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Honors Thesis

Determining the Outcome of Legal Grievances:
An Application of Game Theory to Tort Negotiations

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Department: _____

Game Theory and the Law

Game theory is applied to many fields of study, including law. It is all together fitting and proper to extend this application to the legal negotiation of torts. The success and accuracy of particular predictions by such a game would be dependent on the players' ability to predict the value of certain variables. However, with this assumption, if a game exists it could be valuable to litigants. It could, first, deduce when a grievance might be settled, and second, suggest the manner in which settlement will occur. That is, it could estimate the phase of the process that would end a legal dispute (whether after an offer or a court decision) along with the resultant distribution of capital. These concrete advantages could be developed if the game included two mathematical functions, first, exemplifying a positive correlation between the size of settlement windows and the probability of settlement, and second, quantifying the weight of those settlements. When solved, the model would predict the best strategy for a rational player of the game, one which results in the most desirable equilibrium. It could help litigants decide whether to go to court or to settle.

Note that game theorists refer to rational players under a certain assumption about rationality—that each player is seeking a certain knowable end (Bartos). I have created a game with the assumption that each player wants as a large a share of the distributed capital as possible. My model takes as an axiom that both players know their own objectives, know those of their opponents, and that their opponents know that they know their objectives, ad infinitum (Baird). It is also contingent on the assumption that it accounts for every major decision-making influence.

Because the forecasting of particular inputs must be done, not by the game but by the litigator, the value of the game is not primarily its ability to make particular predictions, but rather its logical way of organizing data, such that the impact of subtle changes in an intricate and complicated process might be observed in many hypothetical scenarios. I suggest that the described game and mathematical models do exist but will leave the formation of mathematical models for further research. For now it is sufficient to say that my game may prove to be a useful tool for litigants and lawyers—even if it assists only in presenting, in a logical, dynamic format, what the players’ intuition might have already told them.

My game is quite unique. Many people have analyzed legal negotiation, but few applications of game theory to legal negotiation exist. One application used old data and did not write an extensive form game applied to tort law (Fournier and Zuehlke). The methodology of my study included two steps. In order to create an effective game I needed information on the process of legal negotiation. When found, I used this information to create a game that accounts for, as much as possible, the data that might affect decision-making. The challenge was to account for as many variables as possible, as efficiently as possible, so as to have a precise but not overly-complicated game.

I will begin my work with a description of the legal negotiation process in tort law. Next, I will explain the key facets and usefulness of game theory. Third, I will suggest how game theory might be applied to the legal negotiation of torts and solved in any particular tort case. Finally I will confirm that the elements of my model are, first, the definitive parts in the legal negotiation process, and second, part of a cohesive and complete game.

What are tort negotiations?

Legal negotiations are the attempts at dispute resolution prior to a court trial. These disputes, or grievances, can be understood as any conflict over the law with particular regard to the method and degree of compensation for the injured party (Friedman). My game is preferential to tort law. A tort is specifically a civil wrong (thus criminal cases do not apply to my game) (Geraty). For this study, the selection of cases has also been limited by ruling out instances where insurance limits the rational action of players. This constricts the range of applicable cases of my game to about 25% of the aggregate set of torts (ibid). If negotiations are unsuccessful, the court is the final arbiter of a grievance (Friedman). However, most conflicts are easily reconcilable and are resolved with no outside assistance. Of the few that progress, the majority are resolved with the assistance of legal professionals before going to court. Of the remainder, many are resolved just prior to the court pronounced judgment, sometimes resolutions are even made during a recess of the trial, though the settlement is often enforced as a court judgment (Geraty). Actually, approximately 99% of all grievances are settled before the court issues a final verdict (Friedman).

It is quite undesirable for either party to resort to the court for judgment (Spier). This is because utilizing the entire process carries with it the disincentive of court fees extended attorney pay and the potential for the plaintiff to receive nothing (Spier; Geraty). Because of this, the majority of resolutions are polarized on the litigation timeline (Geraty). If both parties are willing, it is usually possible to come to an agreement earlier than later in the legal dispute process. However, even in bitter conflict, many cases are settled just prior to the trial to avoid

the said disincentives (ibid). This results in a sort of inverted bell curve on the timeline for legal settlement against frequency.

Another critical feature of the legal negotiation procedure is the investigative portion (Geraty). Legal investigation is the information-seeking portion of the negotiation process (I will call this phase 'discovery'). During this time, each party seeks to find the strength of both his and his opponent's arguments through a variety of discovery tools. One of the most important elements of discovery is the depositions of relevant neutral individuals (ibid). A witness account, the advice of an expert in an appropriate field, or simply the message sent by the plaintiff or the defendant in a deposition can change the dynamics of the negotiation (Spier). A particular discovery phase may also include one or more request for admissions', interrogatories, or production of documents' (Geraty). All of these affect the decision-making processes of the players, whether or not they settle, and how. It is important to recognize, simply that the discovery phase is a significant portion of legal negotiation.

What is game theory?

Game theory is a system of analysis for a situation dictated by the conflicting interests of strategic players (Baird, 1). It is described by gains and losses between cooperative players (sharing mutual interests) or competitive players (as in a zero-sum game) (Baird 42, 10). The defendant and the plaintiff in a formal legal dispute are the players in such a legal game. The game that I have created models the key stages in negotiations and should consequently predict the behavior of rational litigants in a legal dispute.

An outline of the basic tenets of game theory may be expressed with a simple and familiar example. The prisoners' dilemma is an imperfect, single stage, simple form game (Baird). This is an entirely different type of game than I have created. However, it is a straightforward example that demonstrates the type of analytical thinking characteristic of game theory.

The Dilemma is a scenario where two suspects have been apprehended for committing a crime (faculty.html). They are each interrogated in private (without knowledge of the other players' plea) and based on their plea and the plea of the other player, a sentence is determined. The particular numbers given are less important than the process itself, but in our scenario let us outline the four possibilities as follows: If both prisoners confess, they each spend two years in prison. If neither confesses, they each spend six months in prison. If person one confesses and person two does not, person one spends one year in prison and person two spends ten years in prison. And finally, if person two confesses and person one does not, person two spends one year in prison and person one spends ten years in prison. The game can be displayed in a two-by-two matrix (see Figure 1) (faculty.html).

The game is set up in such a way as to encourage confession. Neither player knows what the other will do. But, because the game assumptions are that each player has knowledge of the situation, knowledge of his or her opponent's goals and, particularly that he or she has knowledge that his or her opponent has knowledge of the situation, it becomes even less likely that either player would choose not to confess (Baird). That is, if a rational player knows that his opponent knows that the wise thing to do is to confess, then the wise thing for the first

player to do is to act on the most likely actions of the second player. The second player will likely do the same. When there is a dominant strategy like this we call it the “pure strategy equilibrium,” or the equilibrium solution (Baird 37). Note that each player still has free will to act as they wish. Therefore, we do not know. We predict rational behavior. Note also, that the equilibrium solution is not the “best” solution for either player. It is best for both players if they deny the crime, but yet it is unlikely that either of them will after an evaluation of risks versus benefits.

Figure 1

A Simple Form Game—The Prisoner’s Dilemma

		Player Two	
		Confess	Deny
Player One	Confess	<i>(2, 2)</i>	<i>(1, 10)</i>
	Deny	<i>(10, 1)</i>	<i>(.5, .5)</i>

Years In prison (Player One, Player Two)

The Prisoner's Dilemma is a very basic game; from here this is going to seem to get complicated quickly. My model differs from the Dilemma in that it is a zero sum, single stage, imperfect, sequential, extensive form game with a potential end-game bargaining problem (Baird). Each of these terms is a defining characteristic of the general structure of my game—that is, a game that represents the legal negotiation of torts.

My game is primarily zero-sum. This means that the values of each decision for each player are inversely proportional to the player's opponent. In contrast to the prisoners' dilemma, where the equilibrium solutions may be better overall for both players, my game is of such a manner that a better solution for one player is inherently worse for the other player.

My game is single stage (ibid). This simply means that any two players are likely to only encounter each other once. If players engage each other multiple times, an additional factor is included in the game—namely, how they played the last time. For the sake of practicality and brevity, I have written a single stage game. This means that the reputation of a lawyer, for instance, does not affect how players act.

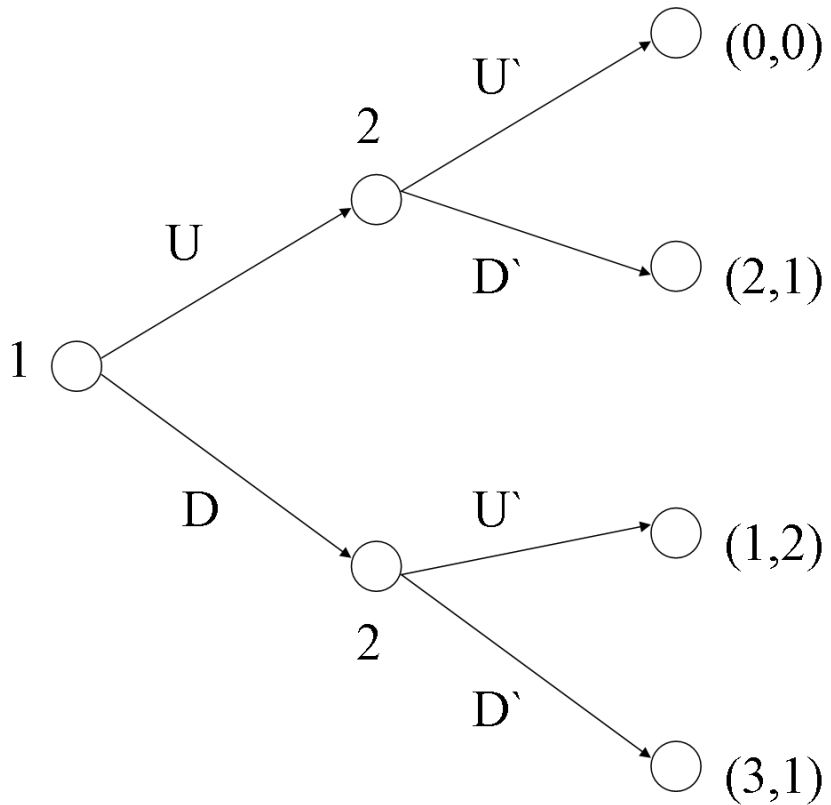
My game is imperfect (ibid). This means that each player has only partial information about his or her opponent and acts based on that information rather than the whole truth. This aspect is in common with the prisoner's dilemma. However, because my game is of the extensive form, knowledge is progressive (ibid). This is perhaps the greatest difference between my game and the prisoner's dilemma. Whereas the dilemma was a two-by-two block with four possible solutions, my game is better represented by a tree diagram with many possible solutions. Each decision the players make is in a one-at-a-time series (hence, it is sequential)

and leads to the next decision making point. The formal decision making points in a game are called nodes. At each node, the condition of the game may change. The tree diagram displays a node by node, or “extensive form”, game (see Figure 2). In the figure, Player 1 has a choice between U and D. Player 2 then has a choice between U’ and D’. Note that the values of U’ and D’ for Player 2 are different based on Player 1’s choice of U or D and vice versa. This demonstrates the variability of options given to a player. We will see that this form models legal negotiation.

Finally, my game has an end-game bargaining problem (Baird). This means the fundamental status of the game changes before the terminal node. This may occur, for instance, with the introduction of a third party. If this party happens to require a share also of the disputed resources, this can actually make the game less than zero-sum for the first two players. For example, if the two parties settle, the distribution of capital may be split 50-50, 40-60, 70-30 etc. but if they introduce the court, the corresponding distributions might be 45-45-10, 35-55-10, 65-25-10 etc., with the court taking the subjective third portions in the latter list. Neither party wants to share any more than they have to. So, this is where each side must determine whether the potential benefits outweigh the costs. A plaintiff may choose to engage the court with the hope of the distribution being, as an example of his or her ideal, 95-(-5)-10. Going to court is a risk that must be evaluated by both sides. However, if either one remains obstinate, the court trial is inevitable.

Figure 2

Sample of an Extensive Form Game—the Tree Diagram



Solving a Particular Case with My Predictive Model

The game might be solved (i.e. find equilibrium nodes) for any given set of circumstances through backward induction. That is, I can find what would be the best solution at each node from an enlightened perspective, and then deduce what a rational player would most likely do. I can then also assign weight of settlements (particular distributions) based on each players calculated probability of winning and how much. This is not what they should win.

Rather, the calculated settlement weights are based on what the players perceive to be their best capital distribution and again are dependent on the accuracy of the inputs. In a just world capital would always be distributed based on what the truth of their condition is. We assume that the court, as an objective and impartial arbiter, makes just decisions. No one really knows the truth but an observer of a theoretical game with complete knowledge. The game does not take into account the probability of the court misinterpreting information.

If both parties calculate a sufficiently similar distribution—they will settle. For instance, if a plaintiff is willing to settle for anything more than \$45,000 and the defendant is willing to settle for anything less than \$50,000. There is a \$5,000 window of offer-acceptance or “zone of agreement” (Neale and Bazerman). However, if for instance, the plaintiff will settle for nothing less than \$50,000 and the defendant will settle for nothing more than \$45,000, we say there is no window of settlement. Just because there is a window, this does not mean that there will necessarily be settlement. The reasoning is simple. Negotiators will not bluntly state their most neutral offer, meaning, a defendant will not tell the plaintiff how high he or she would be willing to accept offers, and likewise, a plaintiff will not tell the defendant how low he or she would be willing to accept offers. If I were to continue my research to include a mathematical model, I would attempt to make predictions about the likelihood of the litigants meeting within this window. So, the existence of a window does not ensure settlement. Instead, I posit only that there is a positive correlation between the size of the window and the likelihood of settlement at any individual stage. If each player’s condition could be assessed at each stage, my model could quite naturally be extended to make such a prediction.

Elements of my Model

I will now explain the particular elements of my model with regard to the pieces that compose a game in game theory. The first elements are the players. The players of my game include precisely one plaintiff and one defendant; however, we could perhaps also call the court an actionless player. Next, both players begin the game as either more responsible or more negligent. A future court makes this verdict, but in the meantime this decision is unknown to both players. They will have a general idea of how responsible they were, but they do not know what the relation of their responsibility is to the other player. I refer to this court verdict as the situation and their perception of the situation as the position or the condition of the players. Due to its unknown nature, players' actions may seem erratic as they become more or less confident in their position (Geraty). However, a strong player does not always act strong and a weak player does not always act weak as we will see later.

I described before that the legal negotiation game applied to tort law is of the sequential, extensive form (see Figure 3). As much as possible, players attempt to gain knowledge of the situation throughout the game. If a player's knowledge of a situation has changed or that player believes the opposing player's knowledge has changed, a new offer might be made. Because of this, one might think that there would not normally be a set number of nodes, but that there would be many according to each new bit of information. I do not need to create a node for every offer made, however. Instead, I use one node to represent all offers and counteroffers made by each player, under a given set of influences. In particular, to predict the probability of settlement we simply need the most ideal offer from each stage.

For each stage, I collected offers by one player into the teal box called “offer”, while the other player’s offers are represented by the teal box called “counteroffer”. I have not distinguished which player makes an offer and which player makes a counteroffer in each phase. This is left arbitrary. In fact, first offers can be made by either side in each phase, but the corresponding counteroffer must then come from the other party.

Figure 3

A Model Representing Tort Negotiations

The initial, mid-game and end-game offers distinguish the three primary phases outlined in my game. The three great game shaping influences are, first, the strategy of players following a grievance, second, the introduction of new information, and third, the end-game bargaining problem (Geraty). The beginning of each phase is colored green in the figure.

Player strategy dictates the first stage of the game. Players consciously or unconsciously choose one of two general strategies; they can play competitive or cooperative. The use of the

terms cooperative and competitive with respect to the players differs from the same terms as used to describe the type of game being played. Based on predictions of who would be found more at fault, players might play cooperatively (Spier). That is, they can make the most directly advantageous moves. Or, in an attempt to mislead their opponent, the actor may, essentially, bluff about their condition. We are particularly interested in cases where offers themselves may be forms of counter-intelligence. A player with a so-called competitive approach utilizes the limited knowledge of the other player to his or her advantage (Spier). This means that even the most cooperative litigant cannot make unilateral decisions. If, for instance, a defendant is willing to settle relatively high, he or she may still be prohibited from doing so if the plaintiff only makes outrageous offers. Likewise, even if the same defendant continually refuses offers, neither can he or she make a unilateral decision. The court ensures closure.

In a study of credible negotiation, one scholar found that in competitive negotiation the strategies utilized by litigators are not entirely arbitrary or impulsive (Nalebuff). In order to maintain credibility, a weak plaintiff cannot risk having a low first offer denied. That is, a weak plaintiff must begin with a competitive strategy. If he or she makes a low offer and the defendant denies it, the case is likely to be dropped. Also, a neutral or strong plaintiff would regret settling low with a defendant if the defendant had a weak case. To be safe, a plaintiff frequently makes intentionally high pretrial offers, mimicking the actions of a strong cooperative player (ibid).

The discovery phase is the epitome of the imperfect, extensive form game. If a piece of evidence shows up that was before unknown, a litigant will have a corresponding change in

their expectations for settlement. For example, a deposition may change a player's perception of their situation when a witness gives a persuasive testimony. New evidence does not necessarily change the window, however, if there is a common shift in the expectations of both players. This might occur, for instance, if the second player knows that the first player took a deposition with the said effect. That is, with a new mutual knowledge, a plaintiff might have his or her case strengthened but the defendant would then also have a corresponding rise in the amount he or she is willing to concede. The same reasoning applies if the plaintiff's case is weakened, the defendant's case is strengthened, or the defendant's case is weakened. So with new information there will be a change in the standard for settlement with the possibility of a fluctuated window.

If we from here assume one-sided intelligence, we can explore the possibilities of a change in the window. If a player has his or her case strengthened, this would necessarily narrow any potential window, such that a plaintiff would expect more or a defendant would expect to concede less. If a player has his or her case weakened, this will necessarily widen the potential window by the same reasoning. These one-sided discoveries are of particular interest in finding the likelihood of settlement, while new mutual intelligence would be useful in determining the magnitude of a change in settlement expectations.

The initial and mid-game offers are fairly similar in that players can accept or deny entirely as they find prudent, whereas the end-game offers are made with the increased pressure of an impending trial date (Spier). The evaluation of potential benefits must be weighed against the continued court costs to determine whether the players' condition will

ever be revealed by the court. This again translates into litigants settling for an amount that is not within their original standards. The bargaining problem takes place when the zero-sum attribute of the end-game is threatened by imminent court intervention. Litigants have an extra incentive to settle before going to trial, because when a third party enters the game it translates into deadweight loss creating Pareto-inefficiency. This changes the dynamic of the game and gives an opportunity for one or both players to improve their positions.

This bargaining problem can have a profound effect on the outcome of a case. As an example, let us assume the previous standards for which there was no window of settlement—a plaintiff demanding \$50,000 and a Defendant unwilling to settle above \$45,000. When court intervention (with the associated lawyerly fees) is imminent, players recalculate their potential gains or losses. If we assume a modest \$10,000 will be deducted from both players, then even if both players were to accept offers on their thresholds, their new efficiency standard for the plaintiff is $\$50,000 - \$10,000 = \$40,000$ and for the defendant it is $-\$45,000 - \$10,000 = -\$55,000$ (note that the defendant is intent on minimizing losses, hence the negative value). So, a nonexistent (or, $-\$50,000$) window expands in this case by \$20,000 to a positive \$15,000 pretrial window. The phenomenon of late negotiation settlements is thus the action of rational litigants and an essential element of my game.

If at any these three stages the two parties accept and choose to settle, the game ends. Thus any of the dark blue boxes could be a terminal node. If the players do not agree on a distribution (if they do not settle) they will proceed to the next node, and the next, and the next—in each phase offering and accepting or denying an offer. The game progresses

sequentially with each denial of an offer (or set of offers). The purple denial boxes are progressive boxes. The official court judgment is the terminal point of games that would otherwise not end.

Conclusions

The model that most precisely applies to tort negotiations is a zero sum, single stage, imperfect, sequential, extensive form game with a potential end-game bargaining problem. The three phases of the game are distinguished as the introduction of player strategy, the introduction of new information, and the introduction of the court. The game accounts for the major influences of a very complicated and abstract process in a concise, precise and analyzable way. The model of tort negotiations I am presenting is an innovation for future study. If the game is advanced to include mathematical functions it could quantify the probability of settlement and predict distribution values at different stages. The game operates under many critical assumptions, most significant of which is that its accuracy in specific cases is entirely subject to the litigators' ability to forecast inputs.

Annotated Bibliography

Baird, Douglas G. 1998. *Game theory and the law*. Harvard University Press.

Baird showed me how to create a game. He explained that there are different types of games. There are games that require simultaneous or sequential decision making. There are normal and extensive form games. Perfect or imperfect knowledge is a factor. There are equilibrium points where rational players will never change their tactic because it best suits them. My model is an imperfect, single stage, sequential, extensive form game with a potential end-game bargaining problem.

Bartos, Otomar J. *Simple Model of Negotiation: A Sociological Point of View*. *The Journal of Conflict Resolution*. December 1977 pp. 565-579.

This source confirmed that in order to analyze negotiation, I would need to make some assumptions about why people negotiate. They are not far-fetched, but “most rigorous theories of negotiation start from the assumption of individual rationality.” The second important factor I discovered was that negotiation fits the requirements of game theory. That is, there are points that can be considered solutions to the game—“an agreement is seen as an equilibrium point in which the opposing interests are balanced.” Finally, the authors suggest that a cooperative strategy is much more likely to settle a conflict than a competitive strategy. I will account for this by having all competitive strategies shift to cooperative in stage three of my game (the imminent trial).

Fenn, Paul and Rickman, Neil. *Delay and Settlement in Litigation*. *The Economic Journal*. July 1999 pp. 476-491.

Fenn and Rickman explain that there are often delays in disputes going to trial. They sought to find the sources of the delay. That is, they found reasons for the specific duration of the negotiation process. Their results are intuitively verifiable. They found that delays were most common: when bargaining remains cheap (either due to a long period before the increased lawyers’ hours of the imminent court decision, or when a plaintiff is legally aided), when there was a lot at stake, or when both sides had a high degree of confidence in their position. I realized that I need to scale cooperation to the size of the estimated settlement and that a player may maintain a competitive strategy if they believe in the strength of their case. I also see that higher potential settlements should create narrower settlement windows and consequently favor late game settlement in such cases.

Fournier, Gary M. and Zuehlke, Thomas W. *Litigation and Settlement: An Empirical Approach*. *The Review of Economics and Statistics*. May 1989 pp. 189-195.

Fournier and Zuehlke ask a very similar question to mine: when and under what conditions will a dispute be settled? However, I would like to make a user-friendly system of analysis that can be used for many cases (a game). I have been able to adapt and build off of this article, applying similar mathematical equations to the conditions of my game. This is probably the most useful article to my research.

Friedman, Lawrence M. "American Law: An Introduction," 1998.

Friedman offered me some of the details of the legal negotiation process. For instance, he gives statistics for the frequency for which legal disputes are settled without court intervention.

Geraty, Brent. Formal Interview, January 19, 2011.

Mr. Geraty informed me of the particular nuisances of legal negotiation. He described the particular acts of discovery used by both sides in a case (requests for documents, depositions). I was also able to clarify the effect of insurance on a dispute. My game will have to exclude cases with such a factor to maintain precision in its aims. Geraty said that this is still a substantial portion of cases otherwise suited to my specifications (perhaps 30%).

<http://plato.stanford.edu/entries/game-theory/>, accessed October 7, 2010.

This site helped me see the application of game theory to law. It helped me understand what a "game" is: "All situations in which at least one agent can only act to maximize his utility through anticipating (either consciously or just implicitly in his behavior) the responses to his actions by one or more other agents..." I could then see that game theory could help me predict behavior in tort litigation.

Nalebuff, Barry. *Credible Pretrial Negotiation*. The RAND Journal of Economics Summer, 1987 pp. 198-210.

Nalebuff made one particularly useful point about the early stage of negotiation. In order to maintain credibility, a weak plaintiff cannot risk having a low first offer denied. That is, a weak plaintiff must begin with a competitive strategy. If he or she makes a low offer and the defendant denies it, the case is likely to be dropped. Also, a neutral or strong plaintiff will not want to settle with any defendant that would accept his offer. To ensure this, he must make intentionally high pretrial offers.

Neale, Margaret A. and Bazerman, Max H. *Perspectives for Understanding Negotiation: Viewing Negotiation as a Judgmental Process*. *The Journal of Conflict Resolution*. March 1985 pp. 33-55.

The authors describe a "zone of agreement" between rational negotiators. They confirm a premise of my game—that settlement will occur (not if) but only if players share such a zone. They also showed me that I need to consider what type of arbiter I am referring to. That is, will the court make a polar decision or create a compromise? Finally, I see that the end-game bargaining problem is natural to my game. That is, when phase two negotiations fail, at that point, the court is the less salient cost.

Spier, Kathryn E. *The Dynamics of Pretrial Negotiation*. The Review of Economic Studies. January 1992. pp. 93-108.

Spier explains the two primary litigation strategies. Particularly, she analyzes the credibility of a competitive plaintiff when the defendant rejects low offers. Essentially, a

plaintiff whose bluff is called may often drop the case without settlement or a trial. She says the main incentive to avoid a court trial is the fees that come with a court decision along with the extended lawyers' wages. This follows the rational choice mentality of game theory. I have to include this as an option in my game. This will be reflected in the "discovery phase". If a deposition or document reveals a devastating weakness in a party's case, the ideal settlements for each side must change. This phase by phase fluctuation in settlement ideals is a defining characteristic of my game.