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Damage averaging and the formation of class action suits

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Abstract

Within a class action suit, similarly injured individuals can collectively obtain compensation through the justice system. Damage averaging occurs when the compensation awarded by the court to individual members is partly or completely determined by the average damage of the class. The key role of damage averaging in influencing the identity of the individual that will initiate the class action suit is illustrated in a waiting game. If there is complete averaging, the individual with the lowest damage will initiate the class action suit, while if there is less damage averaging, other individuals may do so.

1. Introduction

Within a class action suit, similarly injured individuals can collectively obtain compensation through the justice system. Class action suits are nowadays very prevalent and can be of many types.[1] The story behind a class action suit usually resembles the following. First, some individual (hereafter the defendant) undertakes or neglects to undertake an activity so that

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[1] In the United States, class action suits are governed by Rule 23 of the *Federal Rules of Civil Procedure*. Between 1973 and 1994, 34,925 Federal court class actions were filed (see Table 1 of *Class Action Reports*, 1994, "1994 Federal Court Class Action Statistics," 17, 455–465). In 1994, 991 class actions were filed representing 0.4% of all Federal civil actions (*Class Action Reports*, 1994, Tables 2 and 3). Between 1973 and 1994, the class actions filed were of the following types: Securities (11.8%), Antitrust (5.2%), Civil Rights (44.6%), Labor (5.5%), Tort (7.0%), Contract (5.6%), Prisoner (9.8%), and Others (10.5%) (*Class Action Reports*, 1994, Table 1).

damages are caused to many individuals (hereafter the plaintiffs). One of the injured individuals, the representative plaintiff, decides to initiate a class action suit. If the court decides to maintain the class action suit,[2] then all the individuals that have suffered a damage are considered members of the class. However, a limited period of time is given during which any individual has the opportunity to opt out of the class and to sue individually. After this period of time, the class action suit makes its way to the court if no pretrial settlement takes place, and compensation is eventually awarded to the plaintiffs if the defendant is found guilty.

This paper is interested in explaining the formation of a class action suit. The problem is interesting because the individual that initiates the class action suit, the representative plaintiff, incurs a cost (usually in time, but sometimes in money as well) that is not borne by the other members of the suit. The formation of a class action suit is therefore formulated as a waiting game, i.e. as a war of attrition. It is argued that class action suits are basically a public good provided by only one individual. Since everyone benefits from the provision of the good, but that there is a cost to being the initiator, everyone has an incentive to "free ride" and wait for someone else to step forward. However, since waiting is also costly, someone will eventually stop waiting and volunteer to provide the good. The analysis identifies the characteristics of the individual who will step forward.

Class action suits have a key feature that will be examined closely in this paper: damage averaging. Damage averaging designates the compensation of individuals partly or completely according to the average claim of the class, rather than uniquely according to their own claim. This is most likely to occur when members of the class are difficult to identify and/or when it is costly for each member to make his claim separately. Coffee[3] reports that damage averaging has been used in recent antitrust and employment discrimination cases. Damage averaging is also related to the notion of *fluid class recoveries*, i.e. systems meant to ease the compensation of individuals. Many fluid class recovery mechanisms have now been used to replace or supplement individual claims procedures because these tend to be too costly or simply impracticable. Durand provides a discussion of the many mechanisms now used.[4] She distinguishes between non-price (direct rebate, claimant fund-sharing, trust fund, distribution to the government) and price mechanisms. All those mechanisms entail at least some degree of damage averaging. The analysis will explicitly incorporate damage averaging and show how it can affect the formation of a class action suit.[5]

2. The model

Suppose the actions of an economic agent have adversely affected a large group of N individuals. Let θ denote the damage suffered by a particular individual and suppose

[2] Very specific conditions have to be met for a class action suit to be maintained. In the United states, the class action suit has to satisfy the (necessary, non-sufficient) prerequisites of section (a) of Rule 23.

[3] Coffee, J. C., Jr. (1987). The regulation of entrepreneurial litigation: Balancing fairness and efficiency in the large class action. *University of Chicago Law Review*, *54*, 877–937.

[4] Durand, A. L. (1981). An economic analysis of fluid class recovery mechanisms. *Stanford Law Review*, *34*, 173–201.

[5] Note that the extent of damage averaging also affects the net benefit of remaining a member of the class and will therefore influence the opt out decision.

damages are distributed amongst members of the group according to a cumulative distribution J on support $[\theta^{\ell}, \theta^{h}]$ with a mean $\bar{\theta}$. Consider the compensation awarded by the court to an individual who has suffered damage θ. Suppose that the defendant is found guilty in all cases.[6] If individual θ obtains compensation through an individual suit, the court awards him θ in compensation. But the plaintiff also has to pay K in litigation costs[7] so that his net compensation is $\theta - K$. For the moment, we assume that $\theta^{\ell} > K$, meaning that the lowest damage plaintiff would find it profitable to sue individually. We later relax this assumption, as some could argue that part of the rationale for allowing class action suits is that some individuals suffering small damages would otherwise never obtain compensation through the justice system. In the case of an individual suit, the court is able to pin down the exact θ of a particular individual. Now suppose that individual θ obtains compensation through a class action suit. In this case, this individual gets a payoff of $\gamma\theta + (1-\gamma)\bar{\theta} - k$. Here, the court gathers enough information on a plaintiff of type θ to determine that the payment from the defendant to the plaintiff should be $\gamma\theta + (1-\gamma)\bar{\theta}$, where $0 \leq \gamma \leq 1$. Thus, the payment to individual θ is a linear combination of his own damage θ and of the average damage of the class $\bar{\theta}$.[8] We will refer to γ as the averaging parameter, complete averaging taking place when $\gamma = 0$.[9] To obtain the net payoff of an individual, litigation costs also have to be subtracted in the case of a class action suit. The per member litigation costs are denoted by k and it is assumed that $k \leq K$. Hence, the per member litigation costs in a class action suits are less than those in an individual suit.

As was already mentioned, forming a class action suit is far from automatic. For the individual who decides to initiate it and to go through the legal procedures, there is a cost to be borne. Even if the class action suit ultimately wins in court, the individual that originally started it usually spends a lot of time (maybe some money) on the case, thereby incurring a cost that no other individual in the class has to pay. Why would anyone ever be interested in initiating a class action suit? Clearly, everyone could have an incentive to free ride: it is better to join an already formed class action suit than to initiate it. In other words, a class action suit is, to some extent, a public good: it is non-rival,[10] and, as usual in most jurisdictions in the US and Canada, it is non-excludable.[11]

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[6] This assumption could be relaxed without consequences.

[7] It would be possible to make litigation costs a function of the compensation awarded by the court. Also note that concerning the payment of those litigation costs, the American rule is assumed rather than the British one. Hence, each party pays its litigation costs; the losing party is not responsible for the litigation costs of the wining party.

[8] Thinking in terms of a group of individuals who have purchased a good from a manufacturer which eventually caused damages, note that our analysis implicitly assumes that all individuals have purchased the same number of units of the good, and that the court cannot easily identify the damage per unit suffered by a particular individual. It is not clear that our results will obtain if different individuals can purchase different number of units, unless the court also has problems finding out the number of units purchased by a particular individual.

[9] This corresponds to the case where information on a particular plaintiff is very difficult and/or very costly to obtain.

[10] That is, if individual i joins the class action suit, he does not make it impossible for j to do the same.

[11] An individual (or a group of individuals) in the class cannot decide that individual j cannot join the class action suit.

Public goods that are supplied by only one individual were first studied by Bliss and Nalebuff.[12] They modeled this situation as a waiting game, i.e. a war of attrition. Put simply, every one would benefit from the provision of the good but, because of the cost of being the initiator, everyone has an incentive not to provide it and to wait for someone else to step forward. However, if waiting also has a cost, someone will eventually stop waiting and volunteer to provide the good. Since a class action suit is a public good provided by only one individual,[13] it seems natural to model its formation as a waiting game.

While we think it is useful and natural to envision the formation of a class action suit as a waiting game, we nevertheless recognize that this view is not completely satisfactory. Indeed, two legitimate objections can be raised against it. First, it may be argued that even if they appear to have been initiated by some individual who was harmed, a large fraction of class action suits are actually initiated by plaintiff's attorneys who have identified a particular individual with some desirable characteristics, and are largely in control of the situation.[14] The large fees law firms can expect from class action suit litigation clearly gives them the incentive to hunt for potential clients. Our model ignores this phenomenon. However, this phenomenon may well become less important with the recent introduction of the *Class Action Fairness Act 2001* (in the process of being adopted by the United States Congress) which explicitly attempts to limit the fees of class attorneys. Note that even if it does not take into account the incentives of plaintiff's attorneys—a completely different model would be required for that, our analysis actually identifies the individual for which initiating the class action suit is the least costly. We could then argue that this same individual is the one which plaintiff's attorneys, in the process of identifying the 'best' representative plaintiff, would find the easiest to convince. The second objection against our view is that there are cases in which the plaintiff representative is awarded extra compensation by the court so that he may bear no cost when initiating a class action suit. Again, our analysis does not take this possibility into account. However, the *Class Action Fairness Act 2001* is also an attempt to reduce the size of extra compensation. It is probably correct to say that under the new legislation, representative plaintiffs should expect to receive compensation for their time and legitimate expenditures, but nothing more. Then, since there always is a probability of losing in court, the cost for the representative plaintiff of initiating a class action suit would be the risk of losing in court and not being compensated.

So accepting the view that the formation of a class action suit is a waiting game, we now introduce time in the model.[15] At time $t = 0$, the defendant causes the damages to the N individuals. The damages of everyone are common knowledge, i.e. there is no private information. During this period $t = 0$, each of the N individuals can choose to register an individual suit at no cost. We assume that individual suits can only be filed at $t = 0$. Denote by n the number of individual suits filed, $n \leq N$. Still, during this same period, a class

[12] Bliss, C., & Nalebuff, B. (1984). Dragon-slaying and ballroom dancing: The private supply of public good. *Journal of Public Economics*, *25*, 1–12. For recent developments in this literature, see Bilodeau, M., & Slivinski, A. (1996). Toilet cleaning and department chairing: Volunteering a public service. *Journal of Public Economics*, *59*, 299–308.

[13] Or provided by a small number of individuals. In what follows, we ignore this possibility.

[14] On the relationship between plaintiffs and attorneys in class action suits, see Rhode, D. L. (1982). Class conflicts in class actions. *Stanford Law Review*, *34*, 1183–1262.

[15] Note that the model assumes away pretrial settlements.

action could be formed. When a class action suit is formed, all those who suffered a damage are assumed to be a member of it, whether they filed individually or not. Individuals may however opt out, but only at the time the class action suit is being formed (same period t). If a class action is formed at time t, it is heard in court at time $t+1$. We also assume that all those who decided to opt out have their individual suit heard at the same time. Therefore, if a class action suit is formed at time t, the game ends at $t+1$ for everyone.[16] But if a class action is not formed in $t = 0$, period $t = 1$ starts with λ individual suits heard in court, with $0 < \lambda < N$.[17] For the λ individual plaintiffs that have their case heard, the game finishes and they are not to be involved in any future class action suit. But for the remaining plaintiffs, once they know their individual case will not be heard in $t = 1$, they have the possibility of forming a class action suit. Period $t = 2$ and all the following periods starts exactly as period $t = 1$ started if a class action has not been formed in $t = 1$ or in the preceding period. Hence, among the remaining individual suits, λ suits are heard in court. The remaining individuals have the possibility of initiating a class action suit. If a class action suit is never formed, the game eventually ends at time $t = n/\lambda$.[18] We assume that all individual plaintiffs have the same discount factor δ, $0 < \delta \leq 1$. We also assume that any individual initiating a class action suit has to incur a cost $c > 0$ in the period it is formed.

Note that because individuals are impatient ($\delta < 1$), the cost for a plaintiff of not initiating a class action suit is that it could take a number of periods before his individual suit is heard in court. By forming a class action suit, this plaintiff has the certainty of having his case heard next period. Solving this game and taking into consideration this cost will allow for the identification of the individual that will initiate the class action suit. Because this game is dynamic and that there is complete information, the equilibrium concept used is that of Subgame Perfect Equilibrium.

3. Equilibrium

At this stage, it is necessary to establish the possible payoffs for the plaintiffs. First, consider the decision of an individual to file individually at $t = 0$. For now, because $\theta^{\ell} > K$, it is clear that all individuals will file an individual suit, which implies that $n = N$.

Consider now the payoff for an individual of type θ if a class action suit is never formed. We denote this payoff by $S(\theta)$. For a plaintiff, given that λ cases are heard per period, the probability that his case will be heard in court at time t is λ/N.[19] Therefore, at time $t = 0$,

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[16] Thus, it is assumed that the formation of a class action suit accelerates the rate at which *all* suits are resolved. This is not to say that class action suits are resolved at a faster rate than individual suits, but rather that they reduce the level of congestion in the judiciary system. This assumption is more satisfactory for mass tort cases in which thousands, sometimes millions, of individuals are involved.

[17] We assume that $0 < \lambda < N$ to ensure that an individual plaintiff may have to wait a number of periods to have his case heard in court.

[18] The last λ individual suits are heard at that time. Note that we here treat time as a continuous variable and assume away any of the integer problems that could arise.

[19] The probability of not having been heard in court when period t starts is $(1 - (t-1)(\lambda/N))$. Also, given he has not been heard yet when t starts, an individual has a probability $\lambda/[N - (t-1)\lambda]$ of being heard in t. Thus, the non-conditional probability of being heard in t is λ/N.

his expected payoff is

$$S(\theta) = \sum_{\ell=1}^{N/\lambda} \delta^{\ell} \frac{\lambda}{N}(\theta - K), \tag{1}$$

where the plaintiff obtains $(\theta - K)$ when his individual suit is heard in court.

Now consider the expected payoff, at time $t = 0$, of an individual of type θ if he always waits and another individual initiates a class action suit at time t. Denote this payoff by $F(\theta, t)$. To compute this payoff, we need to determine which individuals will choose to opt out of a class action suit formed at time t. Denote by $\hat{\theta}$, the cut-off damage under which individuals opt out of the class action suit, and over which individuals stay in it. If, at time t, an individual decides to stay in the class action suit, his discounted payoff (from a time t point of view) is $\delta[\gamma\theta + (1-\gamma)\bar{\theta} - k]$, while if he rather decides to opt out, his discounted payoff is $\delta[\theta - K]$. Equating those two payoffs yield $\hat{\theta} = \bar{\theta} + [(K-k)/(1-\gamma)]$, which is time invariant. Note that without damage averaging ($\gamma = 1$), no one opts out as $\hat{\theta} \to \infty$, and that with full damage averaging ($\gamma = 0$), all individuals with $\theta \geq \bar{\theta} + (K - k)$ opt out. Given this, $F(\theta, t)$ for an individual with $\theta < \hat{\theta}$ is given by

$$F(\theta, t) = \sum_{\ell=1}^{t} \delta^{\ell} \frac{\lambda}{N}(\theta - K) + \delta^{t+1}\left(1 - t\frac{\lambda}{N}\right)[\gamma\theta + (1-\gamma)\bar{\theta} - k]. \tag{2}$$

Note that from a $t = 0$ point of view, the first term of the expression represents the expected payoff of being heard in court before the class action is formed at time t, while the second term is the payoff of the individual if he makes it to time $t+1$. We assume that an individual initiating a class action suit cannot opt out of it. This implies that none of those with $\theta \geq \hat{\theta}$ will initiate the class action suit, so we need not consider their payoffs.

Finally, at time $t = 0$, the expected payoff of an individual who plans to wait until t and to initiate a class action suit at that time is denoted by $L(\theta, t)$. For an individual with $\theta < \hat{\theta}$, it is given by

$$L(\theta, t) = \sum_{\ell=1}^{t} \delta^{\ell} \frac{\lambda}{N}(\theta - K) + \left(1 - t\frac{\lambda}{N}\right)[\delta^{t+1}[\gamma\theta + (1-\gamma)\bar{\theta} - k] - \delta^{t} c], \tag{3}$$

where it is implicitly assumed that an individual planning to initiate the class action suit at time t is not sure to make it to that time. In fact, there is only a probability $(1 - t(\lambda/N))$ he will have to incur the cost c at time t. Rearranging the expression for $L(\theta, t)$ yields:

$$L(\theta, t) = F(\theta, t) - \left(1 - t\frac{\lambda}{N}\right)\delta^{t} c. \tag{4}$$

These payoffs, depending on the parameter values, can take various forms. However, they will take a very precise form if they satisfy the following five conditions for any $\theta < \hat{\theta}$:[20]

(i) $F(\theta, t) \geq F(\theta, \tau) \quad \forall \tau > t,$

[20] The following condition is also necessary: $L(\theta, t)$ is invariant to the fact that others decide to form a class action suit at time t. We assume it is satisfied. In other words, an individual initiating a class action at time t has to incur c even if another individual is also initiating one at the same time.

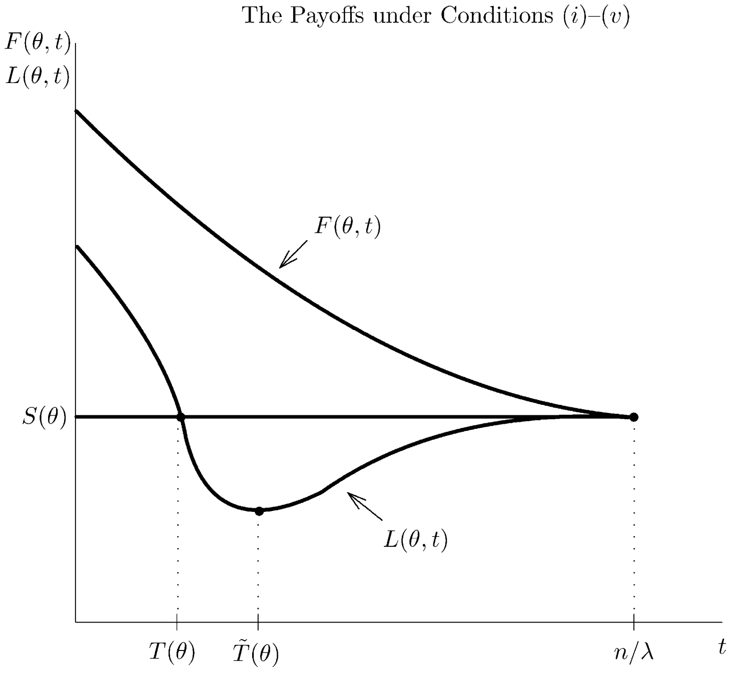

Figure 1. The payoffs under conditions (i)–(v).

(ii) $L(\theta, 0) > S(\theta)$,
(iii) $F(\theta, t+1) > L(\theta, t), \quad \forall t$,
(iv) $\exists T(\theta) | L(\theta, t) > S(\theta) \quad \text{if } t < T(\theta), \quad \text{and} \quad L(\theta, t) < S(\theta) \quad \text{if } t > T(\theta)$,
(v) $\exists \tilde{T}(\theta) | \partial L(\theta, t)/\partial t < 0 \quad \text{if } t < \tilde{T}(\theta), \quad \text{and} \quad \partial L(\theta, t)/\partial t \geq 0 \quad \text{if } t > \tilde{T}(\theta)$.

As is discussed in Fudenberg and Tirole,[21] if the payoffs satisfy these conditions, the game is a *non-stationary war of attrition with eventual continuation* and it has a unique Subgame Perfect Equilibrium. However, before turning to the description of the equilibrium, we first briefly discuss each condition.

Condition (i) says that for any plaintiff, the earlier another player decides to form a class action suit, the better. Condition (ii) states that initiating a class action suit at the very beginning is better than waiting forever if no class action suit is ever formed. Condition (iii) can be interpreted as saying that any plaintiff prefers to wait an extra period to join an already formed class action suit to the possibility of initiating it himself right away. Finally, conditions (iv) and (v) state that the payoff of a plaintiff initiating a class action suit at time t is U-shaped as in Fig. 1.

[21] Fudenberg, D., & Tirole, J. (1991). *Game theory* (pp. 119–126). Cambridge: MIT Press. Note that our five conditions must be re-written to obtain those listed in Fudenberg and Tirole.

Hence, there is a time $T(\theta)$ such that, for any individual $\theta \leq \hat{\theta}$, it is better to never initiate a class action suit for $t > T(\theta)$. This time $T(\theta)$ is implicitly defined by $L(\theta, T) = S(\theta)$.[22] Also note that $\tilde{T}(\theta)$ corresponds to the minimum of $L(\theta, t)$.

While there is no guarantee that these conditions will always be satisfied, it is certainly possible that they will be; in the numerical example below, the payoffs satisfy all the conditions. For now, suppose that the conditions are all satisfied. Then, as is implicit from above, the time T such that it becomes certain that an individual will never initiate a class action suit is a function of θ. Following Fudenberg and Tirole (1991), it is possible to show the following:[23]

Proposition 1. *If the payoffs $S(\theta)$, $F(\theta, t)$, and $L(\theta, t)$ satisfy* conditions (i)–(v), *then the unique Subgame Perfect Equilibrium of the game is that plaintiff $\breve{\theta}$ initiates the class action at time $t = 0$. Plaintiff $\breve{\theta}$, the representative plaintiff, is the one with the largest T: $\breve{\theta} =$* $\arg\max_{\theta \in [\theta^{\ell}, \hat{\theta}]} T(\theta)$.

Of course, in this equilibrium, plaintiff $\breve{\theta}$ obtains $L(\breve{\theta}, 0)$ while any other plaintiff gets $F(\theta, 0)$. The intuition behind Proposition 1 is that for individual $\breve{\theta}$, there is a time $\hat{t}$ ahead such that $T(\theta) < \hat{t} < T(\breve{\theta})$, $\forall \theta \neq \breve{\theta}$. In other words, there is a time such that he will be the only one who could still possibly find it in his interest to initiate the class action suit. At such a time, since he is by himself, there is no reason to wait. Therefore, since $L(\breve{\theta}, \hat{t}) > S(\breve{\theta})$, it is optimal for plaintiff $\breve{\theta}$ to initiate a class action suit in $\hat{t}$. Consider now time $\hat{t} - 1$. At that time, since $F(\theta, \hat{t}) > L(\theta, \hat{t} - 1)$ for any θ, no plaintiff $\theta \neq \breve{\theta}$ will initiate the class action suit because they can do better by waiting to next period (in which plaintiff $\breve{\theta}$ will initiate a class action suit). As to plaintiff $\breve{\theta}$, he might as well initiate the class action suit in $\hat{t} - 1$ since $L(\breve{\theta}, \hat{t} - 1) > L(\breve{\theta}, \hat{t})$. Thus, if a class action suit has not been formed in $\hat{t} - 1$, plaintiff $\breve{\theta}$ initiates a class action at that time. The same reasoning applies for period $\hat{t} - 2$, $\hat{t} - 3$, and so on. Thus, individual $\breve{\theta}$ might as well initiate the class action suit in $t = 0$.

4. Damage averaging and the representative plaintiff

Having determined that the individual with the largest T among the individual with $\theta \leq \hat{\theta}$ will be the representative plaintiff, it is now of interest to see if we can establish who that person will be. Thus, consider now the function $T(\theta)$ which is implicitly defined by $L(\theta, T) = S(\theta)$. Differentiating this last expression yields:

$$\frac{dT}{d\theta} = \frac{\partial S(\theta)/\partial\theta - \partial L(\theta, T)/\partial\theta}{\partial L(\theta, T)/\partial t} \gtrless 0. \tag{5}$$

Note that by assumption, the denominator is negative (see $L(\theta, t)$ where it crosses $S(\theta)$ in Fig. 1). Thus, the sign of the expression will be the opposite of that of the numerator. Using

[22] This is because, as stated in condition (iv), for any time $t > T(\theta)$, $S(\theta) > L(\theta, T)$.

[23] The proof can be found in Fudenberg and Tirole, *supra* note 21, p.124. See also Fudenberg, D., Gilbert, R., Stiglitz, J., & Tirole, J. (1983). Preemption, leapfrogging and competition in patent races. *European Economic Review*, *22*, 3–31.

Eqs. (1) and (3), it is possible to obtain:

$$\frac{\partial S(\theta)}{\partial \theta} - \frac{\partial L(\theta, T)}{\partial \theta} = \sum_{\ell=T+1}^{N/\lambda} \delta^{\ell} \frac{\lambda}{N} - \delta^{T+1}\left(1 - T\frac{\lambda}{N}\right)\gamma \gtrless 0. \tag{6}$$

Damage averaging turns out to be important here. First, consider the case with complete damage averaging ($\gamma = 0$). In this case, Eq. (6) becomes unambiguously positive. Hence, if $\gamma = 0$, $\mathrm{d}T/\mathrm{d}\theta < 0$. This means that the individual with the lowest damage (θ^{ℓ}) initiates the class action suit in $t = 0$. This makes sense since under complete damage averaging, the individual that has the most to gain from a class action suit is the one with the lowest damage. Note that for that case, those with $\theta \geq \hat{\theta} = \bar{\theta} + (K - k)$ opt out of the class action suit when it is formed by the individual with the lowest damage at $t = 0$. Of course, it is not necessarily the case that $\hat{\theta} < \theta^{h}$, so there may be no opt out.

But consider now what happens if there is no damage averaging. First note that $\lim_{\gamma \to 1} \hat{\theta} = \infty$. Therefore, no one opts out in this case. Rearranging Eq. (6) with $\gamma = 1$ yields:

$$\frac{\partial S(\theta)}{\partial \theta} - \frac{\partial L(\theta, T)}{\partial \theta} = \sum_{\ell=T+2}^{N/\lambda} \delta^{\ell} \frac{\lambda}{N} - \delta^{T+1}\left(1 - (T+1)\frac{\lambda}{N}\right) \gtrless 0. \tag{7}$$

Note that if $N/\lambda \leq T(\theta) + 1$ for some θ, then there is a group of players for which conditions (i)–(v) are not satisfied. We cannot solve this problem as a non-stationary war of attrition so we assume away this possibility.

Imposing that conditions (i)–(v) be satisfied for all players implies that $N/\lambda > T(\theta) + 1$ for all θ. Eq. (7) is then either positive or negative. So we are not able to say which of the highest damage or lowest damage individual will initiate the class action suit. To summarize, when $\gamma = 1$, there is no opt out and $T(\theta)$ may be increasing or decreasing. This means that either the individual with the lowest damage (θ^{ℓ}) or the one with the highest damage (θ^{h}) will be the representative plaintiff and initiate the class action suit in $t = 0$.

Generally, there might be some level of damage averaging such that $T(\theta)$ is increasing and for which there is some opt out. In this case, the class action suit will be initiated by the individual which will turn out to have suffered the highest damage within the class. The above discussion can be summarized in the following proposition.

Proposition 2. (*a*) *There is always some level of damage averaging* γ (*e.g.* $\gamma = 0$) *for which* $T(\theta)$ *is decreasing. For such* γ, *the representative plaintiff is the individual with the lowest damage*. (*b*) *Some level of damage averaging* γ *may exist for which* $T(\theta)$ *is increasing. In this case, the class action suit is initiated by the individual with the highest damage in the class to be formed.*

The following numerical example demonstrates the importance of damage averaging in determining the individual who will initiate the class action suit. Suppose that 10,000 individuals have been harmed (and have registered their individual suit in $t = 0$) and let the damages θ be distributed on [11.95, 12.05] with a mean $\bar{\theta} = 12$.[24] Assume that the judicial

[24] The distribution need not be uniform.

system can hear 100 cases per period ($\lambda = 100$), so that it would take 100 periods to hear all the 10,000 plaintiffs. Suppose that in the case of an individual suit, the litigation costs are $K = 10$ while for a class action suit, they are $k = 1$. Also assume that the individual initiating the class action suit has to incur a cost $c = 10$. Finally, suppose that every plaintiff has a discount factor $\delta = 0.95$. Note that for any degree of averaging γ, the payoffs of any individual θ have the shape of those depicted in Fig. 1.[25]

First, consider the case with complete averaging ($\gamma = 0$). Note that because of the large difference in litigation costs, no one opts out, even under complete averaging. For $\theta = 11.95$, it can be shown that $L(11.95, 18) > S(11.95) > L(11.95, 19)$. Hence, for this individual, we have $T(11.95) = 18$.[26] As for the individual with $\theta = 12.05$, we note that $L(12.05, 14) > S(12.05) > L(12.05, 15)$ implying that $T(12.05) = 14$. Hence, in this case, T is non-increasing in θ. Consequently, the individual with damages $\theta = 11.95$ will initiate the class action suit in $t = 0$.[27]

Now consider the case of no averaging ($\gamma = 1$). For $\theta = 11.95$, $L(11.95, 8) > S(11.95) > L(11.95, 9)$ so $T(11.95) = 8$. For $\theta = 12.05$, it is possible to show that $L(12.05, 23) > S(12.05) > L(12.05, 24)$, implying that $T(12.05) = 23$. Hence, in this case, T is non-decreasing in θ. Consequently, individual $\theta = 12.05$ will initiate the class action suit in $t = 0$.

Thus, in this example, the identity of the representative plaintiff varies with the extent of damage averaging.

5. Small damages

In the previous sections, it was assumed that $\theta^\ell \geq K$, so that all individuals had an incentive to file an individual suit. But it may be argued that the rationale for allowing class action suits is to make it possible for relatively small claims to be heard in court. We therefore relax our initial assumption and investigate the case in which $k < \theta^\ell < K$.[28]

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[25] It is easy to find parameters for which the payoffs have the shape of those depicted in Fig. 1. Unfortunately, it is also easy to find alternative sets of parameters for which it is not the case. We view the case we are studying as one among many which are possible and reasonable. Clearly, alternative models will be required to study the other cases, that will lead to possibly very different results.

[26] This is because time is not continuous in this example. Therefore, $T(\theta)$ is defined by $L(\theta, T) \geq S(\theta) > L(\theta, T + 1)$. If time were continuous, it would be possible to use $L(\theta, T) = S(\theta)$.

[27] As to the plaintiffs with $\theta \in]11.95, 12.05[$, they have intermediate values of T. In the current example, clearly, $T(\theta) \in \{14, 15, 16, 17, 18\}$ so that there are many individuals with the same T. If the distribution of θ is uniform on its support $[11.95, 12.05]$, then there is a lower range of the support for which all the plaintiffs have $T = 18$, an intermediate range for which $T = 17$, another intermediate range for which $T = 16$, and so on. The prediction of the model in that case is not clear because there are many individuals with $T = 18$. However, let θ be distributed as follows: 1 individual with $\theta = 11.95$ (or with θ in the lower range of the support), and the rest of the plaintiffs with θ in the other intermediate or upper ranges of the support (provided the mean is still $\bar{\theta} = 12$). Then, without ambiguity, the model predicts that the individual with $\theta = 11.95$ will initiate the class action suit in $t = 0$. Note that the distribution of the damages is here important because time is discrete. If time were continuous, $T(\theta)$ would be different for all plaintiffs so this problem would vanish.

[28] We assume that $\theta^\ell > k$ because if it was not the case, all those with a damage lower than k would not file an individual suit, would not initiate a class action suit, and would opt out of any class action suit. They would simply be irrelevant.

For all those individuals with $\theta > K$, nothing is changed. However, there are some important differences for those individuals with $\theta \leq K$. Clearly, none of those individuals will file an individual suit as they would get a negative payoff if their case was heard in court. Thus, $S(\theta) = 0$. Since an individual with $\theta \leq K$ does not file an individual suit, his payoff if he waits until period t for another individual to initiate a class action suit is $F(\theta) = \delta^{t+1}[\gamma\theta + (1-\gamma)\bar{\theta} - k]$. Similarly, if an individual with $\theta \leq K$ decides to file a class action suit at time t, he gets $L(\theta) = \delta^{t+1}[\gamma\theta + (1-\gamma)\bar{\theta} - k] - \delta^t c$. Clearly, for those individuals, there is no interior solution. If $\delta[\gamma\theta - (1-\gamma)\bar{\theta} - k] \leq c$, none of those individuals will ever initiate a class action suit. This implies that we go back to the problem considered before, but with the lower bound of the distribution given by K rather than θ^ℓ, and the number of individual suits given by $n = N\int_K^{\theta^h} \mathrm{d}J(\cdot) < N$. So if γ is small the individual with $\theta = K$ will initiate the class action suit, while if γ is large, it could be this same individual or the one with the highest θ within the class. Note that no individual with $\theta \leq K$ opt out of the class action suit. On the other hand, if $\delta[\gamma\delta - (1-\gamma)\bar{\theta} - k] > c$, we cannot identify the individual who will initiate the class action suit. This corresponds to a case where $T(\theta) \to \infty$ for a large number of individuals. It is not possible to find a time where only one individual is left with the incentive to file the class action suit. Again, this is a case in which a non-stationary war of attrition with eventual continuation is not an appropriate tool to identify the representative plaintiff.

6. Conclusion

Damage averaging has been shown to influence the identity of the individual who will initiate a class action suit in a waiting game. If there is complete averaging, the representative plaintiff is the one with the lowest damage, while if there is less damage averaging, other individuals may initiate it.

This paper did not address many issues that could be examined in future work. Interesting topics include: the introduction of an active role for the plaintiffs' attorney in the formation of class action suits;[29] the possibility that a judgment on one case affects another case (jurisprudence) thereby inducing a *rush to judgment*;[30] making the defendant possibly insolvent.[31] These topics have received almost no attention in previous work.

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[29] See *supra* note 10.

[30] Coffee, *supra* note 3.

[31] If the defendant does not have enough liquidity to pay for the compensation of all plaintiffs, then the possibility for a plaintiff that he will have his individual suit in front of the court when it is too late (i.e. when the defendant is bankrupt) should provide him with an extra incentive to initiate the class action suit early (at least, he would then be partly compensated). But this is only one of many possible effects, the importance of which will depend on the precise institutional and legal framework considered.

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