

Modeling the Civil Litigation Process in South Africa using Game Theory

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Abstract—This paper reviews the historical background to civil litigation modeling from an economic perspective. After developing a description of the full civil litigation process as it presently exists in South Africa a complete game theoretic model is presented. Various aspects of this model are then discussed. It is clear from the preliminary model that there exists a strong theoretical support for the concept that the civil litigation process favours players who understand the underlying game theoretic elements and discriminates against individuals without the ability to analyse the model.

Keywords— Legal Game Theory, Litigation Model, Civil Litigation.

I. INTRODUCTION

THE initial analysis of law using economic theory found that the common law was the most efficient of the various branches, as it was established specifically in accordance with the needs of the litigants [8],[9]. When the courts were initially established, the state did not control the legal system through the rule of law and prospective plaintiffs approached a certain court based on what the court could offer in terms of a fair and just judgment. As a result of the competition between the courts in this formative period of the common law, the legal system tended towards economic efficiency and these efficient judgments eventually led to the formed precedents.

The largest case in South Africa is currently under way, and it is the highest valued lawsuit in Africa. Over 7,000 miners are suing mining companies for R27 billion to compensate them and their families for a life-threatening disease caused when silica from gold bearing quartz lodges in the lungs. As a result of the largest fraud case in world history, shareholders sued the US Securities and Exchange Commission for \$3.87 trillion as a result of over \$2 trillion worth of fake CMKM Diamonds Inc. shares being sold to the public between June 2004 and October 2005. These class action suits are however also growing in value, and although victims do deserve compensation, resources are being squandered as around 30% of final settlements are related to attorney's fees and other trial costs. There are also indirect social costs involved that place an additional strain on the courts and society as a whole.

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Inefficiency in the civil legal process results in major costs to all parties involved, this is because as the amount at issue increases, the probability of litigation over settlement increases [8]. Rational parties should be willing to settle when the costs of a trial outweigh the amount in dispute; however, the nature of a party may lead to factitious litigation. If a party is willing to litigate, no matter the cost, it puts an additional burden on the courts and squanders legal resources. Judgment's creates new law through the principal of *stare decisis* and if the decisions of the courts are inefficient (or unnecessary) these decisions are carried through the system until the law is appealed or amended.

It is not possible to address all sources of inefficiency in a legal system; however, by providing an efficient judicial body, it will allocate resources efficiently to ensure that remedies are awarded to deserving parties.

An economically rational party must consider the net expected value of the litigation process by considering all the merits of the case, the state of the law, as well as the ideological propensity of the judges [8]. In South Africa, there is no burden of proof needed to initiate civil litigation, therefore the merits of the case are judged, solely on the evidence the litigants produce in court. The nature of the law surrounding civil litigation is that

- everyone deserves a fair trial,
- a person is able to represent themselves whether or not they cannot afford an attorney to be present, and
- if a defendant feels the plaintiff does not have a case, they may request a deposit be paid before commencing to trial.

Concerning the ideological propensity of the judges, a plaintiff and his counsel will base their decisions on how to proceed, on the past information that is available to them in the form of published case law and counsel will also be able to take past experience into account. The magistrates and judges base their decisions on different matters and depending on the nature of the dispute, it can have an impact on the case at hand.

The standard theory surrounding litigation was that it was always better to settle than to litigate [4], however this has been challenged recently [5]. In this paper we develop a theoretical model to determine whether the same is true in South Africa given the costly process of litigation. Using game theory techniques, we will construct a two person game where a defendant is presented with a case, and based on certain signals, he makes an offer to settle, it is then up to the

plaintiff to decide whether to accept the offer or go on to trial.

II. CIVIL LITIGATION

A. *The civil litigation process*

Civil litigation is based on a well-defined and structured process – irrespective of the legal domain. Primary to this process is the procedures to reduce the likelihood of frivolous cases going to trial. If it is the plaintiff who does not base his case on good merits, the defendant can respond with a bare denial of the allegations which will result in avoiding a default judgment and will shift the burden back to the plaintiff. Since the threat to go to trial is not credible, the defendant may ignore the claim hoping the plaintiff will not pursue it. If the plaintiff does pursue a claim, which is not credible, the defendant can request for a deposit for costs to be furnished by the plaintiff with the court. However, if the merits of the plaintiff's case are valid and met with a bare denial¹, the plaintiff can apply for a summary judgment when he is sure that the defendant has no defense and is denying the claims as a stalling tactic. According to Katz [11], there are certain things that are taken into account when establishing the merits of the case, such as, the nature of the parties, strength or weakness of the case according to the evidence, confidence that the parties vest in the case, as well as the existence of asymmetric information.

The nature of the party will affect the signal to the plaintiff, a firm, union or industry is often party to a frivolous lawsuits. Secondly, a plaintiff in a personal injury matter will often engage in a frivolous suit, when a party has been slightly injured as a result of the negligence of another, the nature of the defendant comes into play, for example, a customer who slips on the wet floor of a shopping center. Thirdly, in the case of product liability where an injury is undisputed, but the defendant is aware that the plaintiff may not be entitled to damages due to contributory negligence the plaintiff will still initiate an undeserved suit. While the plaintiff is aware of his negligence, the defendant cannot know this prior to the trial.

It is assumed in this analysis of civil litigation that there is a single offer made by the defendant and it is a restrictive one. It is also assumed that the defendant has no private information about the merits of the case. The defendant may wish to spend resources to obtain information to assess the validity of the lawsuit, for example by paying medical practitioners, so it is assumed that the defendant will estimate his probability of success after optimal investigation, where the injured party cannot communicate the validity of their claim before the trial.

A false claim is more likely to be investigated more intensely by the defendant in an attempt to disprove the claim, before the courts properly weigh the evidence. Thus, a false claim's payoff will theoretically be significantly less than the payoff of a genuine claim, due to the high cost of signaling.

Moreover, both parties realize that the value of having the claim litigated, irrelevant of the truth of the claim, is decreased due to the admission of the alleged defendant's guilt. The value of a frivolous lawsuit is further reduced, as a genuine defendant will put more value into defending the case, no matter the cost, whereas a frivolous plaintiff will attempt to avoid a defendant's statements under oath.

Therefore, a trial is less desirable in the case of a false claim, as the defendant as the receiver of the signal will become better equipped to distinguish the nature of the plaintiff, before the decision to defend the action in court is made. Filing a frivolous claim thus results in a weak case with very low value. In court, if the claim is found to be frivolous, the plaintiff may also be held liable for the costs of such a frivolous suit.

If a plaintiff knows that it is impossible for a defendant to determine the admissibility and relevance of his evidence it will affect the course of the litigation. Many factors come into play such as the relevance and admissibility of the evidence, the judge's inclinations to the admission of certain types of evidence and the credibility of the witnesses. These external factors make it almost impossible for the defense to determine the admissibility and relevance of the evidence before the trial.

Generally, however, defense counsel would rather bear the cost of defending an action with minimal cost than offering a settlement to a party that is not entitled to anything at all. He will argue the admissibility of evidence before the trial, during the discovery process, rather than invest in investigations to determine the admissibility, only to offer a settlement to an unjust party, or accede to a false allegation.

B. *The South African context*

South Africa has recently aligned the Magistrates Court's rules with that of the High Court, as well as extended the jurisdiction of the Magistrate's Court in an attempt to speed up the civil litigation process and relieve the burden on the thirteen High Courts in South Africa [23]. This will benefit potential litigants as the cost of litigation in the Magistrate's Court is drastically lower than in the High Courts. Magistrate's Courts do not have the capacity to develop the law and must simply apply the existing law. When a potential plaintiff is making a decision whether or not to litigate, he needs therefore to consider all the factors and select the right forum, or risk having the matter thrown out.

The hierarchy of South African courts is such that claims can be addressed by the appropriate court. The Magistrate's Courts address claims under R300 000 as their jurisdiction was extended in 2010. The High Court has no upper or lower monetary bound and can address any action, however, if an action is more appropriate for the Magistrate's Court, the matter will be referred there by the High Court and the plaintiff risks having his claim prescribing. This analysis therefore focuses solely on the jurisdiction of the High Court,

¹ In the pleadings stage, the plaintiff furnishes the defendant with a copy of his particulars of claim, which sets out each allegation. The defendant then

makes averments to the allegations and if the plaintiff denies all of the allegations, placing all the facts into dispute, it is referred to as a bare denial.

assuming that litigants are represented, either on a fee basis or on a contingency basis. A plaintiff would not make a substantial investment to retain an attorney on a fee basis for a claim of under R300 000 as there is a risk that the attorney and advocate's costs routinely exceed this value.

The High Court has inherent jurisdiction in that it governs the rules of its own procedure contained in the Rules of Court, which was recently amended to extend the jurisdiction of the Magistrate's Court in order to relieve the burden on the thirteen high courts. This inherent jurisdiction of the court protects the dignity of the courts by allowing them the power to discipline practitioners as well as making any other order that is necessary to further the administration of justice.

C. Practical issues around civil litigation

Chonè and Linnemer [5] investigated the strategic effects of case preparation in litigation. When litigants invest in case preparations with the purpose of improving their position at trial, the informed party, usually the plaintiff, makes the initial decision to invest, and the uninformed party, based on this decision will make a settlement offer. This investment decision is seen as a screening game which leads to either a settlement or a trial, and this investment decision is also seen to have a signaling effect.

A defendant is not able to observe the amount that the plaintiff has invested in his case, but the choice of counsel is a good indicator. This investment involves a sunk cost which will increase the expected value of the trial. In South Africa, it is only plaintiffs with a strong case and the means to invest that approach the larger legal firms, therefore the system has become tailored for plaintiffs with large damages and corporate clients. Thus only plaintiffs with strong cases will invest as in the case of small damages, the costs will often exceed the expected return. This is however only true for the case where information is available to the parties but in reality, the parties have little prior information about the each other's case prior to discovery.

Where plaintiffs with small damages are able to mimic a plaintiff with a more serious case, they will make a larger investment in the hope that the defendant will make a larger settlement offer. However the defendant is often aware of this strategy and the following situations result:

- Plaintiffs with very weak cases will accept all offers and earn an informational rent.
- Plaintiffs with weak cases, who do not invest where information is available, are indifferent to investing where there is limited information. When the defendant has observed that the plaintiff has invested, he makes a settlement offer, which he randomizes between high and low as he is aware that there is an opportunity for a plaintiff to bluff. If the plaintiff does not make an investment, the defendant will make a lower settlement offer.
- Plaintiffs with strong cases, who invest under circumstances where information is available, maintain this decision where information is limited

and only settle when the defendant offers more than the minimum value net of costs that the plaintiff desires.

- Plaintiffs with the strongest cases, who believe that they will earn a greater amount in trial will reject any settlement offer and proceed to trial.
- Where an intermediate plaintiff's investment amounts to a bluff, it could lead to a factitious case going to court. The defendant may make a low offer, which does not even cover the investment made by the plaintiff in preparation and the parties will proceed to trial. A plaintiff, who is certain he will get judgment in his favour will reject offers, and a plaintiff, with a very weak case who does not invest in his case may accept almost any reasonable offer.

Rhee [19] predicts that the probability of trial increases with the strength of the case, however, this model is in direct contrast to Chonè and Linnemer [5] and it is seen that the probability of a trial may decrease with the strength of the case. Chonè and Linnemer [5] explain why the previous logic fails and term this the selection effect. It was originally assumed that the more demanding the plaintiff, the less likely they would be to accept a settlement, but the selection effect states that, the larger the estimated damage, the larger the probability of investment and in turn, the larger the probability of settlement. This is the strategy used by attorneys to reduce the trial costs, and it can even outweigh the socially inefficient increase in the sunk costs of discovery.

When discovery approaches, even the plaintiff who thinks he has a strong case is at a risk, because prior to discovery, they are unaware of the defense. Once the defense is made known, their case may no longer be as strong as was initially assumed. The probability of trial is then driven by two forces, the selection effect and the usual assumption that a plaintiff with a strong case will not be likely to settle.

Discovery is probably the most strategic part of the pre-trial process. It is the second signaling event where information becomes public at a sunk cost. Discovery takes place over an indeterminate time and as time tends to infinity the value of the claim decreases. This allows a recalcitrant defendant to prolong the discovery process as long as possible, so that a lower offer becomes more attractive as the expected value of the plaintiff's claim decreases and the increase cost of counsel erodes the net value. The first signal depends on full or partial discovery as it will reveal the type of plaintiff. In any case discovery is costly and litigants have an incentive to settle before the full discovery costs are sunk.

III. LEGAL APPLICATIONS OF GAME THEORY IN CIVIL LITIGATION

Nash developed a theory to determine the equilibrium solution for a game involving two or more players, in which each player is assumed to have perfect information regarding the equilibrium strategies of the other players, and no player can gain by unilaterally changing his own strategy [15]. That specific set of strategies such that neither player can change his

strategy and affect an increase in his expected value constitutes a so-called Nash equilibrium. It is used to analyse the outcome of interactions where several decision makers are involved, by providing an outcome that depends on the strategies and consequences of their selected strategies. The insight underlying this is that when multiple decision makers are involved, the consequences of their actions cannot be seen in isolation.

Nash also developed a non-cooperative game solution but failed to apply it to strategic behavior [21]. When applied to strategic behaviour, it provides a solution for how individuals conduct themselves when they realise that their acts impact on the decisions of the other players. Game theory formalises this by isolating the players, endowing them with moves, specifying what information is available at each point and assigning payoffs to the player's selected moves. The payoffs are determined by both the player's decision as well as the other player's decision. It is assumed that the structure of the game is common knowledge, that the rules of the game are known, that the strategies are identified and that the players are rational [21].

In the case of legal applications of game theory one can refer to [3][13][14][16][17][18] where a large number of two person games are discussed. It is however a truism that the majority of these game theory discussions relate to the very simplistic Prisoner's Dilemma variant – and that few supply sufficient details around the pay-offs in the games modeled to make them practically important. As a result most of the models that are developed are based on an ordinal preference application of game theory rather than actual pay-offs, a process that we will also be applying.

Fenn and Rickman [7] in a study in the UK using data from medical malpractice and personal injuries claims found that there was a considerable time to settle or go to trial in such cases. This was a specific concern for several reasons:

- It is costly to individuals and society
- Evidence deteriorates and with it, the accuracy of the final judgment
- Parties do not receive timely compensation
- Individuals become deterred from lodging cases
- The law fails to achieve two of its key objectives
 - the deterrence of future offences
 - ensuring that accurate decisions are given

Considering the factors that affect the litigant's settlement decision, Fenn and Rickman [7] test an earlier model, by Spier [22]. Spier adapted previous models in the literature by allowing the pre-trial activity to take place over several periods of bargaining, as opposed to just one period taking into account factors that influence settlement timing. When a defendant expects to invest more in the defense, if the case should go to trial, than the plaintiff expects to receive, there are mutual gains available from settlement. The parties will negotiate over the final distribution; impatience and a desire to avoid future bargaining costs will accelerate the process but asymmetric information will make it more difficult to arrive at

a mutually acceptable settlement.

Spier's contribution was set in a more complicated environment, over several periods in the presence of asymmetric information. The defendant may make any one of a finite set of settlement offers and the plaintiff has private information regarding the extent of the damages suffered. At each period there is an additional cost involved, therefore there is an incentive to settle earlier, but due to the asymmetric information, the defendant cannot compute an offer that would induce settlement and avoid a trial. At every point the defendant gains more information and is able to make an offer that is closer to the plaintiff's acceptable value. If this is done before the case reaches the trial stage, it will settle out of court.

In Spier's model, each offer that the defendant makes is designed to minimise the expected payouts given the number of remaining periods in the process. The defendant will thus prepare a range of settlement offers depending on the signals that he receives; which includes the type of plaintiff. The gains of settlement will be the costs saved in the next period and if such benefits are high, it will benefit the defendant to raise the settlement offer. Higher costs for either party will increase the gain from settlement; therefore it will increase the probability of settlement, which puts a more liable defendant in a weaker position, making it less likely for him to settle. This implies that cases with larger damages naturally will take longer to settle.

Using the data from English health care providers, in relation to the costs, the data was consistent with Spier's theory that more costly cases will settle earlier, however it was found that cases where Legal Aid was involved the hazard became lower for the plaintiff. A plaintiff who is represented by Legal Aid was found to have little monetary interest vested in the matter as there is no financial investment on their part, so they are not cooperative with counsel on the matter of settlement. The more severe the case, the higher the expected value, the longer the case was delayed. Cases where it was thought that it is unlikely for the plaintiff to prevail were often delayed. The settlement delays increase where the plaintiff has the lower cost to bargain, for example where Legal Aid is involved, or when the estimated damages are high. Krauss [13] makes a policy recommendation in the form of case management, suggesting that litigant's positions should be clarified before they decide to litigate. Krauss also concluded that Legal Aid becomes a form of moral hazard assisting a plaintiff in holding out for a settlement for a longer time than would be the case if there was an equal investment required of both litigants.

Krauss [13] used game theory to explain the increase in product liability suits in the USA. He found that when the manufacturer was an out of town defendant, there was a bias in favour of a local plaintiff by the court. From the side of the defendant, the situation presents itself as a variant of the Prisoner's Dilemma being played out at a suboptimal liability. Krauss also illustrates the difficulty of obtaining reliable data on the expansion of liability in the USA as the overwhelming

majority of the cases settle before trial. In the USA, the value of product liability claims is growing exponentially. In Florida smokers received a judgment of \$145 billion in 2010. This trend in product liability litigation has led some American drug companies to stop production of HIV and pregnancy drugs as the estimated costs of defending a lawsuit can outweigh future potential profits Krauss [13]. Another consequence of product liability litigation is higher malpractice insurance leading competent doctors to refrain from certain activities.

IV. THE MODEL

The conceptual model shown in Fig. 1 describes the entire litigation process as it can occur in South Africa. The decision whether to litigate will be analysed using game theory, specifically a signaling game where there are two players (plaintiff and defendant) and nature that determines the initial event that leads to the litigation but is itself not a player was investigated by Torres [24]. As indicated in the figure there is a concave relationship between the value of the claim and the number of claims. As the value of the claim increases, the absolute number of claims tends to zero due to the probability associated with such extremely large damages. However, this number never quite reaches zero as the rise of class action law suits with massive damages proves. The initial event will convert the game of incomplete information to one of imperfect information.

Considering all the probabilities of the decision points in the game, backward induction can be used to determine the initial probability involved in the decision of whether a plaintiff will institute an action. Various factors that influence the decision of a rational plaintiff include

- the probability of success of the case,
- the time cost,
- monetary cost, and the economic cost.

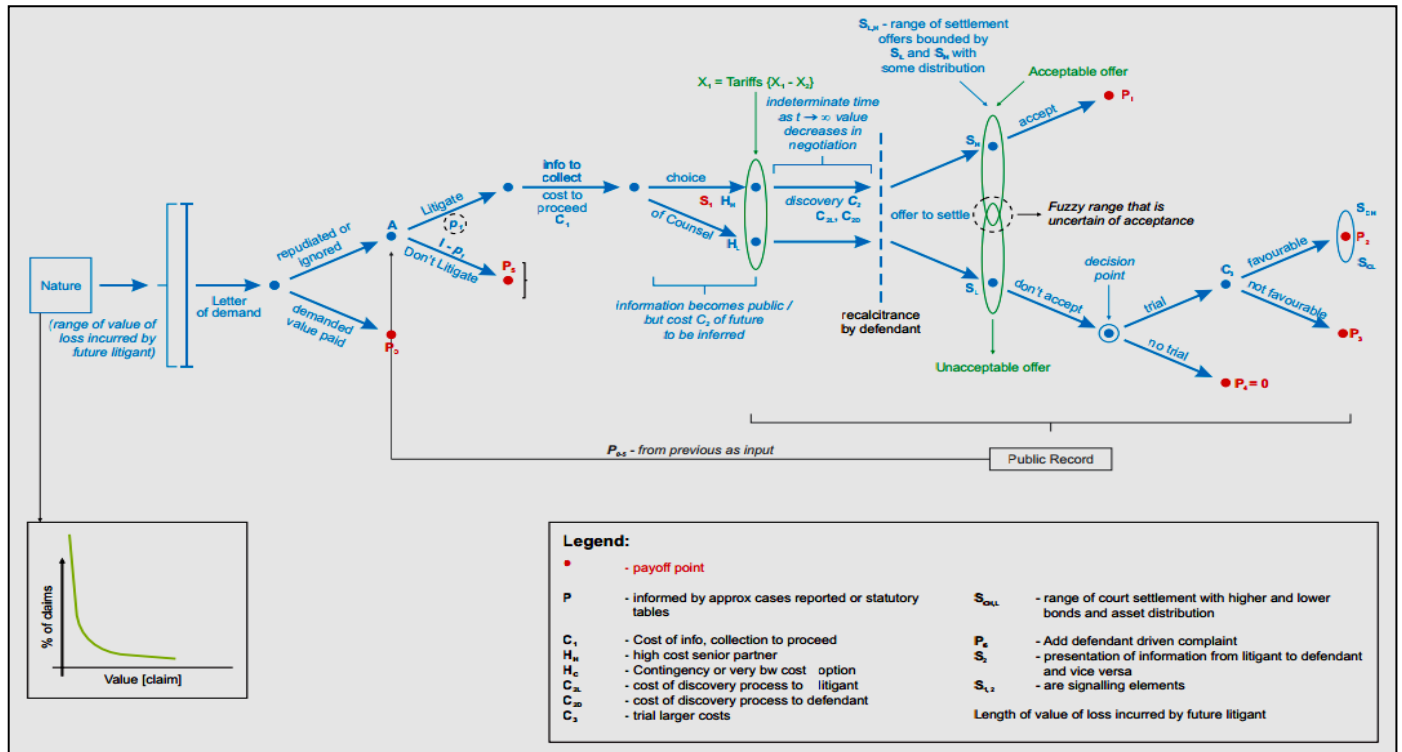
Once the action is instituted, the onus falls onto the defendant to decide whether or not to defend the litigation. The defendant will consider the strength of the plaintiff's case, the strength of his own case as well as the possibility of an apportionment of the damages. Once he has assessed the situation, he can choose between

- defending the matter,
- settling with the plaintiff, or
- letting the court make a summary judgment.

There are a number of factors involved in this decision by the defendant, with each factor affecting the probability of selecting that strategy. If the plaintiff chooses not to litigate, the process stops and this is a terminal node in the game with a payoff of P_6 . If the plaintiff decides to pursue the claim, he will then incur the cost of c_1 to collect information, seek legal counsel, deliver a letter of demand on the defendant and if the defendant does not respond to this demand, he will then issue summons to the defendant.

The plaintiff must then choose between retaining counsel on a fee basis, which is a large investment, or on a contingency

Fig. 1 Conceptual model of the civil litigation process



After an event that has caused damages, the potential plaintiff has a choice whether or not to pursue the claim, some claims are not pursued but he must choose to litigate with a probability of p or not litigate with a probability of $1-p$.

basis, which is a much lower investment. In South Africa, the larger law firms do not take clients on a contingency basis and are also very select about the cases that they pursue, as they

need to ensure client satisfaction so that their fees will be settled. Smaller firms will take clients on a contingency basis where they believe the case can be won or not. Many personal injury claims are pursued on a *no win, no fee* basis.

Using these signals, the defendant makes an offer, and the likelihood of the plaintiff accepting the offer must be determined. This is dependent on the stage in the litigation process, as well as the merits of the claim. If the plaintiff is able to signal how strong his case is, the defendant's offer will be close to an amount that the plaintiff will be willing to settle for. There is no clear answer to when a plaintiff will settle and when they will sue, therefore, they will have certain degree of membership to a specific solution and fuzzy set theory will be needed to analyze the range of possible solutions.

Both types of defendant, the factitious and the genuine, are aware of the constraints of their case, however, these constraints only affect the strategy used to play the game. The genuine plaintiff must send signals and because of his sincerity, he will see to it that he is compensated fully. The factitious plaintiff will only send spurious signals to reduce the cost of signaling in the hopes of a settlement offer. However, if the defendant knows that the plaintiff has no case and still wants to go to trial, he will request the plaintiff to put up security for the costs of the matter. The payoffs may vary because a defendant may or may not be able to distinguish a factitious plaintiff from a genuine one.

Applying this to a signaling game, the cost of signaling increases in both the genuine as well as the frivolous plaintiff's cases, however, the cost to the frivolous plaintiff increases by a greater amount given the poor merits of the case. The overall cost of the trial increases because, the more the defendant discovers the case lacks merits, the more relevant it becomes in proving the defendant's case.

In the conceptual model, the offer to settle appears just before the trial stage, as that is the stage where the defendant has the most information about the plaintiff's case. However, in reality, an offer to settle can be made at any point, and the defendant can make numerous offers to the plaintiff before the trial date. At each stage of the pre-trial process, the costs to each party will increase, and therefore, as each stage passes, the plaintiff will increase the amount at which he will be willing to settle.

In the model the confidence that a party vests in their case is a signal of the merits of their case. According to de la Rosa [6], an overconfident agent can overestimate the probability of success and thus in our model this would result in an overestimate of the offer – but this affects both the plaintiff and the defendant.

Asymmetric information affects all the signals in the game. A plaintiff with low damages may mimic a plaintiff with higher damages in the hope of a higher settlement. This incentive is often known by a defendant. If a plaintiff has a strong case, he will invest in the trial preparation regardless of the asymmetry. The difference is clearer when the plaintiff's case is weak, where the information is asymmetric, the plaintiff

becomes indifferent, as he knows, and if he invests the settlement will be higher than if he does not. If the case is strong, the plaintiff will not settle and if it is weak, the plaintiff accepts the settlement as “informational rent”.

A factitious player will open with a chance move in accordance with a probability distribution that is common knowledge. Nature will also randomly choose the type of player. The defendant as the second mover must now decide if the plaintiff has some sort of hidden agenda that will affect the settlement offer. The defendant can look at past behaviours of the type of plaintiff:

- Previous opportunistic behaviours from that party
- Whether the party is a firm or an individual
- The investment that the party has made in the case

From that information, he can choose a probability based on the percentage of interest of the party. For example in a specific type of claim where a person slips and falls in a shopping centre, the defendant is unsure of the true nature of the plaintiff's injuries. He may decide that 40% of those claims are genuine and the rest are opportunistic. Once he has decided on the probability of the type of plaintiff, he will either invest and increase the settlement offer, or make a low offer and wait.

The plaintiff also has perfect knowledge of his claim; however, the defendant only knows the probabilities of the damage the plaintiff suffered. The plaintiff sends certain signals, in his documentation, the nature of the plaintiff as well as the law firm that the plaintiff selects. The defendant, who has to make a decision about the merits of the plaintiff's case, then interprets these signals. If the defendant has a good knowledge of the plaintiff's case and the merits are strong, it will benefit him to settle the matter, as the longer he progresses, the more costly it becomes. Once the defendant has made an offer based on the signals, the plaintiff must decide whether or not to accept it.

The game will be constructed, starting from a simple perfect information game, to a more complex, more realistic imperfect information signaling game. An example of a situation will be constructed where one party, the plaintiff will institute an action against the defendant. There is no question regarding liability on the part of the injurer, nor is there a question regarding the physical damages suffered, however, the injured party is claiming compensation beyond the costs of the physical injuries to compensate her for her pain and suffering.

After constructing a game tree, it is possible to see how the players will combine their different actions into specific strategies. Then, in order to get the solution of the game, it must be converted into the game theoretic matrix form.

There are three methods commonly used to isolate a single solution to a perfect information game. Firstly, rational moves with strictly dominant strategies, where the rational strategy of the players will eliminate irrational strategies automatically. Secondly, [21] define a Nash equilibrium as a strategy profile with the property that given the strategies of all other players, no player can do strictly better by unilaterally choosing a different strategy than he has. Thus the strategy chosen

becomes the best response to the strategies of others. If there was no Nash equilibrium, one player could unilaterally do better by altering his move. Finally, incredible threats and sub-game perfection must be considered. Harsanyi and Selten [10] refined Nash's theory, where each player's conduct forms a Nash equilibrium, not only for the whole game, but for each sub-game too, this rules out games that rest on incredible threats – such conduct is not rational and therefore it is not considered a threat. This eliminates implausible elements from a set of equilibria.

When imperfect information is introduced into the game, it limits the sub-game perfection. Imperfect information is a situation where at least one player must make at least one move without having observed what some other player has done. This takes place where there is an offer made by the defendant that has some level of uncertainty. This produces new Nash equilibria which cannot be excluded using perfect sub-game equilibrium. Therefore, there is no prediction for the choice if a partial offer is made. This results in a game with multiple equilibria, where none of them are inherently implausible or superior to any other.

In the imperfect information game, regardless of which partial offer is made, the plaintiff will still always do better to settle, so she will act rationally when she receives a partial offer. The refinement of this type of game uses a Bayesian equilibrium which will rule out solutions involving irrational conduct by the plaintiff at the partial information set and will produce a unique solution to the game. In a Bayesian equilibrium, nature is introduced as a player that assigns variables and probabilities to the players, depending on the player's type. This allows for incomplete information to become imperfect information. The type of player determines their player's payoff function, and in a Bayesian game, the incompleteness of the information means that at least one player is unsure of the other's type. Applying this to the offer and settlement game, the nature of the parties will affect the payoffs and the probabilities of the game and can be inferred from the types of signals that they send.

V. CONCLUSION

If a dispute or interpretive question arises, a plaintiff has a choice whether or not to litigate. This choice involves the weighing up of factors such as the nature of the parties involved and the amount in dispute. When a prospective plaintiff takes into account all the costs involved, he often chooses to take a loss and is left in an undesirable situation where there has been an inequitable distribution of income. All people have a right to a fair trial, but in South Africa there is no standard set for a fair trial, which results in frivolous lawsuits and inequitable income distributions.

Research has determined the efficiency of specific laws as well as legal systems as a whole, but not the efficiency of the civil litigation process as a remedy. Taking the entire civil litigation process in the presented model into account it is clear that modeling the parties' strategies surrounding the offer to

settle are central to the question of whether the civil litigation process is efficient.

Future work will involve collecting survey data with which to calibrate parts of the model so that numerical predictions can be made that are essential to understanding the efficiency of the litigation process.

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