share, bypass costly research and development, and enjoy increased profits relative to their rivals. See F.W. RUSTMAN, JR., CIA, INC.: ESPIONAGE AND THE CRAFT OF BUSINESS INTELLIGENCE 110–11 (Brassey’s Inc. ed., 2002) (describing the advantages to the misappropriating firm of trade secret theft).

55. Congressional testimony in hearings that established the Securities Act reveals that Competitive Intelligence was well-established in U.S. industrial practice by the 1930s, as does academic literature of the period. See *Stock Exchange Practices: Hearing before the Senate Banking and Currency Comm.*, 73d Cong., 1 (1934) reprinted in 6 LEGISLATIVE HISTORY OF THE SECURITIES ACT OF 1933 AND THE SECURITIES EXCHANGE ACT OF 1934 (J.S. Ellenberger & Ellen Mahar eds., 1973). (“[T]he system of commercial espionage that exists at the present time in the United States is so perfect that normally the directors of a corporation know much more about their competitors’ business than they do even about their own[.]”); Notes & Legislation, *Industrial Policing and Espionage*, 52 HARV. L. REV. 793, 793 (1939) (describing the rise of “industrial espionage” in the nineteenth century).

(“CI”)⁵⁶ the imperative to monitor pricing by fellow cartel members presents rivals with opportunities and incentives to extend their collection and analysis of data beyond legal and ethical boundaries into what is known as “economic espionage” (“EE”). Although the precise boundary between CI and EE is not sharply limned,⁵⁷ the defining distinction is that whereas CI goes no further than necessary to verify strategies and facilitate cooperation, EE involves the outright theft of trade secrets and the direct inter-firm transfer of value.⁵⁸ When cartel rivals resort to EE,⁵⁹ information

56. “Competitive intelligence [“CI”] is the ethical and lawful application of industry and research expertise to analyze publicly available information on rivals and to produce actionable intelligence that supports informed and strategic business decisions. STRATEGIC AND COMPETITIVE INTELLIGENCE PROFESSIONALS, <http://www.scip.org/content.cfm?itemnumber=2214&&navItemNumber=492>. In the increasingly information- and R&D-dependent economy, knowledge about rivals—capital investment decisions, research plans, R&D data, product designs, marketing strategies, cost structures, and pricing strategies—waxes ever more valuable to the formulation and execution of business strategies. See Chris Carr & Larry Gorman, *The Revictimization of Companies by the Stock Market who Report Trade Secret Theft Under the Economic Espionage Act*, 57 BUS. LAW 25, 25 (2001). Such information aids firms in anticipating changes in demand, preempting market entrants, reducing the cost of innovation, and countering rivals’ strategies, among other desiderata, modeling of rival executives, trade shows, monitoring mass media, and conversations with a rival’s customers, partners, and employees. See generally JOHN E. PRESCOTT, *PROVEN STRATEGIES IN COMPETITIVE INTELLIGENCE* (John E. Prescott & Stephan H. Miller eds., 2001). Common CI methods include data mining, patent tracking, psychological modeling of rival executives, trade shows, monitoring mass media, and conversations with a rival’s customers, partners, and employees. Susan W. Brenner & Anthony C. Crescenzi, *State Sponsored Crime: The Futility of the Economic Espionage Act*, 28 HOUS. J. INT’L L. 389, 413 (2006). CI does not connote misappropriation by theft, deception, or otherwise of proprietary information or trade secrets but depends in the main on open-source public information, shareholders reports, advertising, sales literature, press releases, news stories, published interviews. See generally Anthony J. Dennis, *Assessing the Risks of Competitive Intelligence Activities under the Antitrust Laws*, 46 S.C.L. REV. 263, 266 (1995) (differentiating CI from illegal information gathering activities). CI has a long and rich pedigree: its first recorded use was in the sixth century A.D., when the Byzantine Emperor Justinian dispatched monks to visit China and smuggle away silkworm eggs and mulberry seeds in order to break the Chinese monopoly on silk production. See JACQUES BERGIER, *SECRET ARMIES: THE GROWTH OF CORPORATE AND INDUSTRIAL ESPIONAGE* 4 (Harold J. Salemsen trans., Bobbs-Merrill 1969). The use of CI to monitor tacit cartel arrangements as a trust enhancement or substitute has been recognized for decades. See DEBORA L. SPAR, *THE COOPERATIVE EDGE* 24, 34 (1994). (“While the compulsion to spy belies a deep-seated distrust, the reconnaissance obtained can create some measure of trust or confidence that a cartel partner is abiding by her commitments.”). For a bibliography of the CI field see P. Dishman & V. Knip, *A Chronological and Categorized Bibliography of Key Competitive Intelligence Scholarship*, 1 JOURNAL OF COMPETITIVE INTELLIGENCE & MGMT. 1 (2003).

57. CI activities which are not unlawful but raise ethical questions include appropriating documents misplaced by rivals, overhearing rival executives discuss strategy, hiring employees away from a rival, and “dumpster diving” in a rival’s trash receptacles. See Carr & Gorman, *supra* note 56, at 25 (defining lawful but unethical CI activities); Victoria Sind-Flor, *Industry Spying Still Flourishes*, NAT’L L. J., Mar. 29, 2000, at 1–3.

58. EE is the illegal aspect of information gathering and analysis conducted against rival firms and is sometimes regarded as the “dark” side or unlawful subset of CI. Methods of EE include electronic eavesdropping, surveillance of rival executives and scientists, social engineering (misrepresenting identities to trick people into yielding information), bribing employees or vendors, planting “moles” in rival firms, bugging offices, hacking and stealing computers, cybertheft of data, and outright stealing trade secrets in documentary, electronic, and other formats. Carr & Gorman, *supra* note 56, at 25. By

subject to collection and conversion includes not merely pricing data but everything that competitively advantages the collector relative to the target, and in particular information regarding strategy, technology, and research and development—in short, trade secrets.⁶⁰ Firms that acquire trade secrets increase in value, while firms surrendering secrets decline in value. Thus, while the exchange of information regarding rivals can promote, or substitute for, trust within a cartel, it can also destroy it.

Increasing frequency and severity of trade secret theft, exacerbated by the inadequacy of the jurisdictional reach and available remedies under existing state and federal laws,⁶¹ led the U.S. to enact the Economic Espionage Act of 1996 (“EEA”), which imposes ten years’ imprisonment

using EE, firms can save “millions of dollars and years of research if it can obtain information already gathered by others rather than having to develop it independently.” RUSTMAN, *supra* note 54, at 110. As the pace and cost of technological development have accelerated, the attractiveness of EE as a means for achieving competitive advantage has grown. *Id.* Misappropriation of trade secrets through EE reallocates over \$100 billion from innovators to misappropriators annually by enabling rivals to eliminate developmental dead-ends and introduce goods and services sooner and at lower cost. Carr & Gorman, *supra* note 56, at 26. The value of a trade secret targeted in a single EE operation can exceed \$20 million. *See, e.g.*, U.S. v. Patrick Worthing, No. 97-CR-9 (W.D. Pa., filed Dec. 9, 1996) (alleging a former PPG employee stole trade secrets valued at \$20 million which he attempted to sell to Owens-Corning); United States v. Pin Yen Yang, et al., CR-No. 1:97-CR-288 (N.D. Ohio, filed Sept. 3, 1997) (convicting defendant for stealing R&D with estimated value of \$50 million to \$60 million).

59. Although EE is also conducted by foreign governments for politico-military objectives; such as acquisition of defense technologies or closing the developmental gap, this Article focuses exclusively on the use of EE by cartel members cooperating and competing against each other on economic grounds, and indeed the overwhelming majority of EE prosecutions are brought against domestic, rather than foreign, defendants. *See, e.g.*, Michael L. Rustad, *The Negligent Enablement of Trade Secret Misappropriation*, 22 SANTA CLARA COMPUTER & HIGH TECH L.J. 455, 466–68 (2006) (discussing reasons for very limited prosecution of foreign EE defendants); *id.* at 478–79 (“In general, state-sponsored espionage is carried out with impunity with a trivial chance of being detected let alone prosecuted under the EEA.”). For a discussion of the use of EE by foreign governments, *see generally*, JOHN F. FIALKA, *WAR BY OTHER MEANS: ECONOMIC ESPIONAGE IN AMERICA* (W.W. Norton & Co. Inc., 1997); Karen Sepura, *Economic Espionage: The Front Line of a New World Economic War*, 26 SYRACUSE J. INT’L L. & COM. 127 (1998).

60. *See* Ann S. Jennings & Suzanne E. Tomkies, *An Overlooked Site of Trade Secret and Other Intellectual Property Leaks: Academia*, 8 TEX. INTELL. PROP. L.J. 241, 285 (2000) (enumerating categories of common information sought and accessed in the collection of EE).

61. *See* Harry Wingo, *Dumpster Diving and the Ethical Blindspot of Trade Secret Law*, 16 YALE L & POL’Y REV. 195, 213–15 (1997) (explaining remedial and jurisdictional shortcomings of state trade secrets laws, including lack of criminal sanctions, costs to plaintiffs, and lack of effective damage remedies); Christopher A. Ruhl, *Corporate and Economic Espionage: A Model Penal Approach for Legal Deterrence to Theft of Corporate Trade Secrets and Proprietary Business Information*, 33 VAL. U.L. REV. 763, 772 (1999) (discussing the incongruity of federal statutes that predate the EEA, including legislation governing wire fraud, mail fraud, and transportation of stolen property, with the specific subject matter of the protection of trade secrets); James H.A. Pooley, Mark A. Lemley, & Peter J. Toren, *Understanding the Economic Espionage Act of 1996*, 5 TEX. INTELL. PROP. L.J. 177, 179 (1997) (describing the EEA as a remedial statute to address deficiencies of and fill lacunae in existing state and federal laws). For a substantive and procedural discussion and analysis of the EEA, *see* Shuba Ghosh, *Open Borders, the U.S. Economic Espionage Act of 1996, and the Global Movement of Knowledge and People*, 21 KING’S L.J. 1, 27–32 (2010).

and \$250,000 upon natural persons, fines of up to \$5 million per firm, and property forfeiture upon conviction of the knowing receipt, purchase, or possession of trade secrets.⁶² However, fifteen years after passage of the EEA fewer than sixty cases have been filed—far fewer than anticipated⁶³—and the vast majority of cases go unreported, while many of those that are reported go unprosecuted.⁶⁴ Even when defendants have been convicted under the EEA, punishment has been rather gentle: courts have imposed sentences averaging under two years' imprisonment and fines averaging less than \$50,000—or about a penny for every \$10 of value targeted.⁶⁵

Several grounds have been advanced for the under-enforcement of the EEA. Three are common to the enforcement of criminal statutes more generally. The burden of proof—already high in criminal law—is even more difficult to meet when the prosecution must establish that the defendant could not have simultaneously developed the trade secrets at issue and when reverse engineering is not expressly prohibited by the EEA. Additionally, enforcement resources are scarce, and other priorities drive the exercise of prosecutorial discretion.⁶⁶ Moreover, the EEA fails to afford meaningful remedies to many firms subjected to EE attacks: Although the EEA authorizes courts to award civil restitution for the value

62. See EEA, *supra* note 53, at §§ 1832(a)(2), 1834(e), & 1839(3) (providing criminal penalties, forfeitures, and fines for the knowing but unauthorized taking, alteration or destruction of a trade secret by any means, as well as the knowing receipt of a trade secret taken without authorization).

63. The U.S. Department of Justice has brought fewer than sixty prosecutions under the EEA between 1996 and 2011. Gerald J. Mossinghoff, J. Derek Mason, and David A. Oblon, *The Economic Espionage Act: A Prosecution Update*, OBLON SPIVAK, (July 1998), <http://www.oblon.com/publications/economic-espionage-act-prosecution-update>. Given the volume of EE punishable under the EEA, one would expect an annual average much greater than just under four EEA prosecutions. See Sepura, *supra* note 59, at 139–40 (concluding that the number of cases prosecuted under the EEA is probably a “miniscule portion” of the number of violations that occur). Most EEA prosecutions have involved non-U.S. nationals engaged in EE on behalf of foreign governments; prosecution of domestic EE has been infrequent and the rate has declined in recent years. See Aaron J. Burnstein, *Trade Secrecy as an Instrument of National Security? Rethinking the Foundation of Economic Espionage*, 41 ARIZ. ST. L.J. 933, 971 (2009) (analyzing cases).

64. See WINKLER, *supra* note 9, at 168–70 (stating that thousands of cases of EE go unreported each year and more escape detection); Rustad, *supra* note 59, at 494–95 (analyzing cases and determining that federal law enforcement officials participated in investigations of only one in four reported cases of EE and that “the government will only infrequently devote significant resources to the investigation, prosecution and enforcement of the EEA”); Rustad, *supra* note 59, at 494–95 (reporting that even when the DOJ elects to investigate a report of EEA it waits until the targeted firm performs the bulk of the investigative labor before making an investigative or charging decision).

65. See Chris Carr, et al., *The Economic Espionage Act: Bear Trap or Mousetrap?*, 8 TEX. INTELL. PROP. L.J. 159, 199 (2000) (“For those who wanted to see the EEA used to punish defendants who steal valuable trade secrets, the EEA has proven to be a disappointment”); *id.* at 196–200 (surveying cases and noting that convicted defendants pay fines that represent approximately 1/1000 of the value of those secrets). In the case of *U.S. v. Pin Yen Yang et al.*, two convicted individuals from a firm that stole trade secrets worth up to \$60 million were ordered to pay fines of \$250,000 and \$5,000 respectively. See *United States v. Pin Yen Yang, et al.*, 74 F. Supp. 2d 724, 724 (N.D. Ohio 1999).

66. See Ruhl, *supra* note 61, at 785–86 (enumerating difficulties in proving EEA cases).

of lost trade secrets, in practice such awards have seriously undervalued the loss to the targets of EE.⁶⁷

Other explanations are connected to the practical mechanics of prosecution, but are motivated by the rational self-interest of targeted firms in protecting their value against secondary loss through the market effects of disclosing thefts and through leakage during litigation. The publicity attendant to admitting the theft of trade secrets is, in practice, more costly than the value of the secrets themselves.⁶⁸ Evidence indicates that prosecuting a claim under the EEA is likely to result in two undesirable effects: (1) the defendant, whether an individual or a firm, will likely be granted access through discovery to the trade secrets at issue in order to aid the defense, thus in effect completing the attempted crime and enriching the culpable firm in the amount of the value of the information minus any fines,⁶⁹ and (2) when information that a publicly traded firm has been victimized by EE is revealed in litigation, the stock price of the victimized firm falls to reflect the diminished market view of its value.⁷⁰ Empirical

67. See Marc J. Zwillinger & Christian S. Genetski, *Calculating Loss Under the Economic Espionage Act of 1996*, 9 GEO. MASON L. REV. 323 (2000) (analyzing methods, and in particular the use of market value, of calculating the value of lost trade secrets by courts and arguing that such methods seriously undervalue both the harms to the victims of EE and the gains to the perpetrators). On the valuation of misappropriated intellectual property, see generally Edward M. Roche, *Internet and Computer Related Crime: Economic and Other Harms to Organizational Entities*, 76 MISS. L.J. 639 (2007); F. Russell Denton & Paul J. Heald, *Random Walks, Non-Cooperative Games, and the Complex Mathematics of Patent Pricing*, 55 RUTGERS L.J. 1175 (2002–2003).

68. See Carr & Gorman, *supra* note 56, at 28.

69. See *United States v. Kai-Lo Hsu*, 982 F. Supp. 1022 (E.D. Pa. 1987), *rev'd* 155 F.3d 189 (3d Cir. 1998) (leaving open the opportunity for defendants charged with substantive crimes under the EEA to demand discovery of the victim firm's trade secrets and related documents). This unsavory prospect was anticipated in congressional hearings prior to the enactment of EEA. See S. Rep. No. 104–359, at 11 (1996) (“Even if a company does bring [charges], the . . . penalties are often absorbed by the offender as a cost of doing business and the stolen information retained for continued use.”). Although the EEA provides that the court “shall enter such orders and take such action as may be necessary and appropriate to preserve the confidentiality of trade secrets, consistent with . . . all other applicable laws[,]” in practice EEA defendants have resorted to “graymail,” defined as the practice of obtaining trade secrets through discovery and thereafter threatening to disclose them unless criminal charges are dropped. See Allyson A. McKenzie, *United States v. Kai-Lo Hsu: An Examination of the Confidentiality Provision of the Economic Espionage Act: Is it Suitable to Maintain the Use and Effectiveness of the EEA?*, 35 DEL. J. CORP. L. 309, 319, 321 (describing the use of graymail in EEA prosecutions); EEA, *supra* note 53, at § 1835 (authorizing courts to issue protective discovery orders). Courts are reluctant to limit discovery to protect firms' trade secrets on the ground that overbroad orders limiting discovery might infringe on defendants' constitutional rights to confront witnesses through discovery of documents, to include the very trade secrets they are accused of stealing. See Dennis J. Kelly & Paul Mastrocola, *The Economic Espionage Act of 1996*, 26 NEW ENG. J. ON CRIM. & CIV. CONFINEMENT 181, 190 (2000) (discussing how courts resolve this tension in favor of defendants' rights to access firms' trade secrets through discovery); see also Brenner & Crescenzi, *supra* note 56, at 437.

70. See Carr & Gorman, *supra* note 56, at 39–40; see also Weld Royal, *Too Much Trust?*, INDUSTRY WEEK, Nov. 2, 1998, at 1 (“Information loss is like the AIDS of corporate America . . . For a long time no one would talk about it, fearing the impact on their stock prices and confidence of

research indicates that public disclosures of trade secret theft are associated with a statistically significant negative stock market response: When the market discovers that a firm has been subjected to EE it responds, and the market capitalization of the targeted firm decreases, as the consequence of this discovery, by 0.892% on average.⁷¹ Firms suffer when they are perceived by customers and investors as incapable of safeguarding their classified information. Rational firms understand that, when victimized by EE, they are best off economically if they do not report the crime.⁷²

Whether based upon the narrow economic self-interests of firms and prosecutors or on some other rationale(s), underenforcement of the EEA incentivizes the use of EE, renders trade secrets more vulnerable, destabilizes the trust necessary to creating and maintaining cartels, and advances the objectives of antitrust law and antitrust regulators—increased enforcement, increased competition, and enhanced social welfare.⁷³

ii. Between Firms and the State

A second opportunity to disrupt the information exchange that supports the trust necessary to create and sustain price cartels arises within the antitrust regime itself. Price-fixing is a criminal violation of the Sherman Act, with maximum fines for each offense of \$100 million for a firm,⁷⁴ and additional fines of up to twice the gain from the illegal activity or twice the loss suffered by the victim.⁷⁵ Firms that enter agreements—whether tacit or express—to cooperate in achieving supracompetitive

customers”).

71. See Carr & Gorman, *supra* note 56, at 44–47, 49, 50 (developing a model based on eleven cases of EE where the monetary value of trade secrets stolen is conservatively estimated and data are controlled for other variables and finding a correlation between victimization by CE and loss of market capitalization). Others dispute the quantifiability of the costs of EE. See, e.g., LARRY KAHANER, *COMPETITIVE INTELLIGENCE*, 230 (Simon and Schuster, 1996) (“Trying to quantify the direct effect of competitive intelligence is like a city trying to quantify the return it receives on having excellent schools, fire department, police, and trash pickup.”).

72. See Carr & Gorman, *supra* note 56, at 52 (reporting that rational firms victimized by EE have little incentive to seek prosecution under the EEA). Perhaps the sole reason why a firm might seek criminal charges against another firm for theft of trade secrets is to inflict reputational harm in the hope that the damage will be so great as to eliminate that rival from the market altogether. See *supra* note 57, at 1 (offering this explanation for the EEA). One study indicates the stock market “reacts negatively to the release of news of firm illegality.” Wallace N. Davidson III, et al., *Stock Market Reactions to Announced Corporate Illegality*, 13 J. BUS. ETHICS 979, 985 (1994). Whether this benefits the reporting firm or merely punishes the firm engaged in EE is unclear.

73. For a discussion of additional grounds for underenforcement of the EEA, as well as of the utility of EEA underenforcement to the promotion of the objectives of antitrust law, see *infra* Part IV.C.

74. 15 U.S.C. § 1 (2000).

75. 18 U.S.C. § 3571(d) (1987). In addition, individuals harmed as a result of the criminal act may sue for damages of up to three times their actual damages—usually incurred through the payment of supracompetitive prices—plus attorney’s fees. 15 U.S.C. § 15(a) (2000).

prices incur potential criminal exposure under the Sherman Act. However, in many instances there is insufficient evidence to secure a conviction without testimony from a suspected cartel member. To break cartels, the Antitrust Division of the Department of Justice introduced its Corporate Leniency Policy (“CLP”) in 1993, which offers automatic amnesty to firms willing to “cheat” on their agreements and expose price cartels in exchange for evidence that convicts their rivals.⁷⁶ Firms that confess and provide substantial assistance to the state in the form of testimony and other aids in proving unlawful agreements before their rivals can do so are guaranteed no criminal fines; subsequent confessors can only hope for reductions in fines.⁷⁷ Accordingly, firms who have entered into agreements, whether tacit or express, to achieve supracompetitive pricing must consider, in deciding whether to “rat out” other firms, the likelihood that their counterparts will confess rather than remain silent and preserve the existence, and benefits, of the cartel. In sum the CLP, in recognition of the inability of antitrust law to reach some aspects of anticompetitive conduct and of the importance of trust to the creation and destruction of price cartels, overtly orients federal antitrust enforcement strategy toward the fostering of distrust.

2. *Implications for Antitrust Theory*

Taken together, under-enforcement of the EEA and the CLP suggest a means whereby antitrust regulators can exploit the exchange of information to destroy trust and thereby achieve better suppression of supracompetitive pricing than is possible through antitrust law and standard enforcement measures alone. The implications of these instrumentalities, however, are much broader than their applications to particular instances of anticompetitive pricing in that they point toward a more general theory: specifically, if information exchange can be exploited to promote distrust, and if distrust can be magnified to preclude or to destroy cooperation, then cooperation, which rests on trust, can be denatured through the strategic exploitation of information, and price cartels, which are the external

76. U.S. Dep’t of Justice, Antitrust Div., Corporate Leniency Policy (Aug. 19, 1993) [hereinafter “CLP”] (granting automatic amnesty in the absence of a preexisting government investigation into price-fixing and is available under some circumstances even if the state has initiated an investigation). See also Leslie, *Antitrust Amnesty, Game Theory, and Cartel Stability*, *supra* note 19, at 465–66, 474–75 (describing operation of the CLP). Moreover, although only the first confessor receives full amnesty, subsequent confessors receive discounts on criminal fines. *Id.* First confessors, in addition, are not liable for treble damages or for damages caused by fellow cartel members in follow-on private lawsuits: the CLP eliminates treble damages for the first confessor and limits liability to single damages caused by that firm itself. *Id.*

77. CLP, *supra* note 76.

manifestations of agreements to cooperate, can be prevented or destroyed. If the presumption incorporated within antitrust law is that competition is the default or original relational status of firms before they conspire to achieve supracompetitive prices, and if the objective of antitrust law is to deter or defeat cooperation and maintain or return cartel members to a competitive relationship, then cooperation must be presumed as the result of the evolution of the relational status of firms. Accordingly, a theory that explains and predicts the creation and destruction of price cartels as a function of the degree to which rivals evolve toward or devolve from cooperative behavior must draw the strategic use of information to create and destroy trust within the chain of causation.

III. A THEORY OF THE EVOLUTION AND DEVOLUTION OF PRICE CARTELS

A. INTRODUCTION

1. *The Origin of Competition: Evolutionary Theory and the Struggle for Survival*

Evolutionary theory (“ET”), first developed in the field of biological science, explains the change over time in characteristics of a population as the result of the struggle for life and the tendency for only the fittest organisms to out-compete others for access to resources and mates and therefore to be “selected” by nature to survive and pass along their genes to the next generation.⁷⁸ The differential rates of survival and reproduction of the fittest organisms—a function of their genes as well as of the strategies they employ in competition with other organisms—ensure that their genetic characteristics appear more often in future generations than those of less fit organisms. As adapted from its biological context to explain and predict change in an array of natural and artificial contexts, ET similarly regards entities to be self-interested and in a natural state of competition with one another over status, power, and other resources that contribute to survival and reproduction.⁷⁹ In short, in the explanations and predictions of change offered by ET, survival of the fittest is the default rule, and competition is the default strategy.

78. See generally CHARLES DARWIN, ON THE ORIGIN OF SPECIES (1859).

79. See generally PETER SINGER, A DARWINIAN LEFT: POLITICS, EVOLUTION, AND COOPERATION 6 (2000).

2. *The Problem of Cooperation: Evolution, Advantages, and Devolution*

In the sociobiological context, while the presumption of self-interest and the survival imperative remain,⁸⁰ the “problem of cooperation” presents a challenge to ET’s assumption that competition is the ubiquitous, immutable, and optimal strategy for humans to ensure their survival and genetic propagation into future generations.⁸¹ Although humans do indeed compete over the resources necessary for survival, they also engage in patterns of mutual cooperation and even acts of altruism with kin and members of their social groups,⁸² and these patterns of cooperation and altruism, which ostensibly benefit others in addition to, and even rather than, the individuals who perform cooperative and altruistic acts, seem at first blush to run counter to ET’s specification of competition as the default strategy that renders individuals fit for survival and for the propagation of genes into the future. However, while competition is the default strategy, ET does not compel competition if the object of competition—survival to the end that genes are propagated into future generations—can be achieved more readily and at lower cost with another strategy. As rational actors, humans desire the greatest survival benefits at the lowest costs, and thus their preference for strategy is endogenous—a function of the relative costs and benefits of available strategic alternatives—rather than exogenous—determined solely by nature.⁸³

Moreover, given human rationality and thus the endogeneity of human preferences for survival strategies, the relevant level of analysis upon which natural selection operates to select the fittest genes for propagation into future generations is not the genes themselves but the strategies that rational human decision makers select and reject as they attempt to maximize survival benefits and minimize resource costs: successful

80. HERBERT SIMON, *MODELS OF BOUNDED RATIONALITY: EMPIRICALLY GROUNDED ECONOMIC REASON* 215 (1997) (“In our century, we have watched two great nations, the People’s Republic of China and the Soviet Union, strive to create a ‘new man,’ only to end up by acknowledging that the ‘old man’—self-interested and concerned with his or her economic welfare, or the welfare of the family, clan, ethnic group, or province, was still alive and well.”).

81. See John L. Casti, *Cooperation: The Ghost in the Machinery of Evolution*, in *COOPERATION AND CONFLICT IN GENERAL EVOLUTIONARY PROCESSES* 63–64 (John L. Casti & Anders Karlqvist, eds., 1995) (coining the phrase “problem of cooperation” to describe patterns of noncompetitive behavior within human groupings that present seeming contradictions to the competitive assumption of ET).

82. PETER M. KAPPELER & CAREL P. VAN SCHAİK, *COOPERATION IN PRIMATES AND HUMANS: MECHANISMS AND EVOLUTION* 3 (Peter M. Kappeler & Carel P. van Schaik, eds., 2006) (reporting that most humans, and many primates, will enter into mutually beneficial forms of cooperation and even engage in altruistic acts with no expectation of reciprocal benefit).

83. See *id.* at 254 (explaining that human preferences with regard to survival strategies are endogenous—determined by reference to their relative costs and benefits—rather than exogenous—dictated by nature).

strategies continue to be chosen, and the genes of those who choose successful strategies are passed along to future generations, whereas unsuccessful strategies are abandoned, and the genes of those who choose unsuccessful strategies are not perpetuated.⁸⁴ The problem of cooperation thus raises three primary questions: (1) how does cooperation evolve from competition between rational self-interested individuals with no central authority to guide the process?; (2) does cooperation confer advantages over competition as a survival strategy?; and (3) is cooperation evolutionarily stable,⁸⁵ or will it devolve toward competition?⁸⁶

a. Evolution and Advantages of Cooperation

To the first two questions, scholars contend that, despite the vigorous competition that characterized the struggle for survival among self-interested individuals, cooperation evolved spontaneously “from small clusters of individuals who base[d] their cooperation on reciprocity” and had repeated interactions with each other that, over time, instilled confidence in the probability that risky acts benefiting others would be reciprocated in kind.⁸⁷ Perhaps even more crucially, cooperators learned that cooperation, whether through collective hunting, agriculture, defense, or other joint ventures, increased available resources (collectively as well as individually), reduced resource costs, and conferred survival advantages.⁸⁸ As trust and understandings of the evolutionary benefits of cooperation deepened within groups of cooperators, and as particular individuals developed reputations for cooperation that decreased the risk of

84. AXELROD, *supra* note 37, at ix–x.

85. *See infra* at Part III.A (providing definition of “evolutionary stability”).

86. AXELROD, *supra* note 37, at viii–ix (enumerating central questions in the study of the evolution of cooperation).

87. *Id.* at 20–21 (explaining that for some scholars, trust is not necessary to evolve from competition to cooperation). *See also id.* at 173–74 (suggesting that the expectation that cooperative acts will be reciprocated can be reinforced solely with the threat that cooperation will cease if reciprocation fails). Other scholars regard the mutual expectations of continued cooperation, however supported, as the basis for, and even the very definition of, trust, and maintain that trust is the essence of sustained cooperation. *See, e.g.*, ROBERT BOYD & PETER J. RICHEYSON, *THE ORIGIN AND EVOLUTION OF CULTURES* (2005). This Article subscribes to the view that the divergence between these two positions is, in most applications to strategic interactions between individuals, a distinction without a difference—at least not of sufficient theoretical significance to require the differentiation of the two phenomena.

88. *See* MARTIN A. NOWAK, *SUPERCOOPERATORS: ALTRUISM, EVOLUTION, AND WHY WE NEED EACH OTHER TO SUCCEED* xvi (2011) (tracing the development of cooperation through the emergence of mutual aid and concluding that “cooperation is entirely compatible with the hard-boiled arithmetic of survival in an unremittingly cold-eyed and competitive environment” because it confers survival advantages). Many of these survival advantages of cooperation are termed “public goods” within the field of economics.

investing trust in them, “clear patterns of mutually understood behavior between entities that continue interacting” reinforced the evolution of cooperation,⁸⁹ and over many millennia the human propensity to cooperate conferred survival advantages upon cooperators relative to noncooperators and were passed along through natural selection to subsequent generations.⁹⁰ Thus, over time, human preferences for cooperation over competition that emerged spontaneously became part of the evolutionary logic embedded within the socially constructed cultures of cooperating groups, as well as within the biologically determined “nature” of individuals who bore the genes of progenitors who chose cooperation as a survival strategy, through the exercise of rational choice reinforced by the process of natural selection.⁹¹

b. Devolution of Cooperation

To the third question, cooperation is more evolutionarily stable than competition in that, once established within a population, the long-run benefit of cooperation is sufficiently greater than the short-run benefit of competition such that natural selection alone is sufficient to prevent competition from displacing cooperation.⁹² However, cooperation, although more evolutionarily stable, is, by definition, a more highly evolved form of strategic interaction than competition in that it confers survival advantages relative to competition. Moreover, cooperation is a more organized form of strategic interaction because it is contingent and requires more than just naked self-interest to create and maintain.⁹³ In other words, the defense of cooperation against devolution—defined as the

89. AXELROD, *supra* note 37, at 83.

90. MATT RIDLEY, *THE ORIGINS OF VIRTUE* 6 (1997); NOWAK, *supra* note 88, at xiv (identifying the “breathtaking ability to cooperate” as “one of the main reasons [humans] have managed to survive”).

91. Natural selection works not only upon genes but also upon cultures and strategies. NOWAK, *supra* note 88, at 269 (developing a mathematical argument that natural selection favors cooperators over defectors). The phrase “evolutionary logic” is used to describe the learning that occurs as natural selection proceeds and individuals come to discover the benefits of cooperation over time. KAPPELER & VAN SCHAİK, *supra* note 82, at v.

92. See generally JOHN MAYNARD SMITH, *ON EVOLUTION* (1972) (introducing the concept of evolutionary stability). See also BOYD & RICHERSON, *supra* note 87, at 135 (specifying the conditions for evolutionary stability that the long-run benefit from mutual cooperation be greater than the short-run benefit for competition and that there be sufficient frequency of adoption of and interaction with the cooperative strategy, where b = benefit, c = cost of cooperation, t = average number of interactions between individuals, and evolutionary stability occurs where $t(b-c) > b$); RIDLEY, *supra* note 90, at 59 (same).

93. See NOWAK, *supra* note 88, at 280 (concluding that cooperation is more evolutionarily advanced and complex than competition and “can draw living matter upward to higher levels of organization”).

reversal of the direction of evolution and reversion toward a more primitive, less organized form of strategic interaction—requires more than just ensuring that the benefits of cooperation are greater than those available through competition, a task not especially difficult to accomplish so long as there is a willingness to impose sanctions upon those who abandon cooperation. Thus, devolution to competition, whether engineered from inside or outside the human population in which cooperation has evolved, is possible notwithstanding its evolutionary stability.⁹⁴ What determines whether cooperation endures or devolves toward cooperation is the degree of trust that prevails within the population.

3. *The Condition for Cooperation: Establishing and Preserving Trust*

The defense of cooperation against devolution requires more than just the diffusion of a rational appreciation of its benefits within a population of interest; it also requires the establishment and preservation of trust—a more complex and potentially difficult task, but a necessary task, for, in a real sense, trust is a necessary condition for cooperation.⁹⁵ Cooperation is riskier than competition in that it invites opportunism, and potential cooperators are sensitive to the possibility that others will exploit their cooperative acts by failing to reciprocate or by “bow[ing] out at the moment of [a] dangerous collective action, thereby exposing the partner(s) to considerable risk of injury.”⁹⁶ The evolution and protection of cooperation against devolution thus pose a collective action problem that can only be overcome if potential cooperators come to believe with sufficient confidence that others within the population structure will respond to the vulnerabilities their cooperative acts create with reciprocal cooperative acts such that cooperation becomes rational. Individuals develop reputations for trustworthiness over time as they demonstrate that they can be relied upon not to prey upon the vulnerabilities others create by cooperating with them, and it becomes less risky and less costly to trust them.⁹⁷ Put in mathematical terms, trust is a judgment that any costs incurred by way of a lack of reciprocal cooperation by a rival will be compensated by the relative benefits and probability of cooperation, such that cooperation is rational if trust is present, and irrational if it is not.

94. See AXELROD, *supra* note 37, at 83 (identifying the vulnerabilities of cooperation).

95. See *id.* at 126–141 (identifying maintenance of proper incentives, promotion of reciprocity, deepening of trust, and maintenance of connections within a population as the elements of the defense of cooperation). See also RIDLEY, *supra* note 90, at 4 (describing the human preference for reciprocal trust-based cooperation as a “virtue”).

96. KAPPELER & VAN SCHAİK, *supra* note 82, at 4.

97. Heymann, *supra* note 44, at 806.

Thus, without trust that cooperative acts will be reciprocated, and without repeated interactions in which reciprocity is possible, cooperation is irrational, and potential cooperators will compete instead of cooperate—a rational outcome from the individual standpoint but collectively suboptimal for the population, as under these circumstances natural selection will extinguish cooperation as a survival strategy.⁹⁸ Trust alone does not guarantee cooperation, as potential cooperators must still perceive the long-term benefits of cooperation to be greater than the short-term benefits of competition before they will initiate or sustain cooperation—and this in turn rests upon the gains to be realized through cooperating, as well as upon the certainty and severity of punishment for failing to reciprocate. However, cooperation cannot be created or preserved in the absence of trust, and thus the evolutionary stability of cooperation is, in large measure, a function of trust.

4. *The Communication of Cooperation: Using Information to Create and Destroy Trust*

a. Effect of Asymmetries of Risk

If individuals are unable to communicate their intentions regarding cooperation, trust, and therefore cooperation, are rendered more fragile.⁹⁹ Communication allows potential cooperators to discuss their strategic setting and thereby reduce asymmetries of information about the benefits and costs associated with competition and cooperation.¹⁰⁰ Perhaps more crucially, communication reduces uncertainty and risk by allowing potential cooperators to make promises regarding future cooperation that spark the origins of trust, solve the collective action problem, and induce cooperation.¹⁰¹ The corollary is also true—the absence of communication erects barriers to trust and, in turn, dampens cooperation. Viewed through this lens, communication, defined as the exchange of information to convey a message or create an understanding, can be understood as a process that modifies trust through its effects upon the degree of uncertainty and risk

98. See SARA SINGLETON, *CONSTRUCTING COOPERATION* 7 (1998) (describing a “collective action problem” wherein trust is required to convert cooperation from an irrational to a rational strategy); NOWAK, *supra* note 88, at 269 (concluding that without repeated interactions between individuals where reciprocity can lead to trust, cooperation is irrational and will be eliminated by natural selection).

99. KAPPELER & VAN SCHAİK, *supra* note 82, at 275 (stating that communications about the intentions of individuals regarding cooperation stabilizes trust and cooperation).

100. SINGLETON, *supra* note 98, at 12–13.

101. See Elinor Ostrom, Roy Gardner, & James Walker, *RULES, GAMES AND COMMON-POOL RESOURCES* 23 (1994) (postulating that communication makes it more likely that individuals will commence cooperation); Boyd & Richerson, *supra* note 87, at 253.

within the relational context.¹⁰² An examination of informational theory aids in developing an understanding of the relationship between the exchange of information, trust, and cooperation.

b. Informational Theory

Informational theory¹⁰³ posits that systems tend toward disorder and randomness—a physical state known as “entropy”¹⁰⁴—and that external input, and in particular information, is necessary to overcome chaos and to create and maintain systemic organization, efficiency, and certainty.¹⁰⁵ Developed originally in the field of communications by analogies to mathematics and physics, informational theory has found applications in economics and the life sciences, where information is theorized to alter entropy by increasing or decreasing the efficiency and organization of relevant systems.¹⁰⁶ As entities—whether natural or organizational—encounter information, they process and use it in an attempt to understand its meaning, organize the world around them, and create and protect certain desirable features of the systems they inhabit against chaos. In particular, entities that exist in a state of interdependence can transmit and receive information regarding the benefits and costs of various courses of action,¹⁰⁷ with the most effective information transmission and usage requiring and contributing to certain mutual “understandings,” or common conceptions acquired in advance of specific communications as to what various symbols, signals, data, or other information means.¹⁰⁸ Informational theory

102. See AXELROD, *supra* note 37, at 173 (noting that potential cooperators “do not need words, because their deeds speak for them”).

103. See CLAUDE SHANNON, *A Mathematical Theory of Communication*, 27 BELL SYSTEM TECH. J. 379 (1948).

104. See generally DONALD T. HAYNIE, *BIOLOGICAL THERMODYNAMICS* (2001) (defining “entropy” as the quantitative measure of disorder or uncertainty in a closed but evolving system, where the greater the entropy the greater the disorder or uncertainty). The definition of entropy employed within information theory is related to the Second Law of Thermodynamics, which states that entropy is a measure of the tendency of a process to proceed in a particular direction, that the process reduces the order and organization of the initial system, and that the entropy of a system always increases or remains constant unless energy is added to the system. See also, DANIEL V. SCHROEDER, *INTRODUCTION TO THERMAL PHYSICS* (2000) As used in this Article, “entropy” does not connote, as it does within some antitrust scholarship, a measure of market concentration. See, e.g., J. LAWRENCE HEXTER & JOHN W. SNOW, *AN ENTROPY MEASURE OF RELATIVE AGGREGATE CONCENTRATION*, 36 SOUTH. ECON. J. 239 (1970).

105. See generally Jing Chen, *The Informational Theory of Investment: A Comparison with Behavioral Theories*, (Mar. 20, 2003), available at <http://ssrn.com/abstract=380460>.

106. *Id.* at 2; see also NOWAK, *supra* note 88, at 70 (suggesting that “biological organisms [can] be thought of as information-processing systems.”).

107. See, e.g., Michael Colaresi, *The Benefit of the Doubt: Informational Theory of the Rally Effect*, 61 INT’L ORG. 99 (2007).

108. See, Paolo Manzelli, *Entangling Information Theory*, GENERAL SCI J. 1, 1 (2010).

postulates that the more information is available, the more the information is anchored to available understandings, and the more information is exchanged, the more useful information is to entities in overcoming entropy and supporting the desired characteristics of the system they inhabit.¹⁰⁹ As information is acquired, disseminated, and used by entities to develop mutual understandings regarding the organization of a system in a manner that supports common objectives, entropy diminishes and mutual welfare increases.¹¹⁰ As less information is exchanged, or as understandings regarding the organization of the system to mutual benefit are disrupted, entropy increases and mutual welfare decreases.

c. Relationships Between Information, Trust, and Cooperation

As applied, informational theory, which conceptualizes information exchange as a mechanism that modifies uncertainty, shapes mutual understandings, and influences the degree of organization of systems, postulates that as more information is exchanged between individuals within a population/system, particularly if it is the sort of information that creates mutual understandings regarding the desirability of cooperation and of the intent to cooperate, entropy will decrease and trust will increase, and with increased trust the individuals within the population will be more likely to engage in and sustain acts of cooperation that contribute to the emergence and evolutionary stability of cooperation, along with the welfare advantages that pertain. At the same time, information theory anticipates that as less information is exchanged, and in particular as individuals within the population do not communicate mutual understandings of the desirability of and intent to cooperate or do not abide by their agreements regarding the use of information to cooperate, trust decreases, and with decreased trust the likelihood of and evolutionary stability of cooperation decreases, along with the welfare of competing members.

B. NARRATIVE STATEMENT OF THE THEORY

The proffered theory of the evolution and devolution of price cartels parallels rational choice theory inasmuch as both treat firms' price decisions—whether competitive or cooperative—as the *explanandum*—the thing to be explained—and the expected profit associated with a pricing

109. See Chen, *supra* note 105, at 3.

110. See generally ROBERT M. GRAY, ENTROPY AND INFORMATION THEORY (2009) (developing mathematical proof that the degree of entropy in a system is inversely proportional to the amount of information in the system).

decision as the *explanans*—the explanatory variable. However, beyond an agreement that firms seek to maximize their payoffs by selecting prices, and that cartels will form when the long-term payoff of cooperative pricing is greater than the short-term payoff of competitive pricing, the proffered theory and rational choice theory diverge.¹¹¹

Rational choice theory predicts that the occurrence and persistence of price cartels based on tacit agreements will be very rare given its assumption that transaction costs attending cartelization reduce and even eliminate the payoff premium, rendering cartels irrational. Moreover, given its prediction of the rarity and fragility of price cartels, rational choice theory is relieved of the need to delve into the process of and conditions for the evolution and devolution of cooperation. Accordingly, since rational choice theory regards price cartels as epiphenomenal to social welfare even when markets are concentrated to the point of duopoly, the questions of whether antitrust law is effective in suppressing and destroying tacit agreement price cartels and, if not, what modifications to the antitrust regime are necessary to prevent their evolution and encourage their devolution, are rendered theoretically and practically irrelevant.

In contrast, the proffered theory hypothesizes that price cartels can and do form and endure even in the absence of express agreements, that these cartels do indeed reduce social welfare, and that the enactment, interpretation, and enforcement of laws to prevent their evolution and promote their devolution affords utility to regulators and consumer welfare advocates. Central to informational theory is the informational context that intervenes between price decisions and payoffs and in which firms interact strategically. This informational context provides the setting and the opportunity for firms to reach and communicate, whether directly or indirectly, a set of understandings and tacit agreements as to their preferences for and interest in cooperation, their intent to price cooperatively or competitively, the actions that may legitimately be taken to monitor pricing decisions, the penalties for violating agreements, the likely responses of third parties to the exchange of information, and how such responses will alter payoffs and, in turn, pricing decisions. So long as the long-term benefits of cooperation exceed the short-term benefits of competition, and so long as these understandings and agreements endure, informational theory predicts that firms will generate and sustain the trust necessary for the evolution and preservation of cooperation, supracompetitive pricing, and corresponding high payoffs. However, if payoffs are altered such that the short-term benefits of competition exceed

111. See, e.g., Maurice E. Stucke, *Behavioral Economists at the Gate: Antitrust in the 21st Century*, 38 LOY. U. CHI. L.J. 513 (2007) (outlining the rational choice theory regarding price cartels).

the long-term benefits of cooperation, or if trust is destroyed through the disruption of understandings or the violation of agreements—whether through information gathering that transcends the permissible scope, deviation from expected pricing decisions, state intervention, or some other mechanism, informational theory predicts that the price cartel will devolve toward competition, competitive pricing, decreased profits, and increased social welfare.

C. VARIABLES

1. *Independent Variable*

The proffered informational theory of the evolution and devolution of price cartels hypothesizes that the expected payoff to the firm, measured as the total profit to the firm minus any monitoring costs and any regulatory fines or penalties, is the independent variable (“IV”).

2. *Dependent Variable*

The proffered informational theory of the evolution and devolution of price cartels hypothesizes that the price decision of the firm, measured as either competitive (low) or cooperative (high), is the dependent variable (“DV”).

3. *Intervening Variable*

The proposed informational theory of the evolution and devolution of price cartels hypothesizes that the informational context in which firms conclude and communicate understandings and tacit agreements as to their preferences for and interest in cooperation, their intent to price cooperatively or competitively, the actions that may legitimately be taken to monitor pricing decisions, the penalties for violating agreements, the likely responses of third-parties to the exchange of information, how such responses will alter payoffs and pricing decisions, and the substance of those understandings and agreements, facilitates a better understanding of the causal relationship between the intervening variable (“IV”) and DV and is thus specified as an intervening variable for purposes of theory development and testing.¹¹²

112. For a definition of the concept of “intervening variable” and its utility in the development and testing of theories, see, e.g., K. McCorquodale & Paul E. Meehl, *On A Distinction Between Hypothetical Constructs and Intervening Variables*, 55 PSYCH. REV. 95 (1948).

D. WORKING POSTULATES

The following working postulates are specified as the elements of an information theory of the evolution and devolution of price cartels:

Firms are analogous to natural organisms in that they struggle to survive in competition against firms;

Survival of the fittest applies to firms, with fitness measured in profits;

Firms are rational, and thus seek to maximize profits through their pricing decisions;

The struggle for survival dictates that competition, expressed through competitive pricing decisions, is the strategy for firms *ab initio* regardless of the degree of market concentration;

Mutual cooperation in pricing decisions by firms yields greater individual and collective profits than mutual competition;

Unreciprocated cooperation in pricing decisions by firms yields the lowest possible profit to the sole cooperator, thus rendering cooperation riskier than competition;

Pricing decisions communicate firms' desire for and strategic interest in cooperation;

Price-fixing agreements are unlawful and unenforceable, and thus pricing decisions are uncertain and neither perfectly nor immediately transparent;

Trust is the confidence that the expected profit from cooperation, given the probability of reciprocation and the cost of being the sole cooperator; is greater than its profit from competition, thereby rendering it rational to shift from competitive pricing to cooperative pricing;

To initiate cooperation, a firm must develop sufficient trust that its rival will reciprocate;

Cooperation is possible when trust is sufficient to permit the first firm to shift from competitive pricing to cooperative pricing;

Price cartels evolve when trust is sufficient to permit mutual cooperative price decisions;

Firms seek information about past and future pricing decisions of rival firms when assessing whether to trust their rivals and whether to initiate or continue cooperation;

Members of price cartels conclude tacit agreements regarding the permissible means, methods, and scope of the acquisition and transmission of information regarding pricing decisions, and information gathering consistent with these agreements support and develop trust;

Adherence to tacit agreements regarding the acquisition and transmission of information regarding pricing decisions communicates an

intent to continue cooperation and builds trust, whereas violations of tacit agreements regarding the acquisition of information regarding pricing decisions communicates an intent to discontinue cooperation and destroys trust;

As mutual cooperation persists, trust increases, and as trust increases, the probabilities of mutual cooperation, individual and joint profits, and survival increases; conversely, as cooperation is unreciprocated, trust decreases, and as trust decreases, the probabilities of mutual cooperation, individual and joint profits, and survival decreases;

Cooperation ends when any firm determines that it can no longer trust its rival;

Competition resumes when trust is insufficient to support mutual cooperative price decisions;

Absent trust, the evolution and endurance of price cartels requires unlawful express price-fixing agreements;

Absent either trust or express price-fixing agreements, price cartels devolve toward competition and competitive pricing, and consumer surplus and social welfare increase.

IV. CREATION AND DESTRUCTION OF PRICE CARTELS: HEURISTIC TESTING OF THE THEORY

A. SCENARIO: *DEWEYCHEATHAM OIL V. ENHOWE OIL*

1. *Phase One: Competition*

By the spring of 2012, a wave of consolidations within the global petroleum industry, prompted by the rising costs of exploration and recovery of diminishing petroleum reserves in politically unstable regions and opportunities to achieve greater efficiencies and profit margins, results in a duopoly in which two firms, DeweyCheatham Oil and EnHowe Oil, come to supply over ninety percent of raw crude, refined gas, and fuel additives to the U.S. market, as well as a significant majority of these homogeneous commodity goods to other world regional markets. For the first several months of the duopoly market, DeweyCheatham and EnHowe each employ a strategy that includes the aggressive purchase of new and existing leases, refineries, and logistics capacities to significantly increase production of automotive gasoline, and each competitively prices in an attempt to expand supply and gain market share from the other. Consumers benefit from the “Great Gas War” as gas prices declined from their 2011

nationwide average highs of \$3.99 per gallon to settle at \$1.70 per gallon.¹¹³

Meanwhile, although committed to aggressive price competition in the U.S. gasoline market, each firm continues to labor to produce new fuel additives that might differentiate their gasoline and earn even greater market share and profits. After nearly ten years of research at a cost of over \$10 billion, petroleum engineers at DeweyCheatham's Research and Technology Facility in Houston, Texas, are making great strides in developing a fuel additive named "Formula K2" using kelp, krill, and advanced genetic engineering and bionanotechnology that has the prospect to increase the chemical potential energy of gasoline, and with it the fuel efficiency of gasoline-powered vehicles, by nearly thirty percent.¹¹⁴ Their counterparts at EnHowe's Research and Technology Facility in Long Beach, California, are using a precursor of cold fusion to synthesize complex artificial hydrocarbon chains out of agricultural waste and thereby create an additive, called "Frozen Chain," to the same end. Neither project, which each firm protects as a trade secret, is yet ready for market, and neither firm has yet patented its intellectual property, although rumors of both projects are widely reported in trade publications.

Although both firms have a long history of delving into the gray zone of CI to gather information about the exploration, research, marketing, and pricing decisions of their rival, never has either engaged in clear EE attacks against the other. Nevertheless, to protect their trade secrets in what each expects to confer a vast competitive advantage over its rival, DeweyCheatham's Threat Research and Assessment Group ("TRAG") and EnHowe's Opposition Research and Analysis Group ("ORAG")—organizations within their respective DCIs responsible for information security—expand and intensify their defensive CI efforts as the additives projects develop. TRAG and ORAG increase the monitoring of employees and computers, intensify surveillance of key scientific personnel, and conduct periodic "secrecy seminars" to retrain employees firmwide in the detection of and protection against dumpster diving for documents that

113. This calculation assumes that (1) if the relationship between supply and demand prevailing in 2002 were restored through an increase in supply to offset increased demand by developing countries, (2) if the risk premium were reduced to 2002 levels by a reduction in unrest in the Middle East, and (3) if the currency in which oil prices are denominated—the U.S. dollar—was not beset by pressure due to structural debt obligations, quantitative easing, and government borrowing that triggers additional inflation, then inflation-adjusted average gasoline price nationwide in 2002—\$1.31 per gallon—would yield a 2012 price of \$1.70 per gallon. See *Gasoline and Diesel Fuel Update*, U.S. ENERGY INFORMATION ADMINISTRATION (Jan. 30, 2012), http://www.eia.doe.gov/oil_gas/petroleum/data_publications/wrgp/mogas_history.html (listing historical U.S. gasoline prices).

114. Although current fuel additives extend engine life and performance, none contribute significantly to fuel efficiency. See KEITH OWEN, *GASOLINE AND DIESEL FUEL ADDITIVES*, 164 (1999). For a discussion of the physics involved in the use of gasoline as fuel, see PAUL TIPLER, *PHYSICS FOR SCIENTISTS AND ENGINEERS* 575 (1999).

evade shredding, theft of laptops and documents from hotel rooms and airport security, interception of cellular phone conversations, eavesdropping and electronic surveillance in hotels and airports, and other common CI and EE methods.¹¹⁵

2. *Phase Two: Cooperation*

By the fall of 2012, both firms, eager to offset sunk R&D costs, begin to gradually raise prices, with a price increase by one firm swiftly followed by a price increase by the other. Neither firm directly communicates its intentions regarding price to its rival, but increased prices all along the supply chain—from traders to distributors and ultimately at the pump—are rapidly disseminated by consumers through various media, including internet websites.¹¹⁶ and the secretive Department of Competitive Intelligence (“DCI”) at each firm labors to keep close track of its rival’s pricing decisions. By January 2013, the nationwide average price for a gallon of regular unleaded gasoline is \$5.10—exactly triple what it had been less than one year before, and throughout the remainder of 2013 prices fluctuate around this \$5.10 price median. Gas stations operated or supplied by both firms located in the same geographic areas uniformly charge identical, or near-identical prices, and the trend-line slopes sharply upward; on the rare occasion when one firm reduces prices, the other swiftly follows, and within days the prices for both firms return to the previous high and continue increasing. Consumer anger over gasoline “price gouging” returns to 2011 levels as in their 2012 financial reports DeweyCheatham and EnHowe each report total market capitalization of over \$300 billion, revenues of nearly \$300 billion, and profits of \$20 billion—the latter a twenty percent increase over the previous year.¹¹⁷ Despite several requests by members of Congress and consumer groups, the Antitrust Division of the Department of Justice takes no action, however. An executive decision to release thirty million barrels of petroleum from the Strategic Petroleum Reserve has no effect whatsoever

115. See, e.g., Robert L. Tucker, *Industrial Espionage as Unfair Competition*, 29 U. TOL. L. REV. 245, 245–46 (describing defensive training seminars provided by firms to its employees to protect against EE by rivals).

116. See, e.g., GAS BUDDY, <http://www.gasbuddy.com>, (last visited Jan. 25, 2012) (providing real-time information on prevailing gas prices nationwide).

117. The reported financial data for ExxonMobil—the largest private-sector petroleum firm supplying the U.S. market with a seventeen percent market share—is extrapolated and used as the basis for determining the market capitalization, revenue, and profits of the fictional firms DeweyCheatham and EnHowe, duopolists that each have a fifty percent share of the U.S. market in the hypothetical scenario. See *2010 Financial Statements*, EXXON-MOBIL, http://www.exxonmobil.com/Corporate/Files/news_pub_ir_financial_2010.pdf

on price,¹¹⁸ and a legislative proposal to repeal subsidies for exploration by petroleum firms, increase taxes on petroleum firms, and criminalize the “manipulation” of oil markets—defined as the practice of “fuel price gouging” whether by firms or “speculators—is defeated in Congress.¹¹⁹

3. Phase Three: Defection

In February 2013, TRAG discovers a sophisticated Trojan horse program on a Project K2 mainframe computer that subsequent forensic investigation reveals has been capturing and transmitting sensitive documents and data, including formulas, manufacturing processes, and anticipated project milestone dates, for at least two months.¹²⁰ Careful not to reveal their discovery, TRAG investigators quietly follow the electronic trail and discover a safe house in suburban Houston being used by ORAG to run an extensive EE operation. Several weeks of clandestine investigation and damage assessment reveals three more items of unwelcome information: (1) the EE attack by EnHowe is led by a former TRAG employee who, prior to his termination the previous summer, was able to transmit coded information about Project K2 formulas to EnHowe;¹²¹ (2) an academic publication by a Project K2 genetic engineer,

118. See Robert Bamberger & Robert Pirog, *The Strategic Petroleum Reserve: Possible Effects on Gasoline Prices of Selected Fill Products*, CONGRESSIONAL RESEARCH SERV. (Sept. 27, 2004), available at <http://www.fas.org/sgp/crs/RL32358.pdf> (predicting that release of petroleum out of the Strategic Petroleum Reserve would have such minimal effects on supply that effects on price of gasoline would be near-zero).

119. See Taxpayer and Gas Price Relief Act, H.R. 1748, 112th Cong. (referred to House Subcommittee on Energy and Resources, May 16, 2011) (providing penalties of up to \$500 million per violation). A vote on cutting \$21 billion in subsidies was defeated on May 11, 2011. See Chaddock Gail, *Senate Blocks Big Oil Windfall Profits Tax Bill*, THE CHRISTIAN SCIENCE MONITOR (June 11, 2008), available at <http://www.csmonitor.com/Business/2008/0611/p25s13-usec.html>.

120. EEA cases are almost invariably initiated when the targeted firm discovers the theft of its trade secrets through internal investigations. Rustad, *supra* note 59, at 494–95. Such thefts are often perpetrated through cybercriminal techniques, including the use of computer programs, known as “malware,” to collect intellectual property. See generally C. BURGESS, *SECRETS STOLEN, FORTUNES LOST: PREVENTING INTELLECTUAL PROPERTY THEFT AND ECONOMIC ESPIONAGE IN THE 21ST CENTURY* (2008).

121. Employees with special access and advanced professional subject matter expertise are the misappropriators of trade secrets in a significant fraction of EEA prosecutions. See Rustad, *supra* note 59, at 494 (surveying cases and noting that the defendant was an outsider in only 13 of 48 EEA prosecutions); see also *United States v. Kai-Lo Hsu*, *supra* note 69 (convicting an engineer under Section 1832(a)(4) (attempting to steal a trade secret) and Section 1832(a)(5) (conspiring to steal a trade secret) when he approached an undercover FBI agent mistakenly believing the FBI agent was an information broker to whom he could sell his firm’s trade secrets); *United States v. Thomas Kissane*, No. 1:02CR626 (S.D.N.Y. 2002) (defendant convicted under EEA for sending e-mail messages to two of his employer’s rivals offering to sell source codes for computerized trade secrets); *United States v. Branch and Erskine*, No. 03-M-1453 (C.D. Calif.) (charging former managers with theft of Lockheed Martin trade secrets); *United States v. Case*, 2007 WL 1746399 (S.D. Miss. 2007) (charging departing employees who formed their own firm with theft of trade secrets under EEA). Terminated or

who moonlights as an adjunct professor in the biology department at the University of Houston and is now under suspicion as an EnHowe mole,¹²² was improperly vetted by TRAG prior to publication in a peer-reviewed scientific journal, and as a result an important theoretical discovery regarding the basic science behind Project K2 is now in the public domain;¹²³ and (3) gray zone CI conducted by DeweyCheatham's DCI against EnHowe indicates that EnHowe may be ready to rush an earlier generation fuel additive to market in the next two months that, based on reverse engineering of a small sample deceptively obtained from an EnHowe distributor by DCI personnel impersonating potential wholesale customers—means arguably unethical but not unlawful—appears to have been formulated based in part on DeweyCheatham research.¹²⁴

After two days of intense round-the-clock meetings of senior executives, TRAG, and outside legal counsel in which alternatives are raised, discussed, wargamed, and analyzed, DeweyCheatham's CEO issues a confidential ultimatum to his counterpart at EnHowe demanding EnHowe undertake the following: (1) fire all ORAG executives responsible for the EE attack, (2) disband ORAG, (3) return all trade secret information misappropriated from DeweyCheatham, (4) permit TRAG to interview

disgruntled former employees are a particular risk. See, e.g., Brenner & Crescenzi, *supra* note 56, at 417 (discussing former employees' motives for committing EE). A frequent EE method involves "poaching" of employees valued for their capacity to transmit their former employers' trade secrets to the poaching firms either in physical form or through their memories. See Richard Waters, *Not Spying, Just Hiring*, FIN. TIMES, Apr. 3, 1997, at 7 (reporting that GE attempted to gain knowledge of Dow Chemical's manufacturing process, design, and marketing initiatives by hiring fourteen Dow employees to similar jobs at GE where they would use their recollections of Dow's trade secrets). Whether liability extends under the EEA to employee poaching is unclear, but where there is evidence that the poaching firm intends to misappropriate trade secrets liability can attach. See, e.g., *United States v. Martin*, 228 F.3d 1 (1st Cir. 2000) (finding criminal liability under the EEA based in part on transmission of a "smoking gun" e-mail containing purloined trade secrets between the exiting employee and a manager in the poaching corporation).

122. "Moles" are spies hired for the express purpose of gaining employment in and access to the secrets of a rival firm.

123. Professors engaged in academic research who consult to or work for firms develop and possess valuable theoretical and applied information, and in the process of publishing the results of their research can unintentionally or intentionally divulge information that either *ipso facto* constitutes a trade secret or that, combined with other information, may allow a rival to acquire trade secrets. See Jennings & Tomkies, *supra* note 60, at 242 (warning against the theft of intellectual property during the academic peer review process). Although universities and faculty are committed to "the traditions of open research and prompt transmission of research results[,] firms have a corresponding commitment to pre-publication verification that the research of faculty whom they employ does not contain trade secrets; these interests are in tension. *Id.* at 244–59.

124. The EEA prohibits certain methods of reverse engineering—the unauthorized process whereby a second-comer learns the process or structure of an innovation by deconstruction, analysis, and duplication—including "decompilation" of computer programs, "sketching, drawing, or photographing" trade secrets in publicly sold goods, chemical analysis, and rote memorization; however, examining a lawfully acquired product to determine its content is not *per se* unlawful. See Pooley et al., *supra* note 61, at 185–87 (discussing reverse engineering under the EEA).

EnHowe employees to ascertain the extent of the misappropriation, (5) cease development of any and all fuel additive projects for a period of two years, (6) permit a third-party investigator to review EnHowe data to ensure that future EnHowe products and strategies were not based upon the misappropriated trade secrets, (7) pay an indemnity of \$5 billion (DeweyCheatham's internal valuation of the trade secrets stolen by EnHowe), and (8) resign effective immediately.¹²⁵ The ultimatum specified that refusal to accept it as the basis for a private and confidential settlement within seven days would result in DeweyCheatham referring the matter to the FBI for criminal prosecution under the EEA. On the final day to accept DeweyCheatham's ultimatum, EnHowe's CEO telephones her counterpart to protest his "outrageous demands," imply that the EE attack was "unauthorized," and request additional time for "amicable negotiations" so the two firms can avoid "a destructive cycle of retaliation and counter-retaliation." DeweyCheatham does not respond. Within days, the first of a series of price cuts by DeweyCheatham are followed, albeit with some hesitation, by EnHowe.

4. Phase Four: Sanction

Three mornings later, FBI agents swarm the EnHowe corporate campus with search warrants to seize all information—business records, documents, computers, chemicals, email traffic, computers—as evidence in support of an indictment that is simultaneously unsealed in the District Court for the Southern District of Texas charging EnHowe and seven EnHowe employees with conspiracy to steal trade secrets and theft of trade secrets regarding Project K2 under Section 1832(b) of the EEA. FBI agents arrest the seven indicted employees and detain others for questioning as witnesses. In a press release, the Assistant U.S. Attorney ("AUSA") announces that government will be seeking prison time, fines, and civil restitution.¹²⁶ Later that afternoon, the AUSA requests and receives an order protecting the confidentiality of information regarding the prosecution of the case against EnHowe under Section 1836.

Within days, although neither fuel additive project is complete, both firms begin adding derivatives of their respective projects to the gasoline

125. The elements of the ultimatum in this fictional scenario track closely with the demands made by Unilever to reach a private settlement with Procter & Gamble in lieu of an EEA prosecution when the latter firm undertook EE against Unilever in 2002. For a discussion of this case, see A. Neela Radhika & A. Mukund, *Procter & Gamble vs. Unilever—A Case of Corporate Espionage*, ICMR CENTER FOR MANAGEMENT RESEARCH (2003), available at <http://www.icmrindia.org/casestudies/catalogue/Business%20Ethics/BECG036.htm>.

126. See generally Louis A. Karasik, *Under the Economic Espionage Act*, 48 FED. LAW. 34, 37 (2001) (elaborating on the mechanics of federal procedure as it pertains to prosecution of an EEA case).

they supply in an attempt to capture market share and to arrest the drop in price. However, although the efficiency of gasoline spikes noticeably, both firms remain locked in a price war, and by the summer of 2013 gas is once again under \$2.00 per gallon. As discovery accelerates in the criminal case against EnHowe and EnHowe demands discovery from DeweyCheatham as to the specific nature of the trade secrets EnHowe is alleged to have misappropriated, the share price of DeweyCheatham stock falls to a fifty-two week low, and publications and blogs fault DeweyCheatham's "failure to protect its trade secrets," rather than the alleged EE attack by EnHowe, as the reason for the collapse in DeweyCheatham's firm value. A week before Thanksgiving 2013, as the nationwide average price of a gallon of unleaded regular gasoline falls to \$1.70, a jury convicts all EnHowe defendants on all charges. At sentencing, individual defendants receive prison sentences ranging from six months to eighteen months. EnHowe is fined \$5 million—the maximum available under the EEA—and ordered to pay civil restitution in the amount of an additional \$5 million.

5. Phase Five: Collusion

In July 2014, at the EnHowe Annual Shareholders Meeting in Las Vegas, the CEO of DeweyCheatham makes a surprise appearance with the new CEO of EnHowe to announce the initiation of a joint fuel additives research and development program that will "significantly improve the efficiency of gasoline" while "reducing duplicative efforts and eliminating the pressures toward unethical conduct, and increasing the value that both firms are able to provide to consumers." Gas prices trend upward, as do the share prices of both firms, and as a gallon once again eclipses \$4.00 investigators and attorneys with the Antitrust Division of the U.S. Department of Justice in Washington, D.C., noisily open a preliminary investigation.

6. Phase Six: Prosecution

On the Tuesday after Memorial Day 2015, with the price of a gallon of gas at nearly \$6.00 per gallon, the Deputy Assistant Attorney General for the Antitrust Division of the U.S. Department of Justice ("DAAG") holds a press conference, broadcast live by scores of networks from the Washington, D.C. Headquarters building, to announce the following:

After an investigation of over six months' duration, during which time it has cooperated to render a full exposition of the facts and to assist in developing the case against its co-conspirator, DeweyCheatham has entered into an Agreement under the Corporate Leniency Program in connection

with a criminal conspiracy to fix the price of gasoline in the United States in violation of Section 1 of the Sherman Act.¹²⁷ DeweyCheatham has entered into this Agreement and agreed to make restitution of \$25 billion in exchange for a promise from this office not to prosecute or to levy fines. The Corporate Leniency Program presented DeweyCheatham and its co-conspirator with a golden opportunity—no criminal conviction and no fines to the firm that raced in first and provided evidence against the other. DeweyCheatham made the right decision in abandoning its pattern of wrongdoing and aiding this office in its work on behalf of consumers.¹²⁸

In a separate announcement issued the next day, the DAAG announces the filing of criminal and civil complaints against EnHowe alleging a “combination and conspiracy to fix the price of gasoline” at a supracompetitive level “with the result that the price of gasoline in the United States has been fixed and maintained for over two years and that competition has been restrained, suppressed and eliminated.” The complaints seek \$100 billion in fines against EnHowe—the largest ever sought in an antitrust complaint by orders of magnitude¹²⁹—which represents, in the estimation of the DAAG, twice the gain from the illegal activity and twice the loss suffered by consumers. Within days, class actions are filed against EnHowe on behalf of consumer groups demanding a total of nearly \$150 billion in damages.¹³⁰

127. See U.S. Department of Justice, Antitrust Division, Office of the Deputy Assistant Attorney General, *Model Corporate Conditional Leniency Letter*, available at <http://www.justice.gov/atr/public/criminal/239524.htm>.

128. This language parallels policy statements by the former DAAG. See, e.g., Scott D. Hammond, *Recent Development Related to the Antitrust Division's Corporate Leniency Program*, UNITED STATES DEPARTMENT OF JUSTICE (Mar. 5, 2009), available at <http://www.justice.gov/atr/public/speeches/244840.htm>.

129. 18 U.S.C. § 3571(d). The largest fine a firm has been sentenced to pay to date is \$500 million. *United States v. F. Hoffmann-LaRoche Ltd.*, Cr. No. 99-CR-184-R (N.D. Tex. May 20, 1999) (judgment and plea agreement). The fine imposed is generally a multiple of twenty percent of the volume of commerce affected; the multiplier, which ranges from 0.75 to 4.0, is determined by considering certain characteristics of the offense, including the size of the firm, whether the firm was the ringleader of the conspiracy, whether high-level employees led the conspiracy, whether there was an effective compliance program, and whether the firm had prior antitrust violations. U.S.S.G. §§ 2R1.1, 8C2 (Nov. 2002). All cartel members may be jointly and severally liable for all price-fixing committed in furtherance of the conspiracy. *Id.*

130. See 15 U.S.C. § 15(a) (2000) (permitting individuals harmed as a result of the criminal act to sue for damages of up to three times actual damages). Firms that do not confess first are liable for treble damages both severally and jointly in subsequent private lawsuits, with damages in private price-fixing suits based on the “but-for” price of the affected goods or services and the injury to plaintiffs represented by the difference between the price actually paid and the price the plaintiffs would have paid but for the defendant’s price-fixing. *New York v. Hendrickson Bros.*, 840 F.2d 1065, 1077 (2d Cir. 1988). DeweyCheatham is liable solely for damages caused by its conduct as a result of its Agreement under the CLP. Additional advantages to first confessors under the CLP include avoidance of costs incurred as a result of prosecution, including disruption of business, loss of employees’ time, financial costs of defending against criminal charges, and further reputational harm. Leslie, *Antitrust*

Gas prices fall almost immediately, and by September 2015, shortly before trial commences, EnHowe enters into an agreement whereby it pleads guilty to all charges and pays a fine of \$80 billion. Civil suits are settled as well, and the refund checks consumers receive stimulate the U.S. economy. Later that fall, DeweyCheatham and EnHowe introduce K2 and Frozen Chain with intense advertising campaigns that spark a new price war; by Christmas, gas stabilizes at just over \$2.00 per gallon, and, as I. Ned Gass is thrilled to discover on his next visit to Utopia, that gallon provides thirty percent greater fuel efficiency than the previous generation of gasoline.

B. METHODOLOGY: GAME THEORY

1. Introduction

Game theory (“GT”) is an analytical heuristic that assists in the rigorous development and testing of explanatory and predictive theories of conflict and cooperation in social science¹³¹ by “provid[ing] an account of what behavior to expect in a strategic interaction,” where a strategic interaction is defined as one “in which the actors’ resulting welfare is a function not only of their own actions but of those of others as well.”¹³² Specifically, GT is a branch of mathematics that sharpens logic and “hones . . . intuition by illuminating the basic forces that are at work by not plainly visible” when entities seek to predict and shape the reaction of other entities to their decisions, including the possibility of cooperation and the role of legal sanctions in structuring decisions and outcomes of decisions.¹³³

Amnesty, Game Theory, and Cartel Stability, *supra* note 19, at 458.

131. Developed in the late 1940s, game theory was quickly identified as the “most promising mathematical tool yet devised for the analysis of man’s social relations.” Lewis Fry Richardson, *Commentary on the Social Application of Mathematics*, in *THE WORLD OF MATHEMATICS* 1264, 1264 (1956). In the last sixty years, game theory has found application as a method of theory development and analysis in a wide variety of behavioral fields, including political science, economics, and law. See R.J. Aumann, *Game Theory*, in 2 *THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS* 460, 460–79 (John Eatwell et al., eds., 1987) (identifying the various fields in which game theory has made contributions in theory building and testing).

132. Nicholas Almendares & Dimitri Landa, *Strategic Coordination and the Law*, 26 *L. & PHIL.* 501, 505 (2007).

133. *Id.* at 509–10.

2. *Elements of Games*

a. Players

“Players” are the entities—natural persons, groups of natural persons, or firms—that exist in a closed system and must interact strategically with other players to achieve payoffs.

b. Actions

“Actions” are the choices from among options players must make in order to maximize their expected payoffs.¹³⁴

c. Payoffs

“Payoffs” are the objective consequences of strategies, measured in utility which can be but is not necessarily monetary.

d. Information

“Information” is knowledge about the strategies other players are likely to use, about expected payoffs associated with various strategies, about the strategies other players chose previously, and about how strategic interactions between players have influenced payoffs.¹³⁵

134. When a single strategy is best for a player regardless of what the other player does, it is called a “pure” strategy. BAIRD ET AL., *supra* note 21, at 6. A “dominant strategy” is the optimal strategy for a player to choose irrespective of the strategy chosen by the other player(s). *Id.*

135. See Almendares & Landa, *supra* note 132, at 511 (describing the significance of information regarding “prior strategic interaction” to players). A “perfect” information game, also known as a “C” game (for complete information), implies that players know all that is necessary to determine available actions, payoffs, and periods, whereas an “imperfect” or “incomplete” information game (also known as an “I” game), is such that players lack some or all of this information. DIXIT & SKEATH, *supra* note 6, at 20–24. An “asymmetric” information game is characterized by an informational differential between players, whether by design or by the successful efforts of one or more players to conceal information, mislead other players, or convey private information selectively. *Id.* Uncertainty is intrinsic to many games, and manipulation of available information, and attempts to force better-informed players to reveal their information, are strategies that often correspond with desirable payoffs. See Greenberg, *supra* note 44, at 139 (1982) (discussing the utility of and protection against deception in strategic interactions).

e. Periods

“Periods” are the units of time or turns in which the length of the game is measured—either one unit, multiple units, an uncertain or unknown number of units, or an infinite number.

f. Strategies

“Strategies” are “complete contingency plan[s] for picking [actions] as the game and information about the game develop.”¹³⁶

g. Solutions

A “solution” for a game—also known as an “equilibrium”—is a conjunction of players’ strategies such that each is playing its “best strategy” where a best strategy is that strategy that maximizes its individual payoff.¹³⁷ A “Nash equilibrium” is a solution in which no player can improve its expected payoff by unilaterally switching to a different strategy while holding fixed the strategy(ies) of the other player(s).¹³⁸ A game can have zero, one, or multiple solutions.

3. Assumptions

GT assumes the following: (1) players are rational;¹³⁹ (2) aspects of the strategic context not specified in the game are equivalent for all players;¹⁴⁰ (3) explanations and predictions are sensitive to the way the game is designed and in particular the method whereby payoffs are determined;¹⁴¹ (4) games can model a complex strategic interaction with

136. Martin Shubik, *Game Theory, Law, and the Concept of Competition*, 60 U. CIN. L. REV. 285, 289–90 (1991).

137. See Arthur J. Jacobson, *Origins of the Game Theory of Law and the Limits of Harmony in Plato’s Laws*, 20 CARDOZO L. REV. 1335, 1398 (1998) (defining “equilibrium”). An equilibrium is a function of the available strategies and payoffs which are in turn determined by the game designer. *Id.* It predicts the combination of strategies that rational players will select. *Id.*

138. A “Nash equilibrium” occurs when each player’s strategy is a best response to the other players’ best responses. DREW FUDENBERG & JEAN TIROLE, *GAME THEORY* 11 (1991).

139. See MARTIN J. OSBORNE & ARIEL RUBINSTEIN, *A COURSE IN GAME THEORY* 4 (1994) (defining a “rational” player as one who is “aware of his alternatives, forms expectations about any unknowns, has clear preferences, and chooses his actions deliberately by some process of maximization”). In ascribing rationality to players, GT does not make evaluative judgments as to whether players’ objectives are desirable. Almendares & Landa, *supra* note 132, at 505.

140. See Shubik, *supra* note 136, at 292 (describing the “external symmetry” assumption).

141. See Bruce H. Kobayashi, *Game Theory and Antitrust: A Post-Mortem*, 5 GEO. MASON L. REV. 411, 412 (1997) (indicating that empirical measures or proxies must be developed to specify payoffs). Game theorists “act like gods” in creating the game, and in particular in specifying payoffs, and to the

relatively few elements without losing significant explanatory and predictive power;¹⁴² (5) explanations and predictions are contingent rather than deterministic; (6) games are “self-contained” (payoffs and strategies are not linked to the existence of other games) unless otherwise specified;¹⁴³ (7) players have symmetric and perfect information unless otherwise specified; and (8) games depend upon the existence of non-players to enforce the rules that limit strategies and payoffs.¹⁴⁴ Although GT incorporates these assumptions, it nevertheless provides a rigorous method for analyzing strategic principles and the decisions entities make as they interact within their environment,¹⁴⁵ and the explanations and predictions it offers retain significant power even when these assumptions are relaxed.¹⁴⁶

C. GAME-THEORETIC ANALYSIS OF *DEWEYCHEATHAM V. ENHOWE*

1. *Competition: The Single-Shot Prisoners’ Dilemma*

During the “Competition” phase, DeweyCheatham and EnHowe, despite having created a duopoly market, engaged in aggressive price competition, sacrificing the short-term profits available from supracompetitive pricing in favor of a price war each fought in the hope of securing a larger future market share. Simultaneously, each invested in the development of intellectual property in an effort to differentiate its product from that of its rival in the hope of earning future price premia for products the market would recognize as superior to earlier formulas of gasoline. Neither trusted the other, as their information security precautions attested, nor was trust necessary in the context of fierce competition, and consumers benefited accordingly from low prices. The Single-Shot Prisoner’s Dilemma (“SSPD”)—a game that models the circumstances under which entities will collaborate and under which they will choose to maximize self-

extent that payoffs do not fairly and accurately represents the benefits and costs to the players of various actions, the theorist can influence the results of the game in a manner that dilutes its usefulness to the objectives of rendering explanations and predictions of player behavior. Jacobson, *supra* note 137, at 1399.

142. BAIRD ET AL., *supra* note 21, at 7. Although GT “suppresses details concerning process and information” to “deal with the big picture,” the relationship between actions, strategies, and payoffs is useful for building and testing theories. Shubik, *supra* note 137, at 290.

143. See William J. Edelman, *The Benefit of Spying: Defining the Boundaries of Economic Espionage under the Economic Espionage Act of 1996*, 63 STAN. L. REV. 447, 458–59 (2010) (elaborating the “self-contained” assumption).

144. Jacobson, *supra* note 137, at 1398.

145. Heil et al., *supra* note 7, at 129.

146. David Sally, *Game Theory Behaves*, 87 MARQ. L. REV. 783, 784 (2004).

interest at the expense of others—is useful in explaining the strategic interaction during “Competition.”

a. Game Description: SSPD

In the SSPD game, two self-interested players simultaneously choose strategies and receive payoffs determined by the intersection of strategies. Although each player can gain by the strategy of “cooperation,” defined as collaborating with the other player to achieve common gains, the strategy of “defection,” or betraying the other player, is dominant for each. Thus, if the SSPD cooperation fails, then each player ends up worse off than if he had cooperated and pursued joint interests instead of his own. Consider the classic example: two suspects, A and B, are arrested for a major crime and a minor crime by the police, who have insufficient evidence to convict either of the major crime but enough to convict on the lesser charge. The police, having physically separated both prisoners, visit each to offer the same deal: if one “defects” and testifies for the prosecution against the other while the other “cooperates” and remains silent, the defector goes free on both charges and the cooperator is convicted of the major crime and receives the full ten year sentence. If both cooperate and remain silent, both are sentenced to only six months on the lesser charge. If each defects and betrays the other, each receives a two-year sentence for the major crime. Each prisoner must decide whether to defect or to cooperate.¹⁴⁷ However, neither can be certain what choice the other will make, and they cannot communicate with the other.

b. Payoffs: Standard SSPD Game

The SSPD game can be summarized in a matrix where the row player’s payoff is listed first and the column player’s payoff is listed second in each cell, and the smaller the payoff the lower the sentence and the greater the value to the player:

147. The PD game assumes that players do not necessarily know their choice of strategies and actions at the beginning of the game but must decide based on the payoffs and their estimation of the other player’s strategies and actions.

Single-Shot Prisoners' Dilemma

		Prisoner B	
		Silent	Confess
Prisoner A	Silent	.5, .5	10, 0
	Confess	0, 10	2, 2

Analysis of the payoffs reveals that each prisoner desires for the other to remain silent (cooperate) while he confesses (defects) so that he can go free, yet both know that if each confesses they will receive two-year sentences—a reduction from the most severe sentence granted in light of the willingness to provide incriminating information but a worse outcome than the cooperative outcome of six-month sentences when both remain silent.¹⁴⁸ The cooperative outcome is Pareto optimal—any other decision would be worse for the two prisoners considered together—but unstable, because neither can be sure that the other will not defect in the hope of escaping punishment entirely and forcing the other to serve ten years.¹⁴⁹ As each prisoner further scrutinizes his own payoffs he discovers that, although he would like to remain silent and have the other prisoner remain silent, the fact is that, no matter what the other does, each prisoner is better off confessing. With confession being the strongly dominant strategy for each prisoner, the solution is a Pareto inferior Nash equilibrium in which each prisoner will always confess and receive a longer sentence than if neither confessed, and each is thus worse off than he could be had both been able to cooperate and remain silent. In other words, the SSPD creates an inescapable dilemma in which a better solution—each prisoner serves a six month sentence—is available than the one that rational self-interested players will choose—each prisoner serves a two year sentence—if only both could trust each other enough to cooperate in shifting from the Confess-Confess outcome to the Silent-Silent outcome. Although the prisoners are in a state of interdependence, benefits to defection defeat cooperation, and the individually rational actions of the prisoners produce a

148. The payoffs are often labeled as follows: “S” for “Sucker’s Payoff” earned for confessing while the other player is silent; “T” is for “Temptation” to remain silent while the other player confesses; “R” is the payoff when both players “Resist” the urge to confess and remain silent; and “P” is for “Punishment” when both players confess. Accordingly, in the standard PD, $T > R > P > S$. NOWAK, *supra* note 88, at 8.

149. The credible threat of severe punishment—which is not always available—may be necessary to reinforce the Pareto-optimal equilibrium in the PD game. BAIRD ET AL., *supra* note 21, at 173.

suboptimal and inefficient outcome both individually and collectively in terms of the prisoners' welfare.¹⁵⁰

c. Payoffs: *DeweyCheatham v. EnHowe* During Competition

Applying the insights of the SSPD to the interaction of DeweyCheatham and EnHowe during "Competition" results in the following matrix, which assumes that no other firms can enter the market for gasoline, that customers buy solely based on price, that both firms make pricing decisions simultaneously without communication,¹⁵¹ sell a homogeneous product, have the same costs, and only charge one of two prices—"Low Price" (the competitive price) or "High Price" (the supracompetitive price):¹⁵²

Single-Shot Prisoners' Dilemma: *DeweyCheatham v. EnHowe* During Competition

		EnHowe	
		Low Price	High Price
Dewey Cheatham	Low Price	$\frac{1}{2} D, \frac{1}{2} D$	D – E, E
	High Price	E, D – E	$\frac{1}{2} C, \frac{1}{2} C$

150. Without incentives to defect, the Prisoner's Dilemma is not a dilemma, and cooperation is a "no brainer." NOWAK, *supra* note 88, at 264. For a detailed analysis of the SSPD see John Nash, *Non-cooperative Games*, 54 ANNALS OF MATHEMATICS 286 (1951).

151. In duopoly markets, the three types of competitive relationship that prevail are as follows: "independent," in which both firms make decisions regarding prices independently and simultaneously and competition prevails; "leader-follower," in which one firm sets price followed by its rival and the market and profits are split based on this arrangement; and "collusive," where the rivals collectively decide prices to maximize joint profits. See Day et al., *supra* note 7, at 222–24 (describing various duopoly pricing mechanisms). In SSPD: *DeweyCheatham v. EnHowe*, it is assumed that firms price simultaneously, which is a simplification of reality made in sacrifice to the demands of theory development. For a discussion of the complexity introduced with the modeling of sequential games, particularly in terms of the importance of private information see EILON SOLAN & LEEAT YARIV, *GAMES WITH ESPIONAGE*, 2–27 (2002).

152. These assumptions are standard SSPD simplifying assumptions used to model duopoly interactions. See Kattan & Vigdor, *supra* note 14, at 447. Here, the payoffs in SSPD: Dewey Cheatham v. EnHowe are not denominated in dollars because the value of each strategy is determined not only by the price chosen by each rival but by the number of gallons of gasoline sold (which is somewhat sensitive to demand) and the profit margin per gallon (which is a nonlinear calculation due to the large percentage of costs that are fixed in the petroleum industry). It is assumed that the microeconomic effects on supply and demand of the firms' pricing strategies need not be modeled in greater detail to capture the strategic interaction in terms of payoffs and preferences for rival firms.

Here, C is the payoff where both firms cooperate and charge the High Price of \$3.99, D is the payoff when both firms defect from cooperation and charge the Low Price of \$1.70, D – E is the high payoff that goes to the defector when the other firm cooperates, L is the low payoff that goes to the loser (the cooperator) when the other player defects, and $D - E > \frac{1}{2}C > \frac{1}{2}D > E$.¹⁵³

d. Analysis: *DeweyCheatham v. EnHowe* During Competition

An examination of the payoffs reveals to both firms that, although the desired outcome for each firm was to charge Low Price while its rival charged High Price, thus earning H for itself, the strongly dominant strategy for each was to charge Low Price and avoid the possibility of being stuck with L when it charged High Price and its rival charged Low Price. Although the firms could benefit individually and collectively by each charging High Price and thereby improving the payoffs associated with their dominant strategies, they were unable to generate sufficient trust to achieve this superior equilibrium during “Competition,” and thus a Pareto-inferior but stable Nash equilibrium of Low Price, Low Price solved this game. In other words, DeweyCheatham and EnHowe would have preferred the High Price, High Price solution to the SSPD,¹⁵⁴ but a competitive market where the Low Price of \$1.70 prevailed due to the interaction of the individual self-interests of the firms, their failure to communicate, their inability to generate trust that initial cooperative pricing decision would be reciprocated, and their inability to sanction defection from their mutually preferred equilibrium.

2. *Cooperation: The Infinitely-Repeated Prisoners’ Dilemma with Tit-for-Tat*

During the “Cooperation” phase, DeweyCheatham and EnHowe, despite continuing their intense and expensive competition in fuel

153. The four payoffs in the PD matrix are conventional but arbitrary, and are labeled with letters, C (Cooperate), D (Defect), E (Lose), and D – E (Cheat). Formally, a set of inequalities defines the PD: a game is a PD if $D - E > C/2 > D/2 > E$. See, e.g., Boyd & Richerson, *The Evolution of Reciprocity in Sizable Groups*, 132 J. THEORETICAL BIOLOGY 337 (1988).

154. The assumption as to firms’ rationality has already been specified. See OSBORNE & RUBINSTEIN, *supra*, note 139, at 4. Duopolists dislike low prices for a bevy of reasons, including lost potential profits, and prefer high prices to low prices out of rational self-interest. Rudolf R.J. Peritz, *Toward a Dynamic Antitrust Analysis of Strategic Market Behavior*, 47 N.Y.L. SCH. L. REV. 101, 114 (listing reasons duopolists prefer high prices); BRANDENBURGER & NALEBUFF, *supra* note 8, at 4 (explaining that low prices “lead to surrendered profits all around”).

additives, developed a long-term cooperative relationship and a high-price equilibrium without expressly communicating their interests in doing so. Frequent reciprocal collection of information about rival pricing intentions and decisions acquired using lawful CI was interpreted not as hostile activity but as a useful mechanism to verify an ongoing commitment to ensure that what few defections occurred were swiftly detected and punished and that cooperation was restored. Both firms, in effect, understood that verification was desirable and that CI served this end, and as a result each earned an equal share of supracompetitive profits without incurring antitrust liability. The Infinitely Repeated Prisoners' Dilemma ("IRPD") explains the strategic interaction during "Cooperation."

a. Game Description: IRPD with Tit-for-Tat

The competitive equilibrium in the SSPD is Pareto-inferior as it does not maximize players' welfare. However, repetition of the SSPD game can induce more cooperative behavior and more efficient solutions, particularly if the game is of uncertain duration or is infinitely repeated.¹⁵⁵ Unlike the SSPD, the IRPD allows the shadow of the future to loom over current actions: when players know they will interact beyond the instant period, they must consider not only the present costs and benefits of their strategies but also the costs and benefits incurred in future periods as a result of present actions. In the IRPD each player's best action and strategy still depends upon the other player as it does in SSPD,¹⁵⁶ but now there is the real possibility of cooperation under three separate circumstances: (1) if the players can directly communicate the desired action and strategy to each other in advance of the game and trust each other to choose that action and play that strategy in the absence of any enforcement mechanism, (2) if an external entity can enforce a penalty against defection sufficient to induce the noncompetitive, Pareto-optimal Nash equilibrium, or (3) if the players can derive a self-enforcing mechanism that promotes this cooperative solution and allows for the evolution of trust backed by the threat of sanctions over time.¹⁵⁷

155. The longer the PD is repeated, the greater the chance of cooperation. R.L. Trivers, *The Evolution of Reciprocal Altruism*, 46 QUANT. REV. BIO. 35 (1971).

156. The IRPD game shares the set of assumptions from the SSPD game and incorporates the additional assumption for purposes of simplicity that players determine their strategies before the game begins, although in the real world trial and error is used to search for strategies. Matsui, *supra* note 46, at 110.

157. According to an early game theorist, If we assume that the two players of PD can make a pact to effect the mutually advantageous outcome the prospective partners must have a common language. They must also either profess allegiance to or tender obedience to a common authority, either coercive, like a police force, or internalized like

Direct communication is not always possible, and external entities are not always available or favorably disposed to promoting the goals of the players; in the case of antitrust law, direct communication between firms as to pricing decisions is legally proscribed by the most relevant external entity—the state—which categorically opposes the cooperative solution on behalf of consumers. However, self-enforcement can be created and sustained as an effective mechanism for promoting the cooperative solution if each player can monitor and punish the other upon observed defection in previous periods of the game.¹⁵⁸ Over time, as players gain experience converging their interests in cooperation in their interactions with one another and develop reputations for fairness and reliability,¹⁵⁹ trust can emerge¹⁶⁰ provided players' actions are sufficiently transparent to communicate the interest in and commitment to cooperation and the punishment for defection is swift, sure, cheap, and significant enough to render cooperation more valuable than defection and therefore rational.¹⁶¹ When the credible threat of punishment renders cooperation rational, a “subgame perfect” Nash equilibrium can be achieved which dominates the

conscience. Pacts must be enforceable. ANATOL RAPOPORT, *STRATEGY AND CONSCIENCE* (1962). For a description of the sufficient conditions precedent for cooperation in the IRPD see J.P. Mayberry, John F. Nash, & Martin Shubik, *A Comparison of Treatments of a Duopoly Situation*, 21 *ECONOMETRICA* 141, 144–46 (1953); Matsui, *supra* note 46, at 94, 99.

158. Matsui, *supra* note 46, at 94 (stating that the capacity to punish defection is a necessary condition for cooperation in the repeated PD game). For this reason, games in which punishment for defection is enforceable and cooperation is therefore possible are called “cooperative,” while those in which enforcement is not possible—including the SSPD—are called “noncooperative.” DIXIT & SKEATH, *supra* note 6, at 26.

159. *See id.* at 21–24 (describing the process whereby players in the IRPD develop reputations based on their play in previous periods, and linking reputation to the evolution of trust regarding future periods).

160. *See generally* AXELROD, *supra* note 37.

161. *See* Leslie, *Trust, Distrust, and Antitrust*, *supra* note 19, at 610 (enumerating the requirements for punishment sufficient to prevent defection and produce cooperation in the IRPD); An absence of transparency is a major impediment to cooperation inasmuch as it prevents the observation of the current actions of rivals which is necessary to reinforce the emergence of trust in the commitment that past cooperative actions will be reciprocated and matched by future cooperative actions. BAIRD ET AL., *supra* note 21, at 174; Leslie, *Trust, Distrust, and Antitrust*, *supra* note 19, at 573 (explaining why the inability to observe rivals' actions undermines trust). Moreover, when defection cannot be readily or accurately detected, rivals cannot ensure that punishment minimizes the benefit of defection and increases the costs to outweigh the gains sufficiently to render defection irrational. DIXIT & SKEATH, *supra* note 6, at 355. In other words, only if the prospects for gain through defection are openly, objectively, and sufficiently bleak does defection become irrational and cooperation become rational in the IRPD. One of the most significant obstacles to cooperation is the inability to observe directly the pricing decisions of rivals. A firm may not learn that a rival has defected and cut price until demand for its goods declines or until customers report the information, and under such circumstances the ability to punish defection is diminished, along with the ability to sustain cooperation. Yao, *supra* note 13, at 316.

Pareto-inferior competitive outcome and thus forms the cooperative solution to the IRPD.¹⁶²

Various contingent, or “trigger,” strategies been devised to punish rivals effectively for defection in the previous period of the IRPD and thereby create the enforcement-backed trust necessary to induce the cooperative solution. One of the “nicer” trigger strategies is Tit-for-Tat (“TFT”), which cooperates until the rival defects, punishes the defector in the next period of play, and then resumes cooperating one period after the rival does so.¹⁶³ The IRPD-TFT differs from the SSPD in that the former requires incorporation of time-value of money considerations because the gains of defection are had in the present period while the costs are incurred in future periods.¹⁶⁴ Provided that the present value of the gains of defection are smaller than the present value of future costs, it is rational to cooperate; this quantitative determination depends in turn upon the interest rate, r , at which future costs are discounted.¹⁶⁵ Assuming low interest rates and the reciprocal capacity to punish defection with sufficient severity to

162. “Subgame perfection” implies that players will carry out all threats because the cooperative outcome protected through punishment is more valuable even after paying the costs of punishment, and therefore no player has an incentive to deviate from an equilibrium strategy regardless of actions in previous periods. Paul G. Mahoney & Chris William Sanchirico, *Norms, Repeated Games, and the Role of Law*, 91 CAL. L. REV. 1281, 1286–87 (2003).

163. See DIXIT & SKEATH, *supra* note 6, at 352 (describing TFT as one of the “nicer” trigger strategies due to its swift return to cooperation post-punishment). Moreover TFT is considered a “nice” strategy because it commences by cooperating in the first period of a PD game, and thus cannot, by definition, prevail in a single period. Mayberry et al., *supra* note 157, at 146–48.

164. See DIXIT & SKEATH, *supra* note 6, at 352 (describing TFT as one of the “nicer” trigger strategies due to its swift return to cooperation post-punishment). The probability that a PD game will continue beyond the present—0 is less than or equal to P is less than or equal to 1—is also an important consideration in the decision to defect. For purposes of simplicity the assumption is made that the IRPD is truly an infinitely repeated game and not simply a PD of indefinite duration, and thus the probability the IRPD will continue into the next period is 1.

165. A quantitative analysis of the IRPD played with the TFT strategy reveals that it is rational to defect once against the TFT-playing rival if the one-time gain from defecting, $(H - C)$, is greater than the present value of the single-period loss from being punished prior to returning to cooperation, $(C - L)$. Incorporating r as the periodic interest rate, it is thus rational to defect for one period against a TFT-playing rival if $(H - C) > (C - L)/(1 + r)$, or $(1 + r)(H - C) > (C - L)$, or $r > [(C - L)/(H - C)] - 1$. Similarly, it is rational to defect forever against a TFT-playing rival only if the one-time gain from defecting, $(H - C)$, exceeds the present value of the infinite sum of the per-period losses from perpetual defecting, $(C - D)$, and thus perpetual defection occurs only if $(H - C) > (C - D)/r$, or $r > (C - D)/(H - C)$. Several additional conclusions follow from a quantitative analysis of the IPRD-TFT: (1) if the values of the gains and losses from defecting are fixed, changes in r determine whether a player defects, with defection more likely the higher the value of r ; (2) if r is fixed, changes in per period losses associated with punishment determine whether a player defects, with the severity of the punishment inversely correlated with defection probability; (3) if r and per period losses are fixed, defection is more likely the higher the gain from defection; (4) the faster and more accurately defection can be detected, the sooner and more surely punishment can be inflicted and the less likely defection will be. For a general discussion of the mathematics of the IPRD-TFT game, see, e.g., Daniel Ashlock, Christopher Kuuselo, & Monica Cojocara, *Shopkeeper Strategies in the Iterated Prisoner's Dilemma* (manuscript in possession of the author).

render the payoff for the cooperative outcome— $\frac{1}{2}C$ —greater than the payoff for defection ($D - E$) minus the cost of punishment—($\frac{1}{2}C - E$), IRPD-TFT predicts that the likelihood of defection will be very low and that once established cooperation will be evolutionarily stable.¹⁶⁶ Accordingly, IRPD-TFT predicts further that rational firms will independently recognize their interdependence, intuit the benefits of cooperation, and communicate their interests in and commitment to achieving the cooperative solution to the IRPD by making cooperative pricing decisions in the initial period and employing the TFT strategy in subsequent periods to continue cooperation without the need for express agreements or the exchange of additional information, save for the monitoring necessary to maintain trust and to prevent and punish defections.¹⁶⁷

b. Payoffs: *DeweyCheatham v. EnHowe* During Cooperation

In the IRPD, C is the cooperative payoff split between players, D is the competitive payoff split between players when both defect, $D - E$ (or H) is the “High” payoff to the defector when the other player cooperates, E (or L) is the “Low” payoff to the cooperator when the other player defects, and $D - E > \frac{1}{2}C > \frac{1}{2}D > E$.¹⁶⁸

166. Defection from Pareto-optimal Nash equilibria tends to occur only when prevailing interest rates reach historically high levels. Assume that (a) collusive profit, C , is \$500 million per month, b) high profit, $D - E$, is \$800 million per month, and (c) low profit, E , is \$150 million per month. A firm employing TFT can thus effectively prevent defections by its rival only where $r > [(C - E)/(D - E - C)] - 1$, or where the interest rate is just under 17% per month. U.S. interest rates have not exceeded 2%/month since the Civil War. See Jeffrey Williamson, *American Growth and the Balance of Payments, 1820–1913*, 20 J. FIN. 164, 164–66 (1966). Other conditions which can trigger defection include when an entire industry verges on collapse, and thus the shadow of the future slips away, or when a firm plans a quick exit from the market. DIXIT & SKEATH, *supra* note 6, at 356.

167. This Article considers that, as part of the rationality assumption, players in the IRPD-TFT game recognize and avoid the danger that the TFT strategy can pose to the stability of cooperation if after the first defection and punishment the punished player does not accept the “Low Price” punishment and instead defects again, thereby sending the game into a perpetual series of punishments and a competitive equilibrium from which the players cannot escape. DIXIT & SKEATH, *supra* note 6, at 356 (discussing the “echo” problem in TFT). For an examination of the strength of this assumption based on empirical research in the natural world, see generally Robert Boyd & Jeffrey P. Lorberbaum, *No Pure Strategy Is Evolutionarily Stable in the Repeated Prisoner’s Dilemma Game*, 327 NATURE 58 (1987).

168. The payoffs associated with this version of the PD game have the following properties: (1) $C > D$, (2) E is a small but nonzero number because some consumers are not price sensitive or cannot immediately adapt to purchase at the lowest price, and (3) $D - E > \frac{1}{2}C > \frac{1}{2}D$, where c = cartel profits and d = competitive profits.

**Infinitely Repeated Prisoners’ Dilemma with Tit-for-Tat:
DeweyCheatham v. EnHowe During Cooperation**

		EnHowe	
		Low Price	High Price
Dewey Cheatham	Low Price	$\frac{1}{2} D, \frac{1}{2} D$	D – E, E
	High Price	E, D – E	$\frac{1}{2} C, \frac{1}{2} C$

c. Analysis: *DeweyCheatham v. EnHowe* During Cooperation

Analysis of the strategic interaction between *DeweyCheatham* and *EnHowe* During Phase Two: Cooperation reinforces these predictions. By intuiting that cooperation was possible given the existence of mutual interests, the shadow of the future, and the capacity of both firms to punish defections, and by communicating information through pricing decisions regarding their intent to achieve “High Price” cooperation, *DeweyCheatham* and *EnHowe* developed trust that enabled them to solve the game with the cooperative, subgame perfect, and Pareto-superior Nash equilibrium, earning each firm supracompetitive profits. Moreover, the rivals did so without entering into any express agreement proscribed by antitrust law. In those few instances where one rival defected, the other applied effective “Low Price” punishment in the next period, and the defecting rival recognized the punishment for what it was and returned to cooperation, as prescribed by TFT, in subsequent periods. As a result, *DeweyCheatham* and *EnHowe* earned supracompetitive profits and pushed the price of gasoline to a peak of \$5.10 with legal impunity.

3. *Defection: Infinitely-Repeated Prisoner’s Dilemma with Grim Trigger*

Espionage introduces additional complexity into the IRPD. A firm that commits EE appears to choose the cooperative “High Price, High Price” equilibrium but is secretly defecting because a firm that can produce goods or services without having to pay the necessary research and development and technological costs creates a lower cost structure and thus earn a significantly greater profit even when pricing its goods and services in parity with a rival.¹⁶⁹ Firms that acquire information such as trade

169. A firm that steals information from its rival can cut its own research and development, reduce

secrets at no cost can effectively defect from the high-price equilibrium and charge competitive prices without losing all the gains from pricing high.¹⁷⁰ By contrast, firms that lose their investment in R&D must nevertheless match their rivals' low prices at greatly reduced profit margins. Thus, a firm that engages in EE is effectively charging "Low Price," while deceptively inducing its rival to continue selecting "High Price" in the belief that the cooperative equilibrium prevails.¹⁷¹ EE thus is an abandonment of cooperation and a shift of payoffs to both firms away from the cooperative equilibrium of ($\frac{1}{2} C$, $\frac{1}{2} C$), to ($D - E$, E), for as long as possible. In so doing, the spying firm informs its rival of its willingness to risk the chance that the short-term gains of espionage—however long they endure—will exceed the long-term gains of cooperation, and that it cannot be trusted to confine itself within the boundaries of legitimate information-gathering.

a. Game Description: IRPD with Grim Trigger

Not surprisingly, not all trigger strategies are as nice as TFT; when one player is caught spying, it is often punished for its defection with the "grim trigger" ("GRIT") strategy. A player playing GRIT commences by cooperating but then responds to a single defection in any period with defection forevermore, and thus following the defection of either player the solution for the remainder of the game is the competitive Nash equilibrium.

b. Payoffs: *DeweyCheatham v. EnHowe* During Defection

For every period prior to and include the period in which espionage is detected, the firm engaged in EE earns the "High Price, Low Price" payoff of ($D - E$) while the cheated rival earns (E); for each subsequent period, both firms earn the competitive payoff of $\frac{1}{2} D$:

its long-term cost structure, and either cut prices beneath its rival's marginal cost or produce higher quality goods at the competitive price, thereby enabling it to claim additional market share and profits.

170. This assumes, of course, that the cost of CE operations is less than the value of the information acquired, or else firms would not resort to CE. SOLAN & YAARIV, *supra* note 151, at 4–5.

171. See DIXIT & SKEATH, *supra* note 6, at 4–6 (describing the effects of espionage on the IRPD).

**Infinitely Repeated Prisoners’ Dilemma with Grim Trigger:
DeweyCheatham v. EnHowe Subsequent to Defection**

		EnHowe	
		Low Price	High Price
Dewey Cheatham	Low Price	$\frac{1}{2} D, \frac{1}{2} D$	N/A
	High Price	N/A	N/A

c. Shift to Penance

Escape from the competitive equilibrium and a return to cooperation following the resort to GRIT requires that the firm that employed EE shift to the “Penance” strategy, which calls for the spying firm to return to cooperation under the TFT strategy in the period subsequent to absorbing punishment in the hope that the targeted firm will conclude that it is possible to trust the spying firm again and thus to reciprocate by also cooperating under the TFT strategy.¹⁷² Firms shifting to Penance following punishment under GRIT recognize the need to inform rivals that they are once again trustworthy and therefore predicate their entreaties to restore cooperation upon allegations that the EE was an unauthorized mistake or upon promises to enter private negotiations to resolve the theft.

d. Analysis: *DeweyCheatham v. EnHowe* Under Defection

Examination of the strategic interaction between DeweyCheatham and EnHowe during Phase Three: Defection suggests that, upon discovering EnHowe’s EE attack, DeweyCheatham recognized that it had been deceived into believing a cooperative equilibrium had existed for a number of periods during which it had in fact earned E rather than the anticipated $\frac{1}{2} C$, while EnHowe had earned $(D - E)$. Furthermore, DeweyCheatham conceded, upon subsequent investigation, that EnHowe did not share its understanding of the legitimate boundaries of information exchange, or was unwilling to abide by a tacit understanding as to these boundaries, in the monitoring of pricing decisions. Clearly, EnHowe’s suggestion that the EE attack as the action of rogue operators acting outside the scope of delegated authority was nothing more than an effort to avoid penalties associated with defection and maximize its welfare. Nonetheless, DeweyCheatham, prior

172. See Edelman, *supra* note 143, at 457–58 (discussing the “Penance” strategy).

to shifting from cooperation under TFT to GRIT, offered EnHowe the chance to shift from defection under TFT to Penance predicated upon the compensation to DeweyCheatham for the loss of value represented by the difference between $\frac{1}{2} C$ and E as well as by demonstrating its renewed trustworthiness and its understanding of the acceptable limits of information exchange. When EnHowe refused to accept DeweyCheatham's ultimatum, despite implying that its EE attack on DeweyCheatham had been a mistake and that it recognized the inefficiency of the competitive equilibrium that loomed, this decision was received by DeweyCheatham as EnHowe's continued commitment to EE and defection under TFT.¹⁷³

Accordingly, DeweyCheatham switched strategies from TFT to GRIT and initiated punishment by reducing the price of gasoline and refusing to respond to subsequent signals, in the form of EnHowe's hesitancy to match DeweyCheatham's price cuts, that EnHowe had repented and was now interested in restoring cooperation. In effect, DeweyCheatham communicated to EnHowe that the latter was insufficiently trustworthy to justify the risk of cooperation. Eventually, as GRIT unfolded, the price of gasoline retreated toward the competitive price, and the firms lost producer surplus.

4. *Sanction: Infinitely Repeated Prisoners' Dilemma with Third-Party Penalties*

a. Game Description: IRPD with Third-Party Penalties

When sanctions for defection are insufficient to restore a cooperative equilibrium and/or compensate for losses suffered during periods prior to the discovery of espionage, a player in the IRPD may look to third parties such as the state to impose additional penalties upon its defecting rival. Third-party penalties—which can include deprivations of liberty or property if administered by legal authority, or worse if implemented

173. Clearly, DeweyCheatham cannot have expected EnHowe to accept its ultimatum unconditionally, nor could DeweyCheatham have anticipated that full implementation of its ultimatum would fully eradicate all knowledge of its trade secrets from EnHowe's collective corporate mind, nor could DeweyCheatham have believed that any short-term anticompetitive commitment conferred by EnHowe would make DeweyCheatham whole, let alone grant any sustainable competitive advantage. However, assuming that both firms are rational, negotiation theory would have predicted that a negotiated settlement near the midpoint of the range of possibilities between the ultimatum as presented and no agreement whatsoever should have been concluded that would have substantially disclosed the facts, compensated DeweyCheatham to some significant degree, offered commitments to behave differently in the future, and largely restored the relationship *ex ante* the EE attack. *See generally* GUY BURGESS & HEIDI BURGESS, EDS., *NEGOTIATION THEORY: BEYOND INTRACTABILITY* (2004). That this did not occur made DeweyCheatham's shift in strategy toward third-party party penalties understandable, if, in light of the insufficiency of the EEA, suboptimal. *See infra* at Part III.C.

extralegally—can restore injured parties in whole or in part to their positions *ex ante* the defection, render future defection so unattractive that the cooperative outcome is more stable, or both.¹⁷⁴ In the IRPD with Third-Party Penalty (“IRPD-3PP”) game, a third-party imposes a penalty “X” such that $X > E$, and thus the payoff to the defector from cooperation becomes negative after subtracting the value of the penalty, X. If properly calibrated, X renders defection so unattractive as to suppress it entirely and, in effect, leaves but one strategy for both players—cooperate and choose “High Price.”¹⁷⁵

b. Anticipated Payoffs: *DeweyCheatham v. EnHowe* During IRPD-3PP

In referring the theft of its Project K2 trade secrets to the FBI for prosecution under the EEA, DeweyCheatham intended to have the state impose a penalty, X, equal to either \$5 billion or at least sufficiently high that this punishment, in conjunction with any reputational sanctions against EnHowe imposed by the markets, would compensate DeweyCheatham for the loss suffered in previous periods— $(\frac{1}{2}C - E)$ in each period—while recouping to DeweyCheatham the value of the expropriated trade secrets, convincing EnHowe that future EE would be counterproductive, and restoring the cooperative “High Price” equilibrium.¹⁷⁶ In turning to the state for penalties against EnHowe, DeweyCheatham anticipated that a judicial order protecting Project K2 trade secrets during discovery and trial would prevent further injury. To further indemnify itself against EnHowe’s theft of its trade secrets in Project K2, DeweyCheatham introduced an earlier generation additive into its gasoline while reducing its prices in an attempt to capture market share away from EnHowe and earn X in the period of sanctions as well as $D - E$ in subsequent periods for as long as possible before EnHowe could respond with its own gasoline additive and either signal its intention to restore cooperation or to revert to a competitive market. The payoff matrix DeweyCheatham anticipated during the period(s) of sanction under the EEA was as follows, where $D - E + X > \frac{1}{2}C + X > \frac{1}{2}D + X > E + X > D - E - X > \frac{1}{2}C - X > \frac{1}{2}D - X > E - X$:

174. See DIXIT & SKEATH, *supra* note 6, at 357–58 (illustrating the effects of third-party penalties on the IRPD).

175. See *id.* at 356–57 (suggesting that in fact this is an assurance game with two sustainable equilibria).

176. The possibility of third-party penalties, in addition to the cost of collection, means that the intelligence enterprise, to include EE, “can very well be of no use whatsoever, even counterproductive[.]” Richard Horowitz, *A Framework for Understanding Intelligence*, 8 INT’L J. INTELLIGENCE & COUNTERINTELLIGENCE 389, 389 (1995).

**Infinitely Repeated Prisoners' Dilemma with Third-Party Penalty
(Anticipated): *DeweyCheatham v. EnHowe* Under Sanction**

		EnHowe	
		Low Price	High Price
Dewey Cheatham	Low Price	$\frac{1}{2}D + X, \frac{1}{2}D - X$	$D - E + X, E - X$
	High Price	$E + X, D - E - X$	$\frac{1}{2}C + X, \frac{1}{2}C - X$

c. Analysis: Expected Payoffs

However, in publicizing the theft of its trade secrets and electing to prosecute EnHowe under the EEA, DeweyCheatham miscalculated the reach and scope of third-party penalties, and thus these anticipated payoffs did not materialize. The market did indeed impose penalties; however, DeweyCheatham, rather than EnHowe, was the primary subject. Moreover, the judicial penalties imposed on EnHowe under the EEA were markedly less severe than DeweyCheatham anticipated, inadequate to render EnHowe's payoff negative, and inadequate in making DeweyCheatham whole.

As DeweyCheatham anticipated, historical analysis of EEA prosecutions does in fact reveal that third-party penalties include market-imposed penalties in addition to those imposed by the state, and that the former are even more significant than the latter in terms of their strategic effects upon the IPRD played by the firms involved in EEA cases. However, DeweyCheatham did not discern that these penalties work predominantly against the firm losing trade secrets rather than against the spying firm. Not only does the market not regard EE as deserving of moral opprobrium, but it actually imposes indirect sanctions on firms admitting the theft of trade secrets, and these indirect sanctions are often more costly than the value of the purloined secrets themselves.¹⁷⁷ Reasons for this are two: (1) the defendant firm will likely be granted some access to the trade secrets at issue in order to aid the defense even if a judicial order provides some protection, thus in effect completing the attempted crime and enriching the spying firm in the amount of the value of the information minus any fines,¹⁷⁸ and (2) when information that a firm has been

177. Carr & Gorman, *supra* note 56, at 52.

178. See *United States v. Hsu*, 982 F. Supp. 1022 (E.D. Pa. 1997), rev'd 155 F.3d 189 (3d Cir. 1998) (leaving open the opportunity for defendants charged with substantive crimes under the EEA to

victimized by EE is publicly revealed, the stock price of that firm declines to reflect the potential for additional loss in trade secret value to be wrought through litigation as well as the diminished confidence of investors and analysts in its ability to protect its intellectual property and, by inference, in its managerial competence.¹⁷⁹ Empirical research indicates that public disclosures of trade secret theft are associated with a statistically significant and negative stock market response: when the market discovers that a firm has been subjected to EE the market capitalization of the targeted firm decreases, as the consequence of this discovery, by 8.92% on average.¹⁸⁰ Indeed, rational firms might well consider, when victimized by EE, that they are better off if they treat the fact of their loss as a sunk cost rather than prosecute lest they cause additional trade secret leakage through trial and additional stock price devaluation upon publicization.¹⁸¹

Moreover, the severity of state-imposed penalties for violation of the EEA has proven insufficient to deter against defections, as well as to recoup the loss to firms victimized by EE. In the fifteen years of EEA prosecutions, court-ordered fines, restitution, and forfeitures taken together have ranged from as little as \$200 to no more than \$12 million with the median fine a mere \$50,000.¹⁸² By contrast, the value of trade secrets at issue in an EEA case is frequently much greater than the financial penalties judicially imposed for their unlawful expropriation, and the statute itself caps the maximum fine at \$5 million.¹⁸³ Although the precise calculation

demand discovery of the victim firm's trade secrets). This unsavory prospect was anticipated in congressional hearings prior to the enactment of EEA. See S. REP. NO. 104-359, at 11 (1996) ("Even if a company does bring [charges], the . . . penalties are often absorbed by the offender as a cost of doing business and the stolen information retained for continued use.").

179. See Carr & Gorman, *supra* note 56, at 52–53. See also Weld Royal, *Too Much Trust?*, INDUSTRY WK., Nov. 2, 1998, available at http://www.industryweek.com/articles/too_much_trust_129.aspx ("Information loss is like the AIDS of corporate America . . . For a long time no one would talk about it, fearing the impact on their stock prices and confidence of customers.").

180. See Carr & Gorman, *supra* note 56, at 44–50 (developing a model based on eleven cases of CE where the monetary value of trade secrets stolen is conservatively estimated and data are controlled for other variables and finding a correlation between victimization by CE and loss of market capitalization). Others dispute the quantifiability of the costs of CE. See, e.g., KAHANER, *supra* note 71, at 230 ("Trying to quantify the direct effect of competitive intelligence is like a city trying to quantify the return it receives on having excellent schools, fire department, police, and trash pickup.").

181. Perhaps the sole reason why a rational firm might seek criminal charges against another firm for theft of trade secrets is to inflict reputational harm in the hope that the damage will be so great as to eliminate that rival from the market altogether. See Slind-Flor, *supra* note 57, at 1 (offering this explanation for the EEA).

182. See Rustad, *supra* note 59, at 500–01 (analyzing EEA cases and developing quantitative measurements of prison sentences, fines, and forfeitures). See generally Ghosh, *supra* note 61.

183. Fines are paid to the government under the EEA, whereas restitution is undertaken by the government under the Mandatory Victims Restitution Act with proceeds paid to the victim firm. See EEA, *supra* at note 53, at 18 U.S.C. § 1834; see also 18 U.S.C. § 3663A, Mandatory Victims Restitution Act (providing for restitution of the proceeds of crimes to victims of, *inter alia*, the Economic Espionage Act).

of the value of expropriated trade secrets is a complex and contested venture,¹⁸⁴ research and development costs can reach almost twenty percent of total revenue, particularly in high-technology industries.¹⁸⁵ Adopting a simplifying assumption that the value of trade secrets represents, on average, ten percent of the revenue of any given firm, a \$5 million civil forfeiture penalty levied by a court for the theft of those trade secrets is sufficient to make a victimized firm whole only if that firm's revenues for the period are not greater than \$50 million.

In fact, the scope and extent of third-party penalties triggered by EEA prosecution were such that, had DeweyCheatham had an accurate appreciation of them, it would likely have chosen a different strategy than IRPD-3PP. Specifically, if DeweyCheatham's market capitalization pre-disclosure was \$1 trillion,¹⁸⁶ then the potential self-imposed penalty to DeweyCheatham for disclosing the theft could well approach \$89 billion.¹⁸⁷ Moreover, given annual revenues for each firm of approximately \$900 billion and net annual profits of approximately \$62 billion, or \$5.2 billion/month,¹⁸⁸ at the prevailing low real interest rate r of less than three percent it would be virtually impossible for DeweyCheatham to recover the loss occasioned by disclosure of the theft through punishment of EnHowe, as the latter would have to cease operations and sales of all gasoline, fuel additives, and all other goods and services for eighteen months and voluntarily grant DeweyCheatham a monopoly in order to make

184. The reasons for the difficulties courts face in determining the value of stolen trade secrets are many, complex, and beyond the scope of this Article. For a discussion of the various methods courts use to determine loss under the EEA, including fair market value, reasonable royalty, lost profits, and research and development costs, as well as a discussion of the doctrinal and practical complexities involved in making injured firms whole, see generally Zwillinger & Genetski, *supra* note 67, at 323. For a discussion of how quantitative financial methods might be used to derive the value of intellectual property, see generally F. Russell Denton & Paul J. Heald, *Random Walks, Non-Cooperative Games, and the Complex Mathematics of Patent Pricing*, 55 RUTGERS L. REV. 1175 (2002–2003).

185. See *Research & Development Expenses as a Percentage of Total Revenue*, WIKINVEST (Jan. 22, 2012, 8:00PM), http://www.wikinvest.com/metric/Research_%26_Development_Expenses_as_a_Percentage_of_Total_Revenue.

186. The market capitalization of all the private-sector petroleum firms that currently supply refined gasoline to the U.S. market is approximately \$2 trillion. See *2010 Financial Statements*, *supra* note 117. This Article assumes that each of the fictional firms, DeweyCheatham and EnHowe, is \$1 trillion. See PETROSTRATEGIS, INC., <http://www.petrostrategies.org>.

187. With a market capitalization of \$1 trillion, the average market penalty of 8.92% for disclosing the theft of trade secrets is \$89.2 billion. See *2010 Financial Statements*, *supra* note 117.

188. The reported financial data for ExxonMobil—the largest private-sector petroleum firm supplying the U.S. market with a seventeen percent market share—is extrapolated and used as the basis for determining the market capitalization, revenue, and profits of the fictional firms DeweyCheatham and EnHowe, duopolists that each have a fifty percent share of the U.S. market in the hypothetical scenario. See *Financial Statements & Supplemental Information: For the Fiscal Year Ended December 31, 2010*, EXXONMOBIL (2010), http://www.exxonmobil.com/Corporate/Files/news_pub_ir_financial_2010.pdf (reporting 2010 FY total market capitalization of \$314.5 billion, revenue of \$284.7 billion, and profit of \$19.3 billion).

DeweyCheatham “whole.” The state-imposed penalty of \$10 million against EnHowe—\$5 million paid in forfeiture to DeweyCheatham and another \$5 million fine to the federal treasury—was trivial at best. Thus, by seeking a direct penalty upon EnHowe through EEA prosecution, DeweyCheatham incurred indirect market-based penalties as great as eighteen months of supracompetitive profits in exchange for a meager compensatory payment from EnHowe.¹⁸⁹

d. Actual Payoffs: *DeweyCheatham v. EnHowe* During Sanction

In the IRPD-3PP with the actual payoffs, both firms incurred penalties as the result of public disclosure of a violation of the EEA—the disclosing victim, DeweyCheatham, through the market in the amount of \$89 billion or 9C (calculated as 18 x monthly cartel profits of ½C); the targeting firm, EnHowe, through the court in the amount of \$10 million or about 001C (calculated as 0.1% of monthly cartel profits of ½C). The following matrix illustrates the actual payoffs, where D = 7 billion, C = 10.4 billion, E = 1 billion, and $D - E - .001C > \frac{1}{2} C - .001C > \frac{1}{2} D - .001C > E - .001C > D - E - 8.9995C > \frac{1}{2} C - 8.995C > \frac{1}{2} D - 8.995C > E - 8.9995C$:

**Infinitely Repeated Prisoners’ Dilemma with Third-Party Penalty:
DeweyCheatham v. EnHowe During Sanction (Actual)**

		EnHowe	
		Low Price	High Price
Dewey Cheatham	Low Price	$\frac{1}{2} D - 8.9995C, \frac{1}{2} D - .001C$	$D - E - 8.9995C, E - .001C$
	High Price	$E - 8.9995C, D - E - .001C$	$\frac{1}{2} C - 8.9995C, \frac{1}{2} C - .001C$

e. Analysis: Actual Payoffs

An examination of the payoff matrix that actually attended the IRPD-3PP game explains why DeweyCheatham’s decision to prosecute EnHowe, which failed to appreciate the effects of disclosure of the theft of Project K2 trade secrets upon its firm value and overestimated the sufficiency of state-imposed financial penalties upon EnHowe, was roundly, and fairly,

189. The simplifying assumption is made that the disclosing firm absorbs the entire indirect market penalty for disclosure in the first period following disclosure.

criticized. The resort to third-party penalties not only diminished the value of DeweyCheatham absolutely as well as relative to EnHowe, but it left DeweyCheatham with exclusively negative payoffs and EnHowe with exclusively positive payoffs. Moreover, the decision to prosecute under the EEA, rather than negotiate privately, triggered not only negative payoffs for DeweyCheatham during the period(s) of sanctions, but it also led both firms into a price war which further sacrificed producer surplus as the price of more efficient and therefore more valuable formulations of gasoline than had been available prior to the EE attack, for which both firms could have charged a higher price even under a competitive market structure, tumbled to \$1.70. Had DeweyCheatham taken EnHowe's request to negotiate more seriously, a better outcome was clearly possible.

Moreover, while EnHowe gained relative to DeweyCheatham during Defection, nothing prevented DeweyCheatham from turning the tables on EnHowe in future periods and executing an EE attack against the latter now that trust was utterly destroyed as between the two firms. As the payoff matrix *supra* reveals, EE is costly for the victim, particularly if it seeks a legal remedy, and costly for the perpetrator, which must incur the costs of EE as well as whatever penalties are judicially imposed. Although the gathering and analysis of information to monitor and verify compliance with tacit agreements to price supracompetitively supports high profits, it nonetheless constitutes a cost of doing business. Moreover, the possibility that a rival is engaged in EE rather than permissible monitoring of pricing decisions that support a cooperative equilibrium imposes uncertainty and increases the prospect of misperceptions of defection, leading to spirals of punishment and retaliation that intensify competition and erode profits.¹⁹⁰ As the supracompetitive pricing and profits during Phase Three: Cooperation made manifest, a better strategy was available to both firms provided they could reduce the moral hazard inherent in the monitoring enterprise that had created incentives to EE, and this in turn required that the firms reach agreement as to the permissible means and limits of information exchange and create an information exchange regime that promoted, rather than eroded, trust.

190. See DIXIT & SKEATH, *supra* note 6, at 356 (discussing the danger of "echoing" during the IPRD-TFT game).

5. Collusion: The Assurance Game

a. Game Description: Assurance Game

One strategy to increase individual and joint welfare beyond the limits of what is available within the PD game is to transcend the PD entirely. In the SSPD, each player always does better by defecting regardless of what the other player does, and does best by defecting when the other cooperates, although each would prefer that both could trust the other to cooperate so that each could achieve the mutually preferred but more risky cooperative equilibrium. In the IRPD, players are able, by credibly threatening punishment for defection, to more closely align their interests and make the cooperative equilibrium more likely and more stable if still uncertain. In the “Assurance Game” (“AG”), however, payoffs are structured such that each player prefers mutual cooperation over mutual competition but also prefers mutual competition to unilateral cooperation, because unilateral cooperation yields the worst possible payoff to the cooperator as well as a payoff inferior to both mutual cooperation and mutual competition to the defector.¹⁹¹ AG players maximize their welfare by acting in concert, and the AG models their strategic interactions where mutual cooperation is the best possible, but still risky, outcome.

The classic example of the AG is the “Stag Hunt.” In the Stag Hunt, two hunters forge a temporary alliance to hunt, and both have a preference for stag (deer) over hare (rabbit). To kill a stag successfully, the hunters must cooperate—neither is strong enough independently, and each must remain at his observation post to be prepared to respond to the discovery of a stag and then join together with the other hunter in the kill. However, if a hare ventures within reach of either, he will abandon the stag hunt—in other words, defect from the cooperative outcome—and pursue, kill, and consume most of this hare, leaving the other hunter, who has remained faithfully at his post cooperating in the stag hunt, what little, if anything, remains. On the other hand, if both hunters agree to set out for hare at the outset and both thus defect, each will capture, kill, and eat a hare.¹⁹² Thus, the order of preferences for each hunter is as follows: (a) both hunt stag, (b) both hunt hare, (c) hunt hare while the other hunts stag, and (d) hunt stag while the other hunts hare. In the standard AG game the payoffs take the form $a > b > c > d$, where a is the cooperative payoff, b is the competitive

191. See MICHAEL TAYLOR, *THE POSSIBILITY OF COOPERATION* 38 (Jon Elster & Gudmund Hernes eds., 1987) (defining the relative value of actions and payoffs under the AG); WILLIAM POUNDSTONE, *PRISONER'S DILEMMA* 218–22 (1992). The AG is a “non-zero-sum game” because it enlarges the resources available to both players and leaves them with a sum of gains and losses greater than zero.

192. JEAN-JACQUES ROUSSEAU, *A DISCOURSE ON INEQUALITY* 43 (1755).

payoff, c is the payoff to the lone defector, and d is the payoff to the lone cooperator.

b. Standard Payoffs: Assurance Game

As the following payoff matrix for the Stag Hunt AG game illustrates, the AG payoffs are arbitrarily assigned the values $a = 4$, $b = 3$, $c = 2$, and $d = 1$:

Assurance Game: Stag Hunt

		Hunter 2	
		Hare	Stag
Hunter 1	Hare	3, 3	2, 1
	Stag	1, 2	4, 4

c. Analysis: Assurance Game

As the Stag Hunt illustrates, trust is crucial to the AG, as to achieve superior payoffs and render mutual cooperation a Nash equilibrium the players must work to assure each other that each will choose and continue to choose the cooperative but riskier outcome they both prefer, thereby rendering the decision to cooperate less risky in direct proportion to the degree of assurance against defection each can impress upon the other.¹⁹³ Only if each player can be relatively assured that the other will cooperate is the mutual cooperation necessary to sustain the AG likely. In turn, only if the players can exchange information that communicates their alignment of interests, recognition of the mutual dangers of independent welfare-maximizing behaviors, and intent to cooperate and continue cooperating, is sufficient trust possible.¹⁹⁴

One information exchange regime that is more effective at building trust and less prone to the problem of moral hazard than the CI/EE regime specifies the formal creation of systematic transparency and the reduction of informational asymmetries. Through the deliberate pooling of research and development ventures, the open exchange of technology, and the joint communication of plans regarding strategy and pricing, firms can acquire

193. See Richard H. McAdams, *Beyond the Prisoners' Dilemma: Coordination, Game Theory, and Law*, 82 S. CAL. L. REV. 209, 214, 218–19 (2009) (differentiating the PD from the AG based on payoffs and strategies).

194. See BRANDENBURGER & NALEBUFF, *supra* note 8, at 38 (specifying the cognitive understandings that motivate cooperation and collusion between firms).

the information they would otherwise have been obliged to seek through monitoring activities while obviating, or at least mutually indemnifying each other for, the resort to EE.¹⁹⁵ This quasi-partnership strategy, described by some commentators as “reciprocal altruism”¹⁹⁶ and by others as outright collusion, affords tangible individual and mutual benefits.¹⁹⁷ By committing to formalized information exchange, firms, in effect, “guarantee” to each other, *inter alia*, their pricing decisions.

As a result, each firm receives a benefit each period, including not only the supracompetitive profit of $\frac{1}{2}C$ but also an annuity due. This annuity consists of an additional value “Y” that is quantifiable as the sum of the absolute values of (1) the cost of CI and all other monitoring operations, (2) the costs of EE—direct in the form of expenses and indirect in the form of judicial and market-based sanctions, (3) transaction costs associated with renegotiating the return to the cooperative equilibrium each time defection or a mistaken punishment for perceived defection destabilizes the cooperative equilibrium, (4) supracompetitive profits lost for at least one period subsequent to the use of a trigger strategy, (5) loss of firm value upon public disclosure of the loss of trade secrets, and (6) efficiency gains realized through R&D collaboration.¹⁹⁸

d. Payoffs: *DeweyCheatham v. EnHowe* During Collusion

The following matrix illustrates the payoffs attendant to Collusion, where Y is positive, $\frac{1}{2}(C + Y)$ is the cooperative payoff, $\frac{1}{2}(D + Y)$ is the competitive payoff, D - E is the payoff to the lone defector, E is the payoff to the lone cooperator, and $\frac{1}{2}(C + Y) > \frac{1}{2}(D + Y) > D - E > E$:

195. See Yao, *supra* note 13, at 324–25 (underscoring the importance of information exchange to evolution of collaboration).

196. “Reciprocal altruism” is a strategy derived from instinctive animal behavior that encourages both rivals to produce innovations but directs more successful firms to assist less successful firms by sharing their gains in order to preserve the viability of the less fortunate in the hope and expectation that in the future, should today’s “loser” become tomorrow’s “winner,” the behavior will be reciprocated and joint survival ensured. *Id.* at 322–323.

197. See, e.g., Yun Hsing Cheung, *The Economics of Industrial Espionage*, 1 INT’L J. BUS. & L. 498 (1995) (arguing that without pooling of duopolists’ resources, CI will have the effect of reducing R&D to zero and ultimately causing the profits of both firms to become negative).

198. Although there is theoretical debate about the degree of market concentration that maximizes successful R&D outcomes, concentration can increase efficiencies by reducing duplicative efforts, enhancing financial stability, and allowing for economies of scale in research. See, e.g., Michael Carrier, *Two Puzzles Resolved: Of the Schumpeter-Arrow Stalemate and Pharmaceutical Innovation Markets*, 93 IOWA L. REV. 393 (2007-08).

Assurance Game: *DeweyCheatham v. EnHowe* During Collusion

		EnHowe	
		Low Price	High Price
Dewey Cheatham	Low Price	$\frac{1}{2}(D + Y), \frac{1}{2}(D + Y)$	$D - E, E$
	High Price	$E, D - E$	$\frac{1}{2}(C + Y), \frac{1}{2}(C + Y)$

Due to the enhanced profitability occasioned by the innovative synergies that result from joint research and development as well as the reduction in costs elaborated in (1)–(6), both firms earn a premium through cooperation and joint profits rise to \$12.5 billion,¹⁹⁹ while the current and future opportunity costs of a return to competition increase accordingly. Thus, where $(C + Y) = \$12.5$ billion, $(D + Y) = \$9.5$ billion, $C = \$10.4$ billion, $D = \$7$ billion, and $E = \$2.5$ billion,²⁰⁰ the joint per-period gain of playing AG rather than SSPD is $C + Y - D$ or \$6.5 billion,²⁰¹ while the joint per-period value of (1)–(6), Y , realized through switching from the IRPD-TFT with CI/EE monitoring to the AG, is \$2.1 billion.

e. Analysis: *DeweyCheatham v. EnHowe* During Collusion

Empirical research indicates that Y —the premium earned from switching from the IRPD to the AG—is sufficiently valuable that firms are willing to abandon monitoring in favor of assurance and even outright collusion, so long as their information exchange is symmetric, reciprocal and creates a stable, cooperative equilibrium.²⁰² The appointment of a new CEO to lead EnHowe and his announcement that DeweyCheatham and EnHowe were entering into a joint fuel additives R&D program to improve efficiency, reduce duplicative efforts, increase the value of both firms, and eliminate EE sent a strong signal to the market, as well as to regulators, that in the previous six months the two firms despite or perhaps because of, the use of EE and the state’s failure to impose effective sanctions, had negotiated an agreement to abandon the IRDP in favor of the AG and

199. See *supra* Part III.C.

200. See generally sources cited *supra* note 166; see also *supra* Part III.C.

201. The value of perfect information to each firm in the AG is the difference between the value of the payoff from the strategy chosen when the “rival’s” decision is certain and the value of the payoff from the strategy chosen in the infinitely repeated PD, or profit $[D - E]/2 - C/2 = \text{profit } [D - E - C]/2$. See Greenberg, *supra* note 44, at 150.

202. See AREEDA, *supra* note 21, at 29 (finding that firms will exchange “virtually any information” so long as their informational exchange is symmetric, reciprocal, and in promotion of cooperation).

discard the informational exchange regime of CI/EE in favor of formal information sharing. Precisely *how* the rivals managed to align their interests and change course away from destructive competition and trust-destroying informational conflict and toward collusion and informational sharing is uncertain; *why* they did so requires no more than an examination of the payoffs in the AG *supra*, which were reflected in the share prices of both firms.

As gasoline prices surged upward subsequent to the firms' announcement of their information sharing agreement, questions of how and why they had reached this accord became far less important, especially to the Antitrust Division of the U.S. Department of Justice, than whether in so doing, DeweyCheatham and EnHowe had concluded an express agreement as to pricing decisions—a condition precedent sufficient to open an antitrust investigation held in abeyance theretofore only by the absence of this factual predicate.²⁰³

6. Prosecution: Assurance Game Converted to SSPD with Antitrust

The establishment of tacit collusion is, with nothing more, likely inadequate to sustain an antitrust prosecution. Exchanges of information between rivals, labeled “facilitating practices,” aid coordination but do not by themselves give rise to grounds for prosecution.²⁰⁴ Moreover, based on the policy ground that it is in the public interest to avoid wasteful redundancy and to promote innovation, firms entering into joint ventures to facilitate research and development rather than to fix prices are shielded from *per se* antitrust liability and from treble damages for violations of Section 1 of the Sherman Act provided they inform the Department of Justice in advance of their intent to do so.²⁰⁵ However, in application

203. See *supra* Part III.A.

204. The Court, in *Maple Flooring Manufacturers' Association v. United States*, held that communication and meetings between rival firms wherein price is discussed do not *ipso facto* constitute unlawful price-fixing absent an express agreement to do so:

We decide only that trade associations or combinations of person or corporations which openly and fairly gather and disseminate information as to the cost of their product, the volume of production, the actual price which the product has brought in past transactions, stocks of merchandise on hand, approximate cost of transportation from the principal point of shipment to the points of consumption as did these defendants and who, as they did, meet and discuss such information and statistics without however reaching or attempting to reach any agreement or any concerted action with respect to prices or production or restraining competition, do not thereby engage in unlawful restraint of commerce.

268 U.S. 563, 586 (1925). Precisely what constitutes an agreement or “concerted action” was, however, left somewhat indeterminate. *Id.* For a discussion of this indeterminacy, see generally Wiley, *supra* note 32.

205. See National Cooperative Research and Production Amendments of 1993, 15 U.S.C. § 4301–

uncertainty remains about the legality of any particular joint venture, and firms expressly sharing information enter into new legal terrain and can create the rebuttable presumption that their ultimate object is to collude to suppress competitive forces.²⁰⁶ With the creation of this presumption comes increased state scrutiny, and with increased scrutiny the likelihood of prosecution increases proportionally. Similarly, competitive pricing conditions cause consumers and regulators to expect low prices, and when prices are restored to supracompetitive levels following the discontinuation of competition, antitrust regulators may well be pressured to find grounds to investigate and prosecute.²⁰⁷

Moreover, firms cannot be certain that courts called upon to evaluate their liability in regard to facilitating practices and non-express agreements will not abandon existing doctrine in favor of earlier conceptions of antitrust which considered price-fixing to be inevitable due to the disposition “of men to follow their most intelligent competitors, especially when powerful, by the inherent disposition to make all the money possible, joined with the steady cultivation of the value of ‘harmony’ of action, and by the system of reports, which makes the discovery of price reductions inevitable and immediate.”²⁰⁸ A future Court could “infer[] from the facts which [a]re proved,” that unlawful express price-fixing agreements must develop, as the inevitable result human nature, out of facilitating practices and tacit agreements regarding prices.

Men in general are so easily persuaded to do that which will obviously prove profitable that the reiterated opinion from the analyst of their association, with all obtainable data before him, that higher prices were justified and could easily be obtained, must inevitably have resulted, as it did result, in concert of action in demanding them.²⁰⁹

Still, absent evidence of an express agreement, there is generally insufficient evidence to convict, and in the case of price-fixing conspiracies it is always “significantly easier to secure a conviction when one or more members of a conspiracy has confessed.”²¹⁰

a. Game Description: Assurance Game Converted to SSPD with Antitrust

To remedy this evidentiary deficiency, the CLP offers both members of a suspected price cartel leniency in exchange for being the first to

4303 (2006).

206. AREEDA, *supra* note 21, at 29.

207. *See generally id.*

208. *American Column & Lumber Co. v. U.S.*, 257 U.S. 377, 399, 407 (1921).

209. *Id.* at 407, 410.

210. Leslie, *Antitrust, Amnesty, Game Theory, and Cartel Stability*, *supra* note 19, at 456.

abandon the cartel, confess its existence, and prove evidence to the prosecution. Yet CLP only grants the first confessor amnesty while the second confessor remains subject to criminal and civil penalties. Although price cartel members each want to continue earning supracompetitive profits, and so long as trust endures and their cartel goes undisturbed they can do so, they cannot be certain whether, as regards their particular conspiracy, the state has sufficient evidence to convict them. Thus the promise of amnesty for being first to violate the trust of a rival and confess the existence of the cartel constitutes a valuable inducement that is potentially more valuable than the payoff for continuing a “wait-and-see” pattern of cooperation that, while it yields supracompetitive profits, may lead to conviction and fines. Moreover, winning the race to confess is more valuable than the payoff for losing.²¹¹

In effect, the CLP creates three possible payoffs in descending order of their value: (1) mutual nonconfession, which perpetuates supracompetitive profits and precludes private liability for so long as the state remains unable to develop evidence independently but carries significant risk in inverse proportion to the degree of trust each firm has in its fellow cartel member not to confess, while leaving the firm vulnerable to its share of criminal and civil fines if the state is able to prosecute notwithstanding mutual nonconfession;²¹² (2) first confession, which terminates the cartel, foregoes future supracompetitive profits, and invites potential restitution and single damages private liability but immunizes the first confessor from criminal fines and treble damages;²¹³ and (3) second confession, which occurs after the cartel is already terminated and provides no amnesty against conviction, criminal fines, or treble damages, and no other party to bear the weight of fines. Although both firms would prefer mutual nonconfession and the perpetuation of supracompetitive profits, to the extent that either firm has any ground for not being certain that the other will not confess—in other words, if trust is sufficiently eroded—first confession becomes more attractive as a strategy. Furthermore, because second confessors do not earn amnesty under the CLP, as soon as one firm confesses a second confession becomes irrational, and thus in practice there

211. Philip C. Zane, *The Price Fixer's Dilemma: Applying Game Theory to the Decision of Whether to Plead Guilty to Antitrust Crimes*, 48 ANTITRUST BULL. 1, 3–4 (2003) (analyzing the choices available to price-fixing cartel members under the CLP).

212. Other sources of potential liability—shareholder suits arising from a fall in stock price or the loss of company assets on the theory that corporate officers violated their fiduciary duty to the firm by engaging in price-fixing; criminal and civil liability arising out of violations of securities laws, and other potential causes of action—are eliminated from this analysis for purposes of parsimony in theoretical development. For a discussion of these other potential costs that firms may incur by confession under the CLP, see *id.* at 2–3.

213. See CLP, *supra* note 76.

are only two payoffs—Confess or Silent—with the latter preferable to the former and neither a dominant strategy so long as sufficient trust remains. If, but only if, the state can exploit ambient distrust such that both firms expect to suffer significant penalties as a result of continued participation in the cartel does Confess become more attractive than Silent and thus the dominant strategy, producing an equilibrium of Confess, Confess.

Thus, by making credible threats through vigorous investigation and prosecution of antitrust law generally, scrutiny of suspected price cartel members specifically, and encouragement of private party suits for damages that render price cartels even less attractive propositions, the state can cost-effectively terminate the ongoing AG and (re)create a negative-sum PD game²¹⁴ of uncertain but probably short duration in which competition is more valuable than cooperation. Competition is therefore rational, and thus, the dominant strategy. Price cartels will devolve into competition with each firm racing to confess before the other.²¹⁵ Although both firms lose, the firm that wins the race to be first to confess loses less than its rival in this Single-Shot Prisoner's Dilemma with Antitrust ("SSPD-A"), and consumers gain.²¹⁶

b. Payoffs: *DeweyCheatham v. EnHowe* During Prosecution

The following matrix illustrates the SSPD-A where C = \$10.4 billion, D = \$7 billion, E = \$2.5 billion, Y is \$2.1 billion, Z—a factor that incorporates the probability and magnitude of fines civil and/or criminal—is \$25 billion, and the payoffs are such that $0 > (E - Z) > [\frac{1}{2}(D + Y) - 3Z] > [\frac{1}{2}(C + Y) - 5Z] > D - E - 10Z$, and $E - Z = -\$22.5$ billion, $[\frac{1}{2}(D + Y) - 3Z] = -\70.95 billion, $[\frac{1}{2}(C + Y) - 5Z] = -\118.75 billion, and $D - E - 10Z = -\$245.5$ billion:

214. To render mutual confession the dominant strategy for each player, the state needs to convert the strategic interaction into a negative-sum-game, defined as a game in which the sum of gains and losses in payoffs for both players is less than zero; in such a game, both players expect to lose in relation to their present endowments, and each competes to lose less than the other. See, e.g., B.D. Henderson, *The Anatomy of Competition*, 47 J. MARKETING 7 (1983).

215. See Zane, *supra* note 211, at 2 (analogizing the application of the CLP to price cartels as the (re)creation of a PD); Leslie, *Trust, Distrust, and Antitrust*, *supra* note 19, at 519–20 (reporting that the CLP has been used to destroy a number of price cartels).

216. See DIXIT & SKEATH, *supra* note 6, at 358 (“[A]lthough the . . . equilibrium is bad for the players, it is actually good for the rest of society” because surplus taken by firms pricing supracompetitively is returned to consumers).

Single-Shot Prisoners’ Dilemma with Antitrust: *DeweyCheatham v. EnHowe* During Prosecution

		EnHowe	
		Low Price	High Price
Dewey Cheatham	Low Price	$\frac{1}{2}(D + Y) - 2.5Z, \frac{1}{2}(D + Y) - 2.5Z$	$D - E - 10Z, E - Z$
	High Price	$E - Z, D - E - 10Z$	$\frac{1}{2}(C + Y) - 5Z, \frac{1}{2}(C + Y) - 5Z$

c. Analysis: *DeweyCheatham v. EnHowe* During Prosecution

An analysis of the payoff matrix reveals that given sufficient investigative and prosecutorial zeal and the resulting high probability that the state will develop the evidence necessary to prosecute even absent a confession, trust is destroyed and the payoff is negative no matter whether a firm remains silent or confesses.²¹⁷ In the negative-sum game with the dominant strategy and equilibrium Confess, Confess, the objective becomes merely to outcompete the other player in loss mitigation, and as a consequence, the firms race to win the best possible payoff of $E - Z$, or – \$22.5 billion. Whether achieved by chance, a more accurate assessment of the probability of prosecution than EnHowe, motivation for revenge after EnHowe’s EE attack, clandestine communications with prosecutors, or some combination of these factors, DeweyCheatham, by winning the race to confess the existence of the cartel under the CLP, minimized its losses while foisting the far larger share of the cost of cartel membership onto EnHowe. The big winners, however, were consumers. Fines of \$25 billion (Z) on DeweyCheatham and \$250 billion (10Z) on EnHowe not only returned all supracompetitive profits of approximately \$50 billion earned between late 2012 and early 2015 to consumers, but also subsidized their purchases past and present while stimulating the economy through increased consumer demand. Moreover, successful destruction of the gasoline price cartel restored competitive prices, and may well provide deterrence against future cartelization in the petrochemical industry as well as others.²¹⁸ Despite the additional value of the intellectual property each

217. The penalty for each firm during mutual confession— $5Z$ —is greater than the penalty for mutual silence— $2.5Z$ —based on the arbitrary determination that the likelihood of successful prosecution doubles as a result of the assistance given to the prosecutors by the first confessor under the CLP. “Z” is calculated as the actual lost consumer surplus occasioned by cartel pricing.

218. Evidence suggests that prosecution of price cartels has a deterrent effect on future cartel formation. See, e.g., Michael K. Block, Frederick C. Nold, & Joseph G. Sidak, *The Deterrent Effect of*

firm added to its product, little if any of this innovation resulted in producer surplus as prices fell through competition. Whether the jaundiced eye of antitrust prosecutors would have been directed toward the two firms in the first place had DeweyCheatham not pursued criminal sanctions against EnHowe for its EE attack can never be known; had the two firms developed greater trust or evolved toward an assurance game more quickly, each might have been able to claim the benefits of cooperation without the costs of state intervention.

In sum, with information exchange between DeweyCheatham and EnHowe corrupted by the specter of prosecution and the need to employ strategic deception in order to earn amnesty as the first confessor under the CLP, commitment to the collusive relationship and the trust necessary to sustain it disintegrated, and with it any possibility of cooperation. With cooperation so unattractive to and expensive for players, the competitive outcome became the new equilibrium of a negative-sum game. Accordingly, the strategic interaction between the two firms subsequent to Phase Six: Prosecution devolved to competition, with future periods and future payoffs modeled by the Single-Shot Prisoner's Dilemma: *DeweyCheatham v. EnHowe During Competition* presented *supra*.

D. DISCUSSION

1. *Questions Answered*

Game-theoretic analysis of the hypothetical scenario of *DeweyCheatham v. EnHowe*, which was developed to illustrate an evolutionary pre-theory that postulates trust as essential to the evolution and devolution of price cartels and information exchange as crucial in the creation and destruction of trust, illustrates that rational, self-interested firms will engage in strategic interactions with rivals ranging from vigorous competition to virtual merger, and it suggests answers to the questions begged by the experience of the angry motorist in Utopia.

It is affirmatively legal to charge a premium above the competitive price. However, it is unlawful to do so as the result of an express agreement to fix the price at a supracompetitive level. To the question of how firms are able to charge supracompetitive prices without entering into express agreements to do so, the answer is relatively straightforward: It is

Antitrust Enforcement, 89 J. POL. ECON. 429 (1981). Other research concludes that even if cartel formation is not deterred, prosecution has the effect of reducing the prices cartels can charge in the future. See, e.g., Joe Chen & Joseph E. Harrington, Jr., *The Impact of the Corporate Leniency Program on Cartel Formation and the Cartel Price Path*, in POLITICAL ECONOMY OF ANTITRUST 7-8 (Vivek Ghozal & Johan Stennek eds., 2006) (CLP reduces prices even if cartel formation is undeterred).

in their rational self-interest, and the only impediment to achieving a stable supracompetitive price equilibrium is uncertainty about the prices rivals will charge. Initial spontaneous and cooperative pricing decisions, motivated by the struggle for survival and conditioned by an innate human propensity to cooperate when individual and mutual welfare maximization require it, are reciprocated leading to the development of trust and the achievement of a Pareto-optimal cooperative equilibrium in which both firms achieve high profits without any express agreement to do so. Each receives and understands the supracompetitive pricing decision of its rival as an information exchange that communicates a recognition of the benefits of and a desire for cooperation. Reciprocity communicates and reinforces trust. As trust builds, the evolutionary stability of cooperation increases.

Moreover, as the analysis suggests, firms arrive at the identical supracompetitive price even without reaching any express agreement because they employ monitoring to facilitate the exchange of information about the past, present, and future pricing decisions of their rivals. When prices are not completely or immediately transparent, firms seek to acquire information about the pricing decisions of their rivals, and so long as the methods, means, and scope employed are consistent with the tacit understandings that develop as regards the boundaries of the permissible, monitoring reinforces trust, and duopolists in price cartels adjust their prices in order to optimize profits and achieve a mutually satisfactory and beneficial allocation of the markets. Because a firm that lowered its prices would communicate its abandonment of cooperation, damage trust, and sacrifice the long-term benefits of cooperation, which are more valuable than the short-term benefits of pricing competitively, neither firm, once cooperation is established and stable, lowers its price. If either firm priced competitively in an attempt to increase its market share, the result would be that its rival would cut prices in response and each firm would sacrifice profits, with consumers the only beneficiaries of competition.

To some extent, supracompetitive pricing can be remedied through law, but where supracompetitive pricing does not result from express agreements to fix prices there is little antitrust law can do to suppress it—at least directly. Parallel behavior and supracompetitive prices taken together are almost certainly insufficient to trigger antitrust prosecution without an express agreement to fix prices.²¹⁹ However, this does not suggest antitrust law is merely interstitial, that consumers, legislatures, regulators, and prosecutors are not part of the optimal solution to the failure of competitive markets, or that there are no rules, processes, or instrumentalities that the state or consumers can wield by way of a remedy. In fact, as the preceding

219. See sources cited *supra* note 31 and accompanying text.

analysis underscores, strategic non-enforcement of the Economic Espionage Act and the lure of the Corporate Leniency Program, as well perhaps as other tools and procedures, can trigger a chain of events that disrupts and corrupts inter-firm exchanges of information, undermines trust between firms, promotes the devolution of cooperation, destroys cartels, enhances social welfare, and thereby promotes the end of the antitrust regime. Further examination of how this chain of events can be triggered is useful.

2. *Lessons Learned*

a. The State

Game-theoretic analysis of the strategic interaction between DeweyCheatham and EnHowe reveals that the payoffs available are partially determined by whether and to what extent the state intervenes in the “games” being played by the two firms.²²⁰ Through the creation, interpretation, and adjudication of antitrust law, the state makes the “meta-rules” that govern whether and to what extent cooperation is possible and how costly are any penalties associated with cooperation. Although the state is often an “unseen third force,”²²¹ the capacity to alter payoffs and even eliminate cooperative equilibrium is an important tool in the antitrust arsenal that, if used strategically might yield the result that antitrust law need not be as feeble an instrument against price cartels as an examination of the relevant caselaw might suggest.²²² While of its own accord, antitrust law may muster insufficient deterrent force through the probability and severity of sanctions to suppress parallel supracompetitive pricing when evidence of an express agreement to fix prices is unavailable. The state, by destabilizing the exchange of information between firms, can foster and intensify distrust, degrade and destroy the benefits of cooperation, and force the devolution of the strategic interaction between firms toward competition.²²³ The objectives of antitrust law—detering and defeating price cartels—can thus be secured not solely through the creation,

220. Whether, how, and to what extent the state intervenes in the strategic interaction between cooperating firms is in part a function of antitrust law and in part a function of social, economic, and political pressures. For a discussion of the politico-economic variables that influence how state obligations to enforce law are interpreted and discharged, see Napatoff, *infra* note 224.

221. Yao, *supra* note 13, at 337.

222. See sources cited *supra* notes 23–31 and accompanying text.

223. Theoretically, with the right rules and sanctions, antitrust law could prevent price cartels based on tacit agreements without recourse to underenforcement or mechanisms such as CLP. See Alemandares & Landa, *supra* note 132, at 527 (“[W]ith the right sanctions any law would be an equilibrium and thus a solution to a . . . problem.”).

interpretation, and application of antitrust law but by the identification and exploitation of opportunities to check the information exchange that is essential to creating and sustaining trust, which, in turn, is a prerequisite for cooperation. Through a complementary and opportunistic approach to antitrust that focuses on rendering communication between firms more opaque and more costly, the state can leverage the inherent compliance pull of antitrust law, and thereby enhance its power to deter and defeat supracompetitive pricing. Two opportunities to implement this strategy—underenforcement of the EEA, and the use of the CLP—are suggested by the preceding analysis. The use of the latter to exploit distrust and undermine cooperation is detailed *supra*; an examination of the former requires a brief introduction to underenforcement theory (“UT”).

UT postulates that the deliberate underenforcement of a law is a socio-legal phenomenon that occurs in three circumstances: (1) when a criminal law is so overbroad that neither legislators, regulators, nor citizens expect or demand full enforcement by police and prosecutors, in whom they have tacitly invested discretion to narrow the law in practice;²²⁴ (2) when a state is too politically weak or resource poor to undertake full enforcement of a rule that otherwise enjoys a broad moral and political consensus;²²⁵ and (3) when dictated by sufficiently widespread normative commitments to values not yet enshrined in formal law, and the pragmatic state resolves the dilemma by fashioning a compromise that “satisfies majoritarian preferences by enacting, at low cost, a formal prohibition” and also “satisfies minoritarian preferences by adopting a weak enforcement strategy.”²²⁶ Although there is disagreement as to whether unenforced laws remain legally binding or whether under-enforcement modifies not only the

224. Alexandra Natapoff, *Underenforcement*, 75 *FORDHAM L. REV.* 1717, 1745 (2011). Some commentators suggest that antitrust laws in general fit into this conceptual category. See generally Lawrence M. Frankel, *The Flawed Institutional Design of U.S. Merger Review: Stacking the Deck Against Enforcement*, 2008 *UTAH L. REV.* 159, 159 (2008) (developing this argument); see also Devlin & Jacobs, *supra* note 31.

225. Natapoff, *supra* note 224, at 1717–18. An example of weak state underenforcement might be maximum speed limits on highways, laws prohibiting prostitution or drugs, and income tax laws. See, e.g., Jonathan M. Barnett, *The Rational Underenforcement of Vice Laws*, 54 *RUTGERS L. REV.* 423, 440 (2002).

226. Barnett, *supra* note 225, at 439. Other UT scholars describe underenforcement as a pragmatic political strategy by a state in transition or in political conflict. See Natapoff, *supra* note 224, at 1720–21 (suggesting that “full enforcement of the law may not always be desirable from a democratic or distributive perspective”); *id.* at 1741–42 (noting that “the political process of allocating the valuable resource of law enforcement can be a useful and appropriate vehicle for mediating . . . competing, highly contested claims” and that “underenforcement is a combination of public value judgments, resource allocations, [and political] choices . . .”). Examples of normatively driven underenforcement are the refusal to prosecute members of the Civil Rights Movement or illegal immigrants for technical violations of criminal laws. See *id.* at 1724–25 (discussing examples).

law-in-action but also the law-on-the books,²²⁷ under-enforcement decisions are perceived as positive or negative by various constituencies depending upon conceptions of self-interest, the degree to which underenforcement destabilizes settled understandings of proscribed and prescribed conduct, and the degree to which under-enforcement undermines respect for law more generally;²²⁸ decisions broadly supported are termed “constructive under-enforcement.”

Violation of intellectual property rights is a frequently discussed example of constructive under-enforcement based on normative commitments to values inconsistent with formal legal regimes. Violations of IP rights abound in cyberspace—the “single largest location of violations of intellectual property precepts of any place in human history”²²⁹—and elsewhere, and under-enforcement is described as constructive on grounds that it “enhances creativity and the development of new technologies”²³⁰ and is a pragmatic and democratic response to “competing, legitimate claims” of non-rights-holders over how rights in intellectual property should be allocated.²³¹ More general proposals for broader public disclosure of information would have the effect of revealing trade secrets, yet considerations of competitive harm that might be inflicted on disclosing firms are dismissed as unlikely or insufficient to merit concern.²³² Weak enforcement of intellectual property rights is thus

227. See, e.g., Richard C. Schragger, *The Relative Irrelevance of the Establishment Clause*, 89 TEX. L. REV. 583, 588 (2011) (maintaining that underenforcement decisions are case-specific and do not alter the legally binding character of the underlying rule); see also Mitchell N. Berman, *Constitutional Decision Rules*, 90 VA. L. REV. 1, 9 (2004).

228. See Barnett, *supra* note 225, at 424–25 (explaining that underenforcement can erode the capacity to know what conduct is permitted and prohibited, undermine compliance, and leave the objects of the law in question “unsure whether . . . proscribed conduct or close substitutes are strictly illegal, *de facto* legal, always legal under certain circumstances, or sometimes legal under certain circumstances.”). See also Natapoff, *supra* note 224, at 1720–21 (allowing that underenforcement can become problematic but only “when it weakens broader values of public protection, official evenhandedness, respect for the law, and democratic responsiveness.”).

229. Lawrence Lessig, *The Death of Cyberspace*, 57 WASH. & LEE L. REV. 337, 343 (2000).

230. Natapoff, *supra* note 224, at 1751. This claim is very much contested, including by those entrusted with enforcing intellectual property laws: the U.S. Department of Justice, in announcing prosecutions of EEA cases, has often issued press releases contending that “[t]he vigorous enforcement of intellectual property statutes increases . . . economic vitality” Press Release, U.S. Dep’t of Justice, Two Bay Area Men Indicted On Charges of Economic Espionage (Sept. 26, 2007) (*available at* <http://www.cybercrime.gov/liIndict.htm>).

231. Natapoff, *supra* note 224, at 1741.

232. A series of corporate scandals that destroyed \$1 trillion in shareholder value, eliminated millions of jobs, and felled corporate giants sparked widespread distrust and prompted Congress to enact the Sarbanes-Oxley Act (“SOX”) in 2002, which requires disclosure on a “rapid and current basis such additional information . . . [as] is necessary or useful for the protection of investors and in the public interest.” Sarbanes-Oxley Act of 2002, Pub. L. No. 107–24, 116 Stat. 745 (2002). Several commentators, recognizing in the market failure SOX was crafted to remedy an opportunity to revisit the question of how much information public firms should be obligated to disclose, have suggested that additional disclosures, to include information colorable as trade secrets, would further enhance social

understood by UT as a stimulant to innovation, an inducement to competitive pricing, and an enhancement of social welfare.²³³

Underenforcement of intellectual property intersects with antitrust when firms, in the process of acquiring information about rivals' pricing decisions, venture into EE, prompting targeted firms to seek remedies from the state under the EEA. Deliberate underenforcement of the EEA, whether through the exercise of prosecutorial discretion to decline a case or by affording remedies that do not compensate targeted firms, promotes firms' violation of shared understandings as to the boundaries of the permissible in the monitoring of pricing decisions, erodes trust, and renders cooperation more costly. Although the question of a price cartel earning supracompetitive profits is not part of the gravamen of an EEA prosecution, prosecutors and courts called upon to afford a remedy to an

welfare by diffusing innovations, increasing competition, and reducing prices. *See* Guttentag, *supra* note 31, at 130 (contending that, to enhance social welfare, public firms should be required to disclose additional quantitative and qualitative measures of financial performance, customer relationships, and other competitively sensitive aspects of firm operations and plans); Dale Arthur Oesterle, *The Inexorable March Toward a Continuous Disclosure Requirement for Publicly Traded Corporations: "Are We There Yet?"*, 20 CARDOZO L. REV. 135, 140–58 (1998) (arguing that restrictions on the public disclosures firms are obligated to make can lead to "market failures"). Many firms contend that further required disclosures would benefit their rivals, thereby reducing incentives to invest in innovation. *See, e.g.,* WILLIAM D. NORDHAUS, *INVENTION, GROWTH, AND WELFARE: A THEORETICAL TREATMENT* (1969). Some commentators, however, suggest that under current disclosure requirements firms do not capture all the value of their intellectual property and that the socially optimal level of disclosure required by additional legislation would better allocate resources, reduce market concentration, and facilitate competition. *See, e.g.,* Guttentag, *supra* note 31, at 139–48 (noting that firms fail to capture all the value of their intellectual property and describing how disclosures reduce monopoly power and increase social welfare); *see also* F.M. SCHERER & DAVID ROSS, *INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE* 21–29 (3d ed., 1990). While information that might be classified as trade secrets is not currently subject to disclosure on the ground that to require it would inflict "competitive harm," commentators who regard this argument as "highly suspect" may recognize in underenforcement of the EEA an indirect opportunity to elicit information regarding trade secrets from firms targeted by EE.

233. Trade secrets, along with other forms of intellectual property, have long enjoyed common law and statutory protection on the theory that it is to "the advantage of the public . . . to encourage and protect invention and commercial enterprise . . ." *Peabody v. Norfolk*, 98 Mass. 452, 457 (1868). Trade secret protection "has always been about generating incentives to create." Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1031 (2005). However, the grant of legal protection of unlimited duration to secret information, although it benefits the rights holder, deprives the general public, relevant scientific and creative communities, and rivals from ever accessing this information, with the result that the rights holder enjoys a time-unlimited monopoly over goods or services created from this information that diminishes social welfare. Accordingly, UT suggests that trade secret protection be attenuated to better allocate the benefits of innovation and enhance social welfare, and empirical evidence that federal law enforcement efforts deprioritize protection of trade secrets in favor of forms of intellectual property that secure rights for only a limited time period may well be evidence of tacit governmental acknowledgment that trade secrets protection is inherently anticompetitive. *See, e.g.,* Rustad, *supra* note 59, at 479 (comparing federal protection of various forms of intellectual property rights). For a discussion of the origin and history of trade secret protection in the U.S., *see generally* Robert G. Bone, *A New Look at Trade Secret Law: Doctrine in Search of Justification*, 86 CALIF. L. REV. 243(1998).

aggrieved firm are presented, in effect, with an opportunity to adjust the payoffs in the strategic game between the accused and the aggrieved firm in a manner that further erodes trust, and with it, cooperation.²³⁴ Thus, when a conflict over the process and scope of information exchange between rivals gives rise to an EEA action, the state, with consumer welfare on its agenda, is handed the chance to calibrate, albeit indirectly, the degree of competitiveness in the corner of the market occupied by the victim and defendant firms. Deliberately weak enforcement of the EEA denies aggrieved firms an effective public remedy²³⁵ and forces them to resort to self-help methods—improving their own CE operations and, most importantly from the perspective of the state, punishing defections through TFT or other trigger strategies that match or undercut rivals' prices. Moreover, failing to impose serious punishment on firms that steal trade secrets has the effect of diffusing innovation by condoning cost-free imitation, further enhancing social welfare. In effect, deliberate underenforcement of the EEA can be a valuable strategy to augment antitrust law and achieve its ends, albeit indirectly, because EE, along with any other methods of acquiring information proscribed by the tacit regime developed between rival firms, promotes uncertainty, increases competition and innovation, and reduces prices.

b. Firms

As rational actors, firms wish to attain and preserve the survival benefits of supracompetitive pricing and profits, but to do so they must make strategic decisions that protect cooperation against devolution. Because the gains to the individual firm from defection are small relative to the long-term gains from cooperation, the interests of firms are almost invariably in opposition to those of the state, with the state dedicated to competition and consumer surplus and firms seeking to preserve

234. Scholars of game theory have not yet developed much theoretical insight into the process whereby courts reinforce competitive policy preferences in the absence of an explicit cartel agreement. *See, e.g.*, BAIRD ET AL., *supra* note 21, at 165 (stating that it is “[un]clear how [antitrust laws] affect tacit agreements which come into being when firms increase prices without actually entering into an explicit bargain”). Some suggest that, because the mere existence of collusion without evidence of conspiracy is insufficient to support a conviction, courts are simply powerless to suppress this behavior under existing law. Empirical evidence of post-1996 adjudication of cases brought under the EEA suggests otherwise, however. *See Ghosh, supra* note 61, at 27–32.

235. The average penalty imposed upon conviction under the EEA is almost trivial. *See generally Carr et al., supra* note 56 (reporting that fines levied in EEA cases typically are less than 0.1% of the value of the stolen trade secrets). Thus, if C is the average monthly profit for a cartel duopolist whose theft of trade secrets is analogous to charging low price against its rival's high price, and it is assumed that the penalty for conviction of an EEA violation is absorbed in the first period following conviction, the penalty = $.001C$.

cooperation in order to claim producer surplus. Consequently, firms must guard against the intrusion of the state and its power to trump into their strategic interaction. To achieve this, the preceding game-theoretic analysis counsels firms to be careful in the protection of the trust that is essential for the evolution and preservation of cooperation. While information exchange is necessary to initiate, grow, and sustain trust, agreements as to the permissible means, methods, and scope regarding the collection of information about rivals should be honored and EE eschewed lest violations provide the impetus to defections that prove costly to both firms, whether through the imposition of punishment by a rival playing a trigger strategy, penalties imposed by the state or the markets upon resort to EEA prosecution, penalties imposed by the state under antitrust laws, and/or opportunity costs suffered through the devolution of cooperation. Moreover, upon transgressions regarding information exchange, firms are better off conducting private negotiations that afford remedies that allow for the reestablishment of the cooperative equilibrium as swiftly and as quietly as possible. Allowing the state entry into the dispute diminishes the value of both firms, precludes remedies that would make aggrieved firms whole, and increases regulatory scrutiny that might well pave a path toward antitrust investigation and prosecution. Keeping the state out of the game and honoring agreements, tacit or express, supports trust, cooperation, and maximizes the welfare and survival of price cartels, and therefore, must be the twin imperatives of firms seeking to achieve and preserve supracompetitive pricing and profits.

E. PRELIMINARY HYPOTHESES

The following statements are proposed as preliminary hypotheses (“PHs”):

The more a firm cooperates with its rival, the more likely it is to survive;

The more a firm cooperates with its rival, the greater its profits;

The more a firm trusts that its rival will reciprocate a cooperative pricing decision, the more likely it is to initiate cooperation in its pricing decisions;

The more a firm trusts that its rival will reciprocate a cooperative pricing decision, the more likely it is to reciprocate initial cooperation in its pricing decision;

The more a firm trusts that its rival will reciprocate a cooperative pricing decision, the more likely it is to sustain cooperation in its pricing decisions;

The longer cooperation is reciprocated, the greater the trust between

cooperating firms;

The longer cooperation is unreciprocated, the less the trust between competing firms;

The greater the long-term benefits of cooperation relative to the short-term gains of competition, the more likely a firm will cooperate in its pricing decisions;

The greater the long-term benefits of cooperation relative to the short-term gains of competition, the more likely a firm will adhere to tacit agreements regarding the permissible means, methods, and scope for the acquisition and transmission of information regarding pricing decisions;

The more firms adhere to tacit agreements regarding the permissible means, methods, and scope of the acquisition and transmission of information regarding pricing decisions, the greater the trust between firms that cooperative pricing decisions will be reciprocated;

The less the EEA is enforced, the greater the expected benefits of trade secret misappropriation, and the less likely firms will be to adhere to tacit agreements regarding the permissible means, methods, and scope for the acquisition and transmission of information regarding price decisions;

The less the EEA is enforced, the less the trust between firms that cooperative pricing decisions will be reciprocated;

The less the EEA is enforced, the more likely firms will be to make competitive pricing decisions;

The less a firm trusts that its rival will reciprocate its cooperative pricing decisions, the more likely it will be to seek and enter into express price-fixing agreements;

The greater the risk of antitrust prosecution, the less likely a firm will be to adhere to tacit agreements regarding the permissible means, methods, and scope of the acquisition and transmission of information regarding pricing decisions;

The greater the risk of antitrust prosecution; the less likely firms will trust that cooperative pricing decisions will be reciprocated;

The greater the risk of antitrust prosecution, the more likely firms will be to make competitive pricing decisions;

The more likely that the state will grant amnesty to the first firm to confess the existence of a price cartel, the greater the risk of antitrust prosecution;

The more likely it is that the state will grant amnesty to the first firm to confess the existence of a price cartel, the more likely firms will be to make competitive pricing decisions; and

The more likely firms are to make competitive pricing decisions, the more likely their strategic interaction will be to devolve toward competition.

V. CONCLUSION AND DIRECTIONS FOR FUTURE RESEARCH

Heretofore, game theory has assisted researchers in explaining and predicting how firms compete in markets under various conditions using various assumptions about strategic choices, information, rules, and temporal dimensions. However, in regard to the economics of antitrust law, “game theory is barely visible[,]”²³⁶ in part because of the difficulties in applying the method to permit ready and accurate differentiation of avoidable and unambiguously anticompetitive conduct from conduct that is rational based on interdependence and sound business practices.²³⁷ Game theory has proven useful in identifying patterns of competition and conflict between duopolists and in suggesting variables that render cooperation more or less likely, but it “has yet to yield compelling mechanistic solutions” or predictions to the problem of price cartels.²³⁸ Its use to develop and test a theory of the evolution and devolution of price cartels is part of a broader project. More methodological and substantive research is needed to validate and improve the use of game theory as a heuristic to develop and test theories in the field of antitrust law in general, and the proffered theory of the evolution and devolution of price cartels in particular. Nevertheless, game theory has aided in the specification of working hypotheses regarding the relationship between firms’ pricing decisions and their expected payoffs, as well as in answering questions regarding whether and how the state can intervene in cartelized markets to preserve and restore competitive pricing on behalf of consumers.

Specifically, price cartels generate supracompetitive prices and profits that aid firms in their struggle for survival even as they reduce social welfare. Rational firms seek to form price cartels, yet trust that rivals will reciprocate cooperative pricing decisions is essential to a firm’s evolution and devolution, and information exchange is necessary to create and destroy trust. Even as they avoid the express agreements to fix prices that would create antitrust liability, firms, by exchanging information regarding their interest in and intention to initiate and reciprocate cooperation in their pricing decisions, can generate sufficient trust that price cartels can evolve and endure. So long as the methods, means, and scope of information exchange reinforce trust, the long-term benefits of cooperation exceed the short-term benefits of competition, and cooperation is a stable strategy. For

236. Peritz, *supra* note 154, at 112.

237. See Kobayashi, *supra* note 141, at 415 (describing the limitation of game theory as applied to antitrust analysis).

238. SCHERER & ROSS, *supra* note 232, at 220.

the state, and for the consumers whose interests the state represents, the key to the devolution of price cartels is thus interference with that information exchange in a manner that erodes trust, destabilizes cooperation, and renders competition more valuable, and more rational, to firms.

Although antitrust law has not been crafted or interpreted to allow for the extinguishing of price cartels that form and endure without express agreements to fix prices, the state is not without instrumentalities that, wielded strategically, can force the devolution of price cartels. Strategic nonenforcement of the Economic Espionage Act and the enticement to abandon cooperation in exchange for amnesty offered through the Corporate Leniency Program are but two mechanisms whereby the state can disrupt inter-firm exchanges of information, undermine inter-firm trust, promote the devolution of cooperation, destroy cartels, and enhance social welfare. How to leverage these mechanisms further, and whether other modifications to the process of creating, interpreting, adjudicating, and reinforcing antitrust law can help promote social welfare, await future research.²³⁹

239. Recent scholarship suggests one such reinforcing mechanism: that statutes be modified to permit information acquired in the context of evaluating proposed mergers and acquisitions to be used in investigating and prosecuting price cartels. See Vivek Ghosal, *The Law and Economics of Enhancing Cartel Enforcement: Using Information from Non-Cartel Investigations to Prosecute Cartels*, SSRN.COM (June 17, 2011), <http://ssrn.com/abstract=1866543>. For discussion of trends converging upon the criminalization of price cartels transnationally, see Gregory C. Shaffer & Nathaniel H. Nesbitt, *Criminalizing Cartels: A Global Trend?*, 12 SEDONA CONF. J. 313, 313 (2011).