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Unraveling Predatory Pricing: Insights From Case Studies and Game Theory Modeling

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This paper develops a game-theory model for predatory pricing via in-depth analyses of three case studies: Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., Matsushita Electric Industries Co. v. Zenith Radio Corporation, and AKZO Chemie BV v. Commission of the European Communities. This model is based on subsequent action game theory models and rational economics behavior, offering a chronological outline of the "predation" stages. It presents the predator's decisions, the prey's potential responses, possible loops, and the two distinctive outcomes. The analysis of the model in context of the three case studies demonstrates its practicality in assessing real-life predatory pricing scenarios and players' strategies. It's flexibility also allows applications in related fields. Overall, this paper offers a comprehensive framework that bridges the gap between law, economics, and game theory in the study of predatory pricing, informing future research in this area.

Keywords: behavioral and social sciences, game theory, antitrust, predatory pricing, anticompetitive practices, monopoly, business law

Introduction

"Predatory pricing" is a strategic behavior utilized by firms to eliminate competitors in a given market)Areeda, 1980(. Typically, during the "predation" stage, the "predator" firm, usually the more dominant firm in a market, sets the price of a product unrealistically low. As the less dominant firm cannot match these prices, they are forced to exit the market. For the predator, the price reduction becomes profitable when added market power is gained after eliminating the rival firm, the "prey")Hay, 1989(.

The predatory pricing strategy comprises two-stages: predation and recoupment. As Funk and Jaag (2018(argue, during the predation stage, the predator firm reduces its short-term profit by offering goods or services at low prices. As a result, the equilibrium price for these goods and services adjusts, placing smaller firms and new entrants, the preys, at risk of closure, with some eventually exiting the market. The predator, unlike its less dominant counterparts, can sustain the short-term loss of profit and can successfully eliminate rival firms from the market. In the recoupment stage, the dominant firms will aim to recover their losses from the predation, usually by readjusting their prices close to the monopoly[1] price)Funk & Jaag, 2018(.

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[1] A monopoly firm has exclusive control of a market or industry. Antitrust laws are in place to restrict these firms from forming)The United States Department of Justice, 2022(.

Predatory pricing is prevalent in various industries, namely the airline industries and in the drug and beauty markets. It is also a common practice in the export sector, which attempts to sell products cheaply in foreign markets. An example of the latter will be explored in this paper, where a Japanese cartel faces allegations for maintaining artificially high prices in their domestic market and fixing low prices for the US exports.[2]

Nevertheless, predatory pricing is illegal in many countries as it violates antitrust laws.[3] The prosecution of antitrust violations varies among countries. The antitrust laws that are relevant to this paper include legislations in the United States and Europe. The legislations that build up the foundation of antitrust prosecution in the United States are the Sherman Antitrust Act (1980), the Federal Trade Commission Act (1914), and the Clayton Antitrust Act (1914))The United States Department of Justice, 2022(. In Europe, the EU Antitrust Policy is built on Articles 101[4] and 102[5] of the Treaty on the Functioning of the European Union (TFEU))European Commission, 2023(. Other legislations relevant to this paper include the Robinson-Patman Act (1936)[6], the Wilson Tariff Act (1894), and Article 86 of the Roman Treaty (1958).

However, it remains a subject of ongoing debate and poses challenges in prosecution. Proving predatory pricing can be difficult, as reducing prices is a common practice in competitive markets and does not necessarily indicate the intent to damage the market. Furthermore, predatory pricing itself is hard to execute as the predator must be able to withstand the damage and loss of profit during the predation stage.

This paper employs a game theory approach to examine predatory pricing, utilizing a tree model to map out the various stages of the "predation" process. The next section provides a review of pertinent literature. The third section presents the proposed model and provides a step-by-step analysis of the game. The fourth section will introduce the three case studies: Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., Matsushita Electric Industries Co. v. Zenith Radio Corporation, and AKZO Chemie BV v. Commission of the European Communities. In this section, the tree model will be examined in the context of the case studies to demonstrate its application. Limitations of the model will be discussed in Section five. Finally, Section six offers a conclusion.

Literature Review

The pertinent literature to this topic will be analyzed in three sections: law, economics, and game theory.

The legal implications of predatory pricing have been the subject of considerable attention, particularly in the context of court decisions and their effects on subsequent cases. Baker (1994(, Denger and Herfort (1994(, and Glazer (1994(discuss the effect that Brooke Group Ltd. v. Brown & Williamson Tobacco Corp. case had on the prosecution of predatory pricing. Baker (1994) offers an economic view on the differences between Chicago and post-Chicago perspectives[7] on predatory pricing. He concludes that the ruling in this case neither embraced nor rejected the post-Chicago perspective. Similarly, Boudreaux, Elzinga, and Mills (1995) analyze the same

[2] Other similar cases range from Indian frozen shrimps to South African lemon juice. In both cases, the products are sold at lower-than-normal prices in the United States, but higher elsewhere. These cases, depending on the prosecution, usually end with products being withdrawn upon entry to the United States)Federal Register, 2023(.

[3] Antitrust laws are used to limit market power of a firm in order to encourage competition. This usually prevents the formation of monopolies and the overconcentration of market power by mergers and acquisitions. Antitrust laws also prevent collusion and the formation of cartels which could lead to illegal practices such as price fixing)The United States Department of Justice, 2022(.

[4] Article 101 prohibits the formation of cartels or anti-competitive agreements between firms.

[5] Article 102 prohibits abusive behavior from a dominant position in any market.

[6] The Robinson Patman Act is an amendment to the Clayton Antitrust Act of 1914.

[7] The Chicago (school) perspective is that predatory pricing is almost always irrational, and therefore, unlikely to actually occur. The post-Chicago perspective considers another aspect of recoupment, suggesting a new theory that if predation occurs in one market, recoupment can also occur rapidly in other markets)Baker, 1994(.

case alongside the 1967 Utah Pie case[8], questioning the court's decision regarding price cutting by members of non-collusive oligopolies.[9] They highlight the difference in court ruling in the two cases, with Brooke Group Ltd. seen as a more sophisticated approach to predatory pricing as the court recognized that below-cost pricing was no longer a sufficient condition for monopolization. Boudreaux et al. (1995)'s paper provides a detailed analysis of the rebates war between Brooke Group Ltd. and Brown & Williamson Tobacco Corp. which we use to develop our proposed model. Austin (1989) takes a similar approach, discussing the law perspectives of predatory pricing, but with the Matsushita Electric Industries Co. v. Zenith Radio Corporation case instead, raising questions about the controversial nature of Matsushita's possible recoupment after two decades of predation.

The literature on predatory pricing also includes numerous economic analyses of the strategies and tests used to identify it. Funk and Jaag (2018) explore the stages of predatory pricing strategies, and take an economics-based approach in suggesting a separation between predatory pricing and discriminatory[10] or selective abuse by a dominant firm. They argue that elements from merger control laws[11] should be adopted in antitrust prosecution. Funk and Jaag (2018) also stress that economic theory does not require dominance for predation to be a rational strategy. We acknowledge this viewpoint; however, for our model's simplicity, we keep the assumption that the predator firm is the more dominant one in the market. Hay (1989) discusses the different conclusions reached by law and economic theory regarding predatory pricing as a rational or irrational strategy. They also discuss the proposed cost-based rules by Areeda and Turner (1975) and how a legal definition needs not to be identical to the economic concept of predation. Elzinga and Mills (2001) focus on the assumptions of "asymmetrical information" and predatory pricing's structural setting. These concepts are relevant to our paper and model as we utilize similar assumptions of asymmetric information and access to financial resources between the two players. Ursic and Helgeson (1994) examine the possibilities of proving the illegality of predatory pricing and aspects of consumer harm from predation. They find that proving pricing practices illegal is difficult, but courts typically rely on cost-related standards in prosecution. The Brooke Group Ltd. v. Brown & Williamson Tobacco Corp. case discussed in our paper relies on cost-related tests in the prosecution. Ursic and Helgeson (1994) provide a baseline for the analysis and understanding of the case's eventual ruling that Brown & Williamson Tobacco Corp. was not a predator based on cost-related tests.

When it comes to a game-theory modeling approach, Moras and Phlips (1993) suggest a game theory approach with repeated games of the chain-store paradox.[12] He explores the credibility of the threats used as evidence in the AKZO Chemie BV v. Commission of the European Communities case which will be explored in

[8] 1967's Utah Pie v. Continental Baking Co. is also a case of alleged predatory pricing. Utah Pie is charged under Sections 1 and 2 of the Sherman Act and Section 2(a) of the Clayton Act, as amended by the Robinson-Patman Act)Utah Pie Co. v. Continental Baking Co., 1967(.

[9] An oligopoly is a market structure with a small number of firms, all attempting to restrict output and the influence of other firms. It has competitive demand and the supply side is not monopolized)Friedman, 1982(.

[10] Discriminatory pricing is a pricing strategy in which the same product is sold at different prices to different customers based on how much the customer is willing to pay)Varian, 1989(.

[11] The main antitrust legislation which deals with mergers and acquisitions control is the Clayton Antitrust Act of 1914. Like predatory pricing, mergers and acquisitions are viewed as likely to decrease market competition and have the tendency to increase prices)The United States Department of Justice, 2022(.

[12] The chain-store paradox is a paradox which demonstrates inconsistency between game theoretical reasoning and human behavior. The chain-store game introduces two strategies: induction theory and deterrence theory. Game theory states that the induction theory should be the optimal strategy; however, the paradox is created as the deterrence strategy seems to be the one with the higher payoff)Selten, 1978(.

this paper. Moras and Phlips establish that threats of this nature are not credible in perfect sub-equilibrium games where information is perfect and complete. Moras and Phlips (1993) allow for an in-depth analysis of the process of predation in the AKZO Chemie BV v. Commission of the European Communities case, which is essential in the development of our model. Salinger (2007) acknowledges the limits of game theory in providing predictions of market outcomes by exploring the Prisoner's Dilemma and the Battle of the Sexes models. We acknowledge similar limitations in our own model. Salinger states that a firm's decisions are influenced by the expectation that other firms will behave in their own economic interest. Similarly, our proposed model follows this approach and predicts outcomes through behavioral expectations. Roberts (1986) proposes a mathematical signaling model which recognizes informational asymmetry and operates under the Cournot duopoly model.[13] Robert models a situation between an "incumbent" and a new entrant in the market and evaluates the likelihood of the entrant's exit following the level of demand and the Cournot equilibrium. Our proposed model also utilizes the Cournot duopoly model to model predation and predict outcomes.

This paper seeks to bridge the gap between the three distinct approaches to predatory pricing: law, economics, and game-theory. In terms of law, the impact of prominent cases on future prosecutions and its implications are often explored. Economic analysis typically evaluates the rationality of predatory pricing practices and employs various tests to justify their presence. Game-theory papers discuss predatory pricing in the context of other game theory models, often providing insights into potential market outcomes. By incorporating all three approaches into a model, our paper aims to offer a more comprehensive understanding of predatory pricing, integrating both legal and economic implications of such practices.

The Model

Figure 1 maps the "predation" stages of predatory pricing scenarios, and predicts possible outcomes. This model is developed using subsequent action game theory models as its base. Further refinements of actions and outcomes are made by observing cases of predatory pricing, most notably, those of the three case studies explored in this paper.

In the model above, Player A's actions are represented by the bolded letters, and Player B's actions are in italics. Court decisions are neither bolded nor in italics.

The model's assumptions are:

1. There are only two players: A and B.
2. Player A is the dominant firm. Once threatened, Player A will remain in the market indefinitely.
3. Player B has no other adaptation strategies apart from lowering prices once threatened.
4. Player B cannot lower prices into predatory pricing territory.

These assumptions are intended to prevent the over-complication of the game. The model is restricted to only two players: the predator (A), and the prey (B). This is not always reflective of real-world scenarios involving predatory pricing; however, it is maintained for the sake of simplicity. A "player" can also be used to refer to a cartel or a collective of firms, as will be exemplified in the case between Matsushita Electric Industries Co. and Zenith Radio Corporation. The restriction of Player B's adaptation strategies will allow the game to end or restart, rather than entering a continuous scenario where Player B's non-price adaptation allows it to remain

[13] The Cournot duopoly model is an oligopoly market game with two players. In a Cournot model, there are two or more players in a market where no new entrants and collusive behavior is allowed. Each player aims to maximize their own profit)Elsadany, 2015(.

in the market indefinitely. Finally, the assumption that Player B is not allowed to engage in predatory pricing permits the possibility that Player B may resort to legal action after the initial response of price reduction proves ineffective. This assumption allows for consistency, as Player B, the less dominant firm, theoretically, should not be able to withstand the short-term loss of revenue from engaging in predatory pricing.

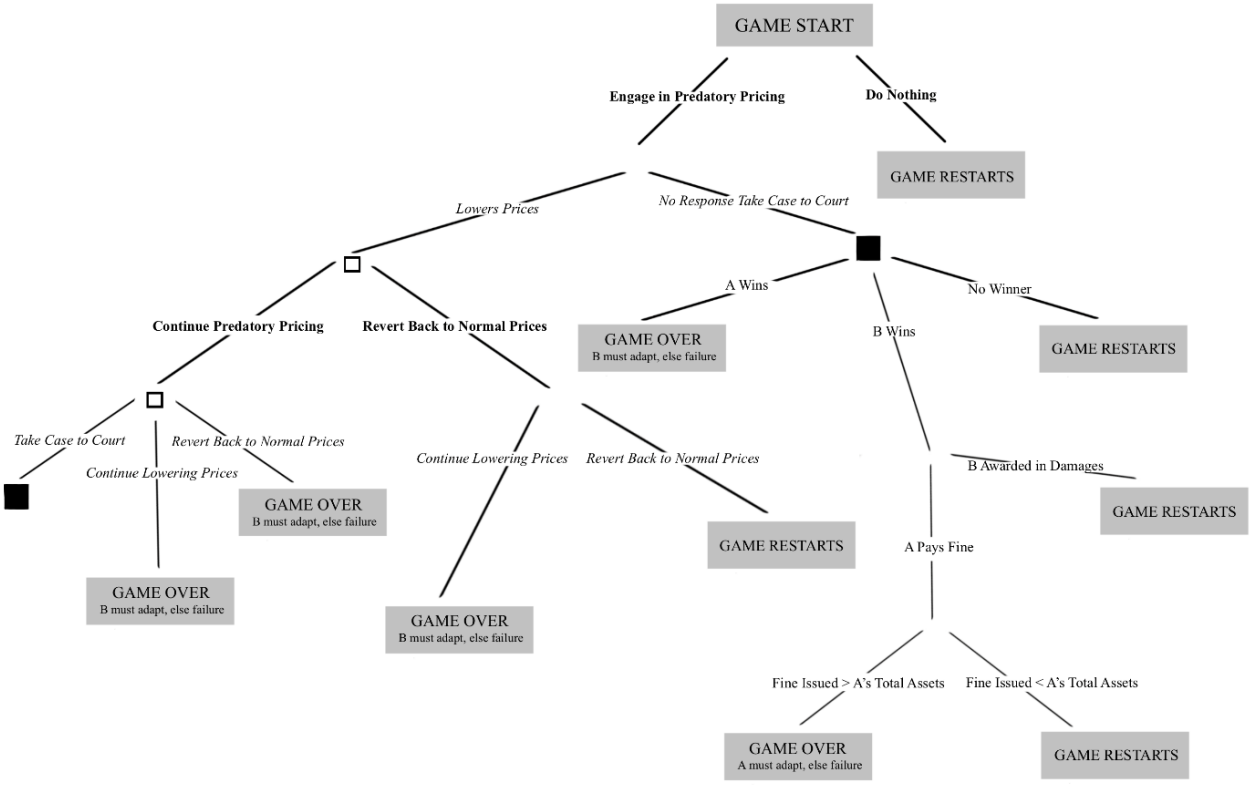

Figure 1. Predatory pricing decision tree.

The game starts with Player A's, the dominant firm, actions. To start the game, Player A has two options: either engage in predatory pricing or do nothing. In the event that Player A does nothing, the game ends, labeled as "Game Over". If Player A chooses to engage in predatory pricing, we will progress to Player B's turn. As no other adaptation strategies are allowed, Player B is presented with two choices: either lower the price to compete with Player A, or not respond and take Player A to court. If Player B decides to pursue legal actions against Player A, our analysis of the case studies has revealed three possible outcomes: Player A wins, Player B wins, and no winners. Player A winning will lead to Player B having to adapt and thus the game ending.[14] If Player B wins, there are two possible outcomes: Player A pays a fine or Player B is awarded in damages. If Player B is awarded, the market will restore to normal conditions, meaning that prices will return to the normal market level. If Player A is required to pay a fine, it will either end in Player A having to adapt or the market restoring, depending on the size of the fine issued by the court. In the case that the fine issued exceeds Player A's total assets, Player A will be forced to adapt or risk failure/bankruptcy. On the other hand, if Player A's total assets

[14] Reminder that this game allows for no other adaptation strategies. The outcome labeled "A/B must adapt, else failure" signals the end of the game. From this point on, the player is no longer bounded by the assumptions of the game. Therefore, the player must adapt, using any adaptation strategies, to avoid bankruptcy or losing their position in the market.

surpass the fine issued, the market will restore to normal conditions, allowing the game to restart. This will lead to a loop in the game. A third scenario may arise wherein there are no winners, such as when a court investigation or provisional measure is enforced. Similar to the outcome in the third option, this result leads to a loop.

This model features loops or redirections that are represented by the boxes, or labeled as “Game Restarts”. As the name suggests, when the game restarts, we once again return to Player A’s first option between engaging in predatory pricing or not (the very beginning of the game). In this model, in order for the game to restart, the players must return to their normal prices. For example, in the situation where Player A decides to stop predatory pricing after Player B responds by price cutting, the game can only restart once Player B has also reverted back to its normal price. If Player B continues to lower its prices, Player B will lose the market and the game ends. The redirection is represented by the filled squares in the diagram. Once the scenario has reached the filled square on the far left, the game will be moved and continued at the filled square on the right where the court decisions take place. The loop is represented by the unfilled squares and is used in the situation where a price war occurs. An example of this scenario will be shown in the case between Brooke Group Ltd. and Brown & Williamson Tobacco Corp. In this scenario, Player B’s first response is to lower their prices and Player A continues to engage in predatory pricing. This will take us to the lower unfilled square. Once we reach the lower unfilled square, we will repeat the steps again starting at the upper unfilled square. This will continue until either Player B decides to take Player A to court or Player B is forced to adapt and the game restarts.

Case Studies

We have selected three case studies: Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., Matsushita Electric Industries Co. v. Zenith Radio Corporation, and AKZO Chemie BV v. Commission of the European Communities. The processes of predation in these three cases are all vastly different and result in varied outcomes. They are representative examples, chosen to demonstrate the different ways the game can be played in our proposed model.

The technical information presented in this section, unless otherwise specified, is from the following legal cases: Brooke Group Ltd. v. Brown & Williamson Tobacco Corp. (1993), Matsushita Electrical Industrial Co., Ltd. v. Zenith Radio Corp. (1986), and Case C-62/86 (1991), respectively.

Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.)1993(

In 1993, the United States Supreme Court decided that the Brooke Group Ltd. v. Brown & Williamson Tobacco Corp. was a case of predatory pricing. This was the first Supreme Court decision on predatory pricing in nearly three decades. The ruling in the Brooke decision required that allegations must show prices below rival’s cost and that the competitor had a chance of recouping its losses, challenging an earlier view that below-cost pricing was a sufficient condition)Boudreaux et al., 1995(.

The US cigarette industry is dominated by six firms, two of which are Brooke Group Ltd. (formerly known as Liggett) and Brown & Williamson Tobacco Corp. Prior to the 1980s, prices in the industry were relatively uniform; however, this pattern began to shift as smoking declined in popularity and firms suffered from excess supplies. Liggett’s successful line of generic cigarettes led Brown & Williamson to also introduce its own line of generic cigarettes alongside the discounted segment. This triggered a rebates war that persisted until mid-1985.

In 1984, Liggett filed a lawsuit against Brown & Williamson, alleging that the latter’s conduct during the rebates war violated Section 2(a) of the Clayton Act, as amended by the Robinson-Patman Act. Liggett claimed

that Brown & Williamson predatory scheme was to pressure Liggett into keeping high prices on its generics, thereby protecting the highly competitive profits on their branded cigarettes. Although the judges found no evidence of injury to competition, Brown & Williamson was nonetheless held liable as a matter of law. The court awarded Liggett $49.6 million in damages.

However, while it was concluded that Brown & Williamson had priced its generics below cost for 18 months, there was no clear evidence of recoupment or recovery from the pricing scheme. Some proposed that the lack of reasonable prospect for recovery could be due to Brown & Williamson's simultaneous predation-recoupment strategy. Disagreements also arose regarding Brown & Williamson's variable cost during this period, with some estimates suggesting that the company lost $8.1 million during its predatory pricing campaign, while others argued that the company actually benefitted, acquiring an estimated $3.6 million after accounting for tax benefits.

In summary, the dispute between Brooke Group Ltd. and Brown & Williamson Tobacco Corp arose from their respective entry into the generic cigarette market and the subsequent rebates war. Liggett (Brooke Group Ltd.) filed a lawsuit against Brown & Williamson, but it was ultimately ruled that Liggett had not been harmed. There was also no clear evidence that Brown & Williamson had successfully recouped any losses from its pricing scheme.

Game model walkthrough: In this case, Brown & Williamson would be Player A and Liggett would be Player B. The game starts with Brown & Williamson choosing to engage in predatory pricing. It is important to note that prior to the lawsuit, the two firms had engaged in a rebates war; therefore, in the tree game, it can be assumed that Liggett would choose to lower its prices and Brown & Williamson would continue to engage in predatory pricing. This forms a loop as shown by the unfilled square in the diagram where Brown & Williamson continues its predation and Liggett responds by also lowering its price. This loop continues until Liggett decides to file a lawsuit in 1984. This leads us to the filled square in the tree diagram, which will then take us to the other branch labeled with a filled square on the right. In this case, Liggett "wins" and is awarded in damages. The market restores to normal conditions and the game can be restarted. This demonstrates how our game model can be applied to real-world cases of predatory pricing and can be used to assess the strategic behavior of market participants.

Matsushita Electric Industries Co. v. Zenith Radio Corporation)1986(

In 1974, Zenith Radio Corporation and other American consumer electronics products (CEPs) corporations filed a lawsuit in the Federal District Court against a foreign cartel comprising 21 Japanese or Japanese-controlled CEPs corporations, including Matsushita Electric Industries Co. The lawsuit alleged that the Japanese cartel engaged in a scheme to drive the American CEPs out of their own market. The American corporations claimed that the Japanese cartel were engaging in a scheme which maintained artificially high prices in the Japanese market while fixing low prices for their United States' exports and products, violating Sections 1 and 2 of the Sherman Act, Section 2(a) of the Robinson-Patman Act, and Section 73 of the Wilson Tariff Act. These violations include engaging in predatory pricing, price discrimination, conspiracy, and attempts at monopolization.

Initially, judges found no evidence of a connection between the Japanese firms' behavior in domestic markets and its export sales, and artificially low prices could not be inferred. Matsushita Electric Industries Co. and the Japanese firms, therefore, won the judgement. On appeal, however, Zenith Radio Corporation and the American CEPs pulled in evidence from the horizontal price fixing scheme as the Japanese firms are part of a *keiretsu*,[15] which had agreed to stabilize domestic prize amongst the dominant firms. The American CEPs

[15] A *keiretsu* is a tightly-organized Japanese trade association similar to a cartel)Ahmadjian & Lincoln, 2001(.

claimed that the Japanese firms used export markets to absorb the excess supply stemming from the conspiracy, and that eliminating American firms would lead to higher profitability levels. They further asserted that prices for Japanese firms in US markets were below cost and 50% lower than in Japanese markets. Despite this evidence, the Court concluded that there was no predatory conduct due to the lack of evidence on the "conspiracy" and low possibility of recoupment from the 20-year period of predation. Matsushita Electric Industries Co. and the Japanese firms were not held liable.

In summary, the Matsushita Electric Industries Co. v. Zenith Radio Corporation case starts with the American CEPs alleging that the Japanese cartel is maintaining artificially high prices in the Japanese market and fixing low prices in America. The initial judgement favored the Japanese firms due to lack of evidence. On appeal, the American CEPs presented new evidence, but it was still deemed insufficient by the court, and there was no evidence of recoupment during the 20 years of alleged predation. Therefore, the Japanese cartel won again.

Game model walkthrough: In this game, the Japanese cartel is Player A and the American CEPs are Player B. This game is much simpler. Once the American CEPs are threatened by the Japanese cartel, rather than engaging in a price war, they bring an action to the Federal District Court. Unfortunately for the American CEPs and Zenith Radio Corporation, the court's ruling was in favor of the Japanese, even after appeal. In the case of the game tree, we will be going down the path where A (the Japanese cartel) wins and results in B (American CEPs) being forced to adapt. In the case of Zenith Radio Corporation, they continue to lose money in the television industry where the "predation" had taken place as they fail to adapt suitably to remain in the market. Currently, we are at the very end of the tree where Player B is forced to adapt and the game ends. As the game ends, Zenith Radio Corporation is no longer bounded by the assumptions of the game and can utilize other adaptation strategies to avoid bankruptcy. In this case, Zenith Radio Corporation adapts by entering the computer market in 1979)Computerworld, 1979(.

AKZO Chemie BV v. Commission of the European Communities)Case C-62/86, 1991(

AKZO Chemie BV faces allegations for abuse of a dominant position held in the European Economic Community organic peroxides market by its discriminatory and below-cost pricing techniques—as well as the aim to damage and remove a smaller firm, Engineering Chemical Supplies (ECS) as a competitor. ECS started off as a small privately-owned company, mainly producing flour additives. It eventually entered as a competitor in the continental plastics market. When ECS began supplying one of AKZO's major customers in the polymer industry, AKZO responded with threats during a meeting between the two firms. These threats were used to establish the predatory intent later by the Commission. As AKZO's threats targeted the flour additives market (where the alleged predation had occurred) rather than the plastics one, the evidence was even more substantial)Moras & Phlips, 1993(.

ECS claims AKZO had attempted to keep it out of business by the systematic price cutting that had started since the end of 1980. This likely started when ECS refused to follow AKZO's price increase despite past compliance, leading to a widening price gap between the two firms. Eventually, the price gap between them led to two of AKZO's main customers asking ECS for quotations on supply of flour additives. In late 1980, AKZO reacts, approaching ECS' main customer with new and lower prices. In June 1982, ECS submits a complaint stating that AKZO was abusing its dominant position via discriminatory and below-cost pricing techniques in order to exclude ECS as a competitor. In December 1982, the Commission begins investigations on AKZO

Chemie and AKZO UK. ECS made another complaint in May 1983 about how AKZO's price tactics had continued after the investigation. The Commission accepted the new complaint in July of the same year and imposed minimum prices for flour additives on AKZO as a provisional measure. AKZO was eventually fined 10 million ECU in December 1985 for infringement of Article 86 of the Roman Treaty for abuse of its dominant position.

In summary, the AKZO Chemie BV v. Commission of the European Communities case starts once ECS joins the polymer industry and starts supplying to one of AKZO's main customers. The threats used after this are used to establish predatory intent legally. AKZO's predation occurs after ECS refuses to follow AKZO's price increase and AKZO responds by using discriminatory pricing techniques. After the first investigation in 1982, AKZO continues its price tactics. The second complaint filed in 1983 led to minimum prices being imposed on AKZO. AKZO continues its predation until it is fined in 1985.

Game model walkthrough: Once again, AKZO Chemie BV, the dominant firm, is represented by Player A in the game, and ECS is represented by Player B. As the game starts, AKZO engages in predatory pricing, which in this case is AKZO approaching ECS' main customers with cheaper flour additives. In response, ECS submits a complaint to the Commission. This process in the tree game is the Commission's initial investigation of AKZO Chemie BV and AKZO UK in 1982. In this case, there is no winner. Therefore, the game restarts. AKZO chooses to engage in predatory pricing again and ECS chooses the same response of making another complaint in May 1983. There is no clear winner as the Commission merely imposes minimum prices as a provisional measure. The game restarts. AKZO chooses to engage in predatory pricing once again, and ECS continues with its chosen strategy and takes it to the Commission. This time, ECS wins the case (or Player B wins) and AKZO Chemie (Player A) pays a fine of 10 million ECU. The game can now restart if both firms return to their normal market prices. Our analysis demonstrates how our model can help in understanding real-world predatory pricing cases, including those which feature loops, and account for the strategies firms employ to adapt and survive.

Discussion

This model depicts multiple predation strategies and offers predictions regarding the possible outcomes of predatory pricing schemes. There are two possible outcomes of the game: the firms being forced to adapt in order to remain in the market, or a return to normal conditions with a game restart. As demonstrated in the walkthroughs of the three case studies, this model is effective in various situations.

Our proposed model both builds off and addresses the identified gaps in the literature. Funk and Jaag (2018) suggest including elements of merger control laws into antitrust. This model can be applied in the analysis of mergers and acquisitions, addressing Funk and Jaag (2018('s suggestion. With the same logic, the model can be adapted to analyze market structures and predict market entry and exit. Furthermore, this model builds on Elzinga and Mills (2001)'s discussion of asymmetrical information and Salinger (2007)'s idea of behavioral expectations and how they influence decisions in the development of the model. Our model bridges the gap between these two concepts by utilizing both models as a foundation for its structure.

The application of our model is brought together through the discussion of the three case studies, all with distinct processes and outcomes. While these case studies have been previously discussed in the fields of law and economics, game theory has not been applied to them. This paper fills this gap and presents the case studies through a game theory lens. This will support the analysis of decisions and interaction between the firms in each case. In addition, this model will aid in the evaluation of past and future cases through the clear and chronological

visualization of the processes and outcomes of predatory pricing. Our model also addresses the controversial nature of predatory pricing and the court's rulings, which is often highlighted in law papers such as Boudreaux et al. (1995), Austin (1989), or Denger and Herfort (1994), but it is not usually seen in models, hence the importance of the development of a model that analyzes case studies via a legal lens.

In accordance with Salinger's (2007) views on the limitations of game theory in predicting market outcomes, this model is subject to certain assumptions that may restrict its applicability. While the assumptions allow for the model's simplicity, they may also result in certain aspects of realistic behavior to be sacrificed. For instance, the model is designed for only two players, therefore, only accounting for predatory pricing cases between two firms or cartels. An example of a case which breaches this assumption is Air Canada's predatory pricing case against WestJet and CanJet)Zhang, 2003(where there are more than two opposing players as Player A (Air Canada) has to play against two new entrants rather than just the one Player B. However, it is possible to adapt both the case and the model to make it suitable for the scenario as WestJet and CanJet could be counted as a single player similar to the Japanese cartel in Matsushita Electric Industries Co. v. Zenith Radio Corporation; or to introduce more firms or players into the model. Additionally, the model does not account for other non-price adaptations such as marketing and advertisement, product differentiation, or quality improvement. These are undeniably the strategies many firms use to respond to threats. An example of a non-price adaptation can be seen in one of our case studies, Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., where before the predation allegations, both firms attempted to regain their position in the market by introducing a differentiated product—generic cigarettes.

Further development of the model could include the introduction of a mathematical-based system. As highlighted by Ursic and Helgeson (1994), cost-based tools are common in the prosecution of predatory pricing. By incorporating mathematical calculations of payoffs or even the qualifying thresholds for a choice, this model would be more beneficial for the analysis of predatory pricing. Moreover, it is essential to keep the model updated to reflect recent court rulings and changing market conditions.

Conclusion

Our proposed model addresses a gap in the literature by bridging three prevalent areas commonly explored in predatory pricing: law, economics, and game theory. Through the incorporation of expectations regarding the competitive practices of firms in an oligopoly, as well as prosecutions of antitrust violations, our proposed model is a contribution to the field. This model outlines the predation stages of predatory pricing strategies, starting from the predator's initial decision, to a range of possible responses by the prey, and acknowledges loops that can be present during this process. It predicts possible outcomes both from rational economics behavior and from analysis of case studies with diverse processes and results. This approach to modeling predatory pricing represents a significant contribution to the field, with the potential to inform both theory and practice.

The applicability of our proposed model extends beyond the scope of predatory pricing analyses. As it maps out the possible decisions and outcomes in generic competitive settings, it will be useful in business strategies or mergers and acquisitions analyses. The flexibility of the model allows for adaptations to fit specific situations, thereby enabling closer analyses and the development of strategical approaches to business dilemmas such as pricing strategies, or bargaining and negotiations. The predictive nature of the model means the logic can be utilized in the study of market structures and can provide insights on future changes. This includes planning entries and exits in a particular market or anticipating the formation of cartels and monopolies. Overall, our model

is a comprehensive representation of the various aspects of related fields. It enables efficient analyses and studies, thereby contributing to the literature in this area.

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