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Delayed Compensation for Lost Income

JOHN W. PRATT
Graduate School of Business Administration, Harvard University, Boston, MA 02163

RICHARD ZECKHAUSER
John F. Kennedy School of Government, Harvard University, 79 Kennedy St., Cambridge, MA 02138

Abstract

Lengthy legal proceedings are often required before an individual who has unjustly lost income is compensated. The utility loss while waiting in straitened circumstances exceeds the utility gain from later compensation if compensation is merely monies lost plus interest. The excess loss will be larger the more averse the individual is to intertemporal variation in consumption, the less complete and perfect the markets for borrowing and trading contingent claims, and the less the certainty about whether an award will be made. To make an injured individual whole, the focus should be on compensating not for loss of discounted income, but for loss of utility.

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JEL Subject Category Numbers: D8, K1, D1

Our systems for tort and contract law function on the principle that an individual who has been injured by the action of another should be made whole by the responsible or breaching party, respectively. (Similar principles appear in other areas of law. For example, "equitable relief" for discrimination in hiring, a "purposeful wrong," employs back pay awards to restore the individual's economic position.) In many circumstances, it is not clear whether an action should be considered negligent, breaching, or wrongful. Hence, we turn to the legal system, with its suits, countersuits, and delay. The court is final arbiter. Even with out-of-court settlements, expectations of what the court would do are the lodestar.

Past analyses of this subject have focused on such issues as the information-gathering capabilities of alternative liability systems, the provision of efficient incentives, and the tradeoff between compensating individuals for losses and reducing their incentive to act with caution. Classic works addressing these issues include Calabresi (1970), Posner (1972), Brown (1973), and Shavell (1987). For the most part, we abstract from these considerations.[1]

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1. Delayed compensation for injury

Even if the justice system operated on an instantaneous basis, making an individual whole might well be difficult: determining what an injured individual has lost is often a challenge. In practice, the wheels of justice grind slowly; cases may take years to resolve. In the interim, the injured party must manage his life on resources reduced by the injury. He must decide how much to borrow to supplement his income stream, without knowing whether compensation will be forthcoming. Many do not or cannot borrow at all. When an injured party is ultimately compensated for lost income, it has been traditional to award a sum equal to the monies lost. In some jurisdictions, lost interest from the time of harm is awarded as well; in others, interest just accumulates from the time of judgment.

A "monies-lost" award misses a major category of loss: A lump sum later on, carefully calculated to equal prior losses, even with interest, will not compensate for waiting in straitened circumstances. The pattern thus created—lowered consumption before resolution, followed by higher consumption if the outcome is favorable—imposes a real loss; the individual would not accept such variation voluntarily without substantial compensation.[2] Rather, to make the individual whole, we must give him the same utility or expected utility that he would have received had he never suffered the injury in the first place.[3] An individual who has lost income and has a chance to be compensated in the future would like to shift money from the future to the present, and from contingent states in which he receives compensation to those in which he does not.

Our system of law generally requires that when damages are sustained, the injured party must make appropriate efforts to reduce avoidable consequences. A construction company whose contract is breached, for example, must look for alternate work. So too must the employee who is unjustly dismissed. Presumably, this principle requires an income-losing injured party to borrow money to level his income stream while a law suit plays out. Unfortunately, the ex post correct mitigating action will only become known after the suit has been settled, so one who applies this principle will be subject to second guessing.

This article examines how we should compensate for income lost because of the negligent or wrongful actions of another, taking into account difficulties in borrowing and the absence of contingent claims markets that would allow parties to sell their interest in a judgment. The analysis primarily addresses the case in which substantial time passes before an individual receives compensation, and in which it is not clear at the outset whether guilt, negligence, or responsibility will be established. To simplify the discussion, we leave aside losses, such as pain and suffering or disfigurement, that do not directly affect income or wealth.

Section 2 sets up a simple model adequate to capture the effects of uncertainty and unequal consumption streams on individual utility and utility-equalizing compensation. Section 3 illustrates the problem in three scenarios, classified by whether borrowing is possible and when uncertainties are resolved. Section 4 discusses the role of subjective probabilities. Section 5 contains our conclusions.

2. The model

Following most of the economics literature, our examples deal with a utility function that is merely the discounted sum of single-period utilities; the special features of this form are immaterial here. A two-period model, with a zero discount rate, is sufficient for illustration. Consider an individual whose utility for consumption of value c_1 in period 1 and c_2 in period 2 is $U(c_1, c_2)$. Preference for leveling consumption over time means that $c_1 - d, c_2 + d$ is less desirable than c_1, c_2, that is, $U(c_1 - d, c_2 + d) < U(c_1, c_2)$, if the former stream is more variable, as when $c_2 \geq c_1$ and $d > 0$. Risk aversion means that uncertain consumption $\tilde{c}_1, \tilde{c}_2$ is less desirable than its expected value $E\tilde{c}_1, E\tilde{c}_2$, corresponding to $U(E\tilde{c}_1 E\tilde{c}_2) > EU(\tilde{c}_1, \tilde{c}_2)$. If also

$$U(c_1, c_2) = u(c_1) + u(c_2) \tag{1}$$

where u is a single-period utility function, then each property corresponds to $u((c_1 + c_2)/2) > (u(c_1) + u(c_2))/2$ (concavity of u). Although the two properties coincide in this case, they are conceptually different.

If an individual who would consume c per period in the absence of damage loses d in the first period, then to achieve the same utility he must recover an amount a in the second period such that $U(c - d, c + a) = U(c, c)$. In the 0-interest additive case (1) this gives

$$u(c + a) = 2u(c) - u(c - d), \tag{2}$$

Thus the utility compensation in the second period, $u(c + a) - u(c)$, must equal the utility loss in the first period, $u(c) - u(c - d)$, as illustrated in figure 1.

If u is bounded above and approaches $u(\infty)$ when consumption is unlimited, and if $u(\infty) \leq 2u(c) - u(c - d)$, then no recovery is adequate. Otherwise, (2) is easily solved

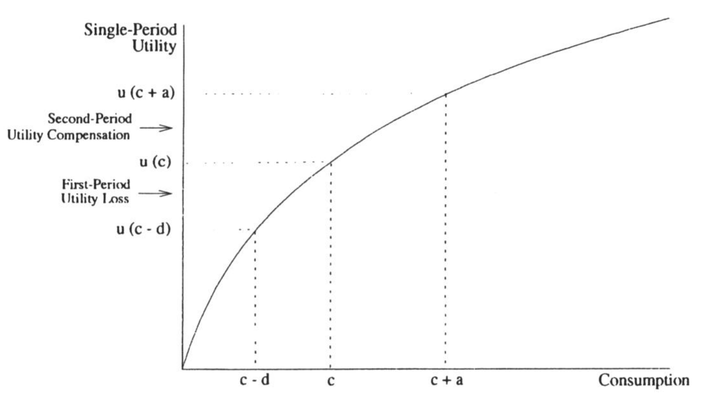

Figure 1. Making whole in utility terms (zero interest, additive case)

for a by search, since u is monotonic and smooth. Alternatively, if the inverse function u^{-1} is tractable, one can use

$$a = u^{-1}(2u(c) - u(c - d)) - c. \tag{3}$$

If borrowing is possible and resolution is immediate, then the individual's best choice, whether he wins or loses, is to borrow just enough to equalize consumption in the two periods. If his probability of winning is p and the recovery makes him exactly whole when he wins, then his expected utility is, with $q = 1 - p$:

$$pU(c, c) + qU(c - d/2, c - d/2) = 2pu(c) + 2qu(c - d/2). \tag{4}$$

If resolution is delayed and an award a will occur with probability p, then borrowing b has expected utility

$$\begin{aligned} pU(c - d + b, c - b + a) + qU(c - d + b, c - b) \\ = u(c - d + b) + pu(c - b + a) + qu(c - b). \end{aligned} \tag{5}$$

The maximum can be found by search over b, or by solving

$$u'(c - d + b) = pu'(c - b + a) + qu'(c - b), \tag{6}$$

perhaps also through a search algorithm. To provide a prudent borrower the same expected utility as an award d with immediate resolution, the award a would have to equate (5) to (4) when b maximizes (5).

In any event, if uncertain variable consumption has expected utility $U_\circ$, then as a dollar measure we may be interested in the certainty equivalent (equally desirable) constant consumption $c_\circ$, which is the solution of $U(c_\circ, c_\circ) = U_\circ$. Hence, under (1),

$$c_\circ = u^{-1}(U_\circ/2). \tag{7}$$

3. Illustrations under alternative scenarios

Without the loss, let us assume our individual would have had an income and consumption stream of 100 per period. The loss reduces his income to 40 in the first period. What amount is required as compensation in the second period to make him whole? How much worse is compensation equal only to monetary loss?

We shall address three situations in which payment is delayed. The situations differ as to whether borrowing is possible, and when the outcome of the case is determined. The situations are: A, no borrowing; B, borrowing and immediate resolution of the lottery; and C, borrowing and delayed resolution of the lottery. For any prespecified level of potential compensation, B is preferred to C, and C is preferred to A. Similarly, to make the individual whole, B calls for less compensation than C, and C less than A. For all of our numerical illustrations, we use the single-period utility $u(x) = -e^{-kx}$, implying that aversion to risk and to consumption variation is the same in absolute terms at all risk levels. For calculations, please see the appendix.

A: *No borrowing*. If borrowing is not possible, then it is immaterial when the lottery is resolved. Since the individual will have higher income next period should he win the case, it seems likely that the individual would wish to consume all of his income in the first period. (The U.S. savings rate of less than 4% suggests that he is unlikely to be a saver).

Being unable to borrow increases the individual's losses; required compensation is higher. Superficially, it might seem unfair that the amount the liable party must pay will depend on the credit position of the plaintiff. In fact, however, many aspects of recoveries parallel this feature. Making whole is quite different from making the punishment fit the crime. When, in breach of contract, a plumber fails to plumb a building, the damages for which he is responsible will depend not only on what it costs to get someone else to do the work, but also on the costs of the construction delay to the plaintiff. Medical damages and lost income itself depend on plaintiff characteristics as well.

With risk aversion parameter $k = 0.01$, the amount required to make our individual whole will be 172.664, far more than his loss of 60, because $u(100) + u(100) = u(40) + u(272.664)$; the total utility (sum of utilities) for the two-period lifetime will then be the same as if there had been no loss. For some utility functions, as mentioned earlier, no amount of compensation can make the individual whole. For example, for $u(x) = -e^{-kx}$, with $k \geq 0.012$, even infinite second-period consumption does not provide enough utility to compensate for the utility loss incurred when first-period consumption is reduced from 100 to 40. (The appendix discusses generalizations of this result to longer lifetimes.)

B: *Borrowing possible, immediate resolution*. If borrowing is possible, uncertainties due to delayed resolution may impose substantial costs. The immediate-resolution case provides a benchmark against which we will judge the loss due to delay. Suppose our individual, who had lost 60 in the first period, has a one-half chance of winning the case. In situation B, responsibility is determined immediately; then the first-period consumption decision is made. Let us assume initially that the compensation will be just 60 when the other party is found to be at fault. This presumably makes the individual legally whole. He will borrow 30 when he loses and will face the following consumption streams:

100, 100 (if he wins), or
70, 70 (if he loses).

The probability of winning (0.5) does not affect his borrowing decision but does affect his expected utility.

C: *Borrowing possible, delayed resolution*. If it is not immediately determined whether there will be an award, the individual must select first-period consumption before the case is resolved. This injects additional uncertainty into the situation, and the benefits of borrowing are reduced.[4] The individual must decide now how much to borrow, recognizing that he has a 0.5 chance to recover 60 later. He has a tough problem in decision making under uncertainty. With $u(x) = -e^{-.01x}$, analysis shows that the best he can do is to borrow 42.783. The result is that he gets one of two consumption streams:

82.783, 117.217 (if he wins), or
82.783, 57.217 (if he loses),

each with probability one-half. The cost of the uncertainty due to delayed resolution arises from variability in the consumption stream. Though the winning and losing streams have the same present value as the situation B streams 100, 100 and 70, 70, with delayed resolution, the individual cannot even out his two contingent consumption streams over time because his first-period consumption must be the same for the two outcomes. The resulting variability in each stream imposes a loss in utility. It would be an unusual legal argument that the individual suffered because he was uncertain whether he would recover.[5] But suffer he surely did, because he did not know how much to borrow from the second period to consume in the first.

D:*The costs of delayed resolution*. There are a variety of ways to compute the loss from delayed resolution. One way considers the individual's certainty-equivalent income stream for each of two situations; it turns out to be 83.879, 83.879 for situation B, and 82.783, 82.783 for situation C.[6] A second way to look at the utility loss from delayed resolution on a monetary basis is to observe that in situation C the individual would have to receive 66.315 to be as well off as he would be receiving 60 in situation B. With 66.315 in compensation, the optimal borrowing amount for the individual is 43.879, producing the two equally likely consumption streams:

83.879, 122.436 (if he wins), or
83.879, 56.121 (if he loses).

This provides the same expected utility as situation B. Note that the probability of winning affects the compensation needed even if the individual borrows optimally.

4. The role of subjective probabilities

The examples above compensate the individual on an expected utility basis. Ex ante probabilities thus play a role in the analysis. The traditional legal system seeks to make the injured person whole in the particular state of the world where another party is held responsible. Hence, prior probabilities may be thought to play no role.

If liability is established, the injured party must be given a sufficient amount to put him on the same indifference curve as if he consumed 100, 100. A difficulty arises: the amount that it will take to make the individual whole will depend on the action that he takes, namely, his choice of first-period consumption. The less he consumes first period, the more compensation he receives now. The rational calculating individual will balance the marginal pain of further underconsumption against the marginal gain from increased compensation. Since the individual will be made whole if liability is determined, his best course is merely to optimize his well-being, assuming he will not be compensated. Thus, in our example he will borrow 30 and consume 70 in each period if liability is not established. With liability, he will be awarded 73.057, since the consumption stream 70, 70 + 73.057 is just as attractive as the stream 100, 100. Probabilities do not affect the award or borrowings.

In contract law, a party who has been "wronged by a breach of contract may not unreasonably sit idly by and allow damages to accumulate. The law does not permit him to recover from the wrongdoer those damages which he 'could have avoided, without undue risk, burden or humiliation.'"[7] In torts, the parallel principle is: "One injured by the tort of another is not entitled to recover damages for any harm that he could have avoided by the use of reasonable effort or expenditure after the commission of the tort."[8] Therefore, if our individual knew that he would be compensated, he would have a duty to borrow 60, and the necessary compensation would merely be 60.

What then is the individual's responsibility if there is only a chance of compensation? That is an intriguing question for future work. Alas, unlike the implicit assumption of our examples, there is no objective probability of recovery. The individual's subjective probability of recovery will guide his actions. Assuming that the amount of compensation is fixed, the more the individual's initial probability estimate diverges from what happens the worse off he is on an ex ante expected value basis. That is, if he thought he had only a 0.1 chance to win the case and won, more compensation would be required to make him whole than if he thought he had a 0.9 chance. This leads to the perverse result that cases for which probabilities of recovery are low—cases that appear weak—require greater compensation for the same loss to make the individual whole if he wins.

5. Conclusion

Unevenness in consumption streams diminishes utility. An individual who has unjustly lost income and must await legal proceedings before receiving compensation thus has lost more than the value of monies lost plus compound interest. The more averse the individual is to intertemporal variation in consumption, and the less complete and perfect the markets on which he can borrow and trade contingent claims, the greater the excess loss. For many reasonable utility functions, no amount of subsequent income over a finite lifetime can make up for past denials of sufficient magnitude, a strong illustration of the costs of justice delayed.

If the policy objective is truly to make an injured individual whole, the focus should be on compensating not for his loss of discounted income, but for his loss of utility.

Appendix

In the case $u(x) = -e^{-kx}$ (implying that aversion to risk and to consumption variation is the same in absolute terms at all income levels), $u^{-1}(y) = -(1/k)\log(-y)$ and the make-whole amount (3) is $a = -(1/k)\log(2e^{-kc} - e^{-kc+kd}) - c = -(1/k)\log(2 - e^{kd})$, independent of the initial c. A solution exists if and only if $2 - e^{kd} > 0$, that is, $kd < \log 2 = 0.69315$. For $d = 60$, making whole is impossible if $k \geq 0.69315/60 = 0.01156$, and requires $a = -100\log(2 - e^{0.6}) = 172.664$ if $k = 0.01$.

With borrowing, immediate resolution, and award damage, the expected utility (4) is $-2pe^{-kc} - 2qe^{-kc+kd/2} = -e^{-1} - e^{-0.7} = -0.86446$ when $p = ½$ and $c = 100$, and the equally desirable constant consumption (7) is $c = -(1/k)\log(0.86446) = 83.879$.

With delayed resolution, since $u'(x) = ke^{-kx} = -ku(x)$, the optimum borrowing condition (6) reduces to $e^{-2kb} = e^{-kd}(pe^{-ka} + q)$ and makes the first-period and certainty-equivalent consumptions equal. Hence the optimum borrowing is $b = d/2 - (1/(2k))\log(pe^{-ka} + q) = 30 - 50\log(½ + ½e^{-0.01a})$ with expected utility $-2e^{-kc+kd/2}(pe^{-ka} + q)^{1/2} = -e^{-0.7}(2 + 2e^{-0.01a})^{1/2}$. The equally desirable constant consumption is $70 - 50\log(½ + ½e^{-0.01a})$. This equals 82.783 for $a = 60$. To provide the same expected utility as immediate resolution requires $pe^{-ka} + q = (pe^{-kd/2} + q)^2$, or $a = -(1/k)\log[(e^{-kd/2} + q/p)^2 p - q/p] = -100\log[½(1 + e^{-0.3})^2 - 1] = 66.315$.

Consider now a multiperiod model with utility function

$$U(c_1, c_2, \cdots) = \sum_t \theta^t u(c_t) \tag{A1}$$

where the discount factor $\theta = 1/(1 + i)$ corresponds to the interest rate i when borrowing is possible. (Optimal borrowing then equalizes the c_t under certainty.) If an individual who would consume c per period without damage loses d in the first m periods and recovers a in the next n periods, wholeness requires

$$\begin{aligned} u(c + a) &= u(c) + s[u(c) - u(c - d)] \\ \text{where } s &= \sum_1^m \theta^t \Big/ \sum_{m+1}^{m+n} \theta^t \\ &= \frac{\theta^{-m} - 1}{1 - \theta^n} = \frac{(1+i)^m - 1}{1 - (1+i)^{-n}}. \end{aligned} \tag{A2}$$

Some values of s for infinite life ($n = \infty$) are given in the following table.

for m =	1	2	5	10
at i = .05	.05	.1025	0.276	0.629
.10	.10	.21	0.611	1.594
.15	.15	.3225	1.011	3.046
.20	.20	.44	1.488	5.192

If $u(\infty) \leq u(c) + s[u(c) - u(c - d)]$, then no solution exists. Otherwise the solution is

$$a = u^{-1}(u(c) + s[u(c) - u(c - d)]) - c. \tag{A3}$$

In the 0-interest case, $\theta = 1, s = m/n$, and a solution always exists if n is large enough. The present value of the award divided by the present value of the damage, a/sd where a satisfies (A3), is increasing in s (since u^{-1} is convex) and it also approaches $[u(c) - u(c - d)]/du'(c)$ as $s \to 0$. This limit is therefore the minimum of all possible present-value ratios. It is the slope of the utility across $(c - d, c)$ divided by the slope at c, which exceeds 1. For $u(x) = -e^{-kx}$, the minimum present-value ratio is $(e^{kd} - 1)/kd$. For $k = 0.01$ and $d = 60$, this is 1.37 compared to $172.664/60 = 2.88$ when $s = 1$ (as in the 2-period, 0-interest case).

With borrowing and immediate resolution, an award with the same present value as the damage makes the individual whole when he wins. When he loses, optimal borrowing equalizes consumption in every period and hence results in a constant loss d' with the same present value as the damage, namely $d' = s'd$ where $s' = s/(s + 1)$. Expected utility is then

$$(pu(c) + qu(c - s'd))S \text{ where } S = \sum_{1}^{m+n} \theta^t. \tag{A4}$$

If resolution is delayed, optimal borrowing will equalize consumption before resolution at some level $c - d + b$, say, and after resolution at $c - sb + a$ if he wins and $c - sb$ if he loses, where a represents the award and b, to be chosen optimally, represents borrowing. Expected utility is the maximum over b of

$$[su(c - d + b) + pu(c - sb + a) + qu(c - sb)]S/(s + 1). \tag{A5}$$

At the maximum

$$u'(c - d + b) = pu'(c - sb + a) + qu'(c - sb). \tag{A6}$$

If the maximum of (A5) equals (4), then a provides a prudent borrower the same expected utility as immediate resolution. For $u(x) = -e^{-kx}$, the optimum b is $[d - (1/k)\log(pe^{-ka} + q)]/(1 + s)$. To provide the same expected utility as immediate resolution requires $a = -(1/k)\log[(e^{-ks'd} + q/p)^{s+1}p^s - q/p]$. As $s \to 0$, the award/damage present-value ratio a/sd approaches 1, because when the before/after present value ratio s is small and borrowing is possible, only small changes in consumption are needed and hence utility is approximately linear. By comparison, $a/sd = 66.315/60 = 1.11$ for $s = 1$ when $k = 0.01$ and $d = 60$.

Notes

1. The tort approach to liability for injuries has been questioned, given high transactions costs and problems of contracting. Proposed alternatives include first-party insurance, no-fault compensation systems, or government payments for illness. See Danzon (1987) on occupational disease, or Weiler et al. (1993) on

medical malpractice. Even within the tort framework, many aspects of the recovery process have been questioned: lawyers' fees, contingency arrangements, payments for pain and suffering, punitive damages, etc. We abstract from these considerations as well.

2. A referee reminded us that if the victim had first-party insurance that made him whole immediately, this category of loss would be avoided. The analysis in this article could be viewed as measuring this advantage of first-party insurance. Presumably the insurance company, to whom the individual's right of recovery would be subrogated, needs no compensation for variability in cash flow of this magnitude.
3. What would happen if contractually we could waive the legal requirement that the victim be made whole? If the injurer is risk averse as well, and if some probability of injury is a feature of the efficient outcome, ex ante the parties would contract to share the risk. Less than "make-whole" compensation would be paid; the ex ante price would be reduced. Some moral hazard would be incurred as a price of better risk sharing.
4. In most real-world situations, there is a major additional element of uncertainty, namely, how large the award will be. The size-of-award issue, not discussed here, could be addressed with an extension of this analysis.
5. That uncertainty of expenditures after the trial (e.g., on medical costs) imposes a welfare loss on the victim is well known. W. Kip Viscusi informs us that he has made this argument in actual testimony. Our uncertainty is before trial.
6. It can be shown that for our two-period exponential case with a one-half chance of compensation, the optimal first-period consumption equals the certainty equivalent in situation C. In most cases, they differ.
7. Calamari and Perillo (1987, p. 610).
8. American Law Institute (1979, p. 500).

References

American Law Institute. (1979). *Restatement of the Law, Second: Torts 2nd,* Vol. 4. St. Paul: American Law Institute Publishers, p. 500.

Brown, John P. (1973). "Toward an Economic Theory of Liability," *Journal of Legal Studies* 2, 323–350.

Calabresi, Guido. (1970). *The Costs of Accidents.* New Haven, Conn.: Yale University Press.

Calamari, John D., and Joseph M. Perillo. (1987). *The Law of Contracts.* St. Paul: West Publishing Company.

Danzon, Patricia M. (1987). "Compensation for Occupational Disease: Evaluating the Options," *Journal of Risk and Insurance* 2, 262–282.

Posner, Richard A. (1972). "A Theory of Negligence," *Journal of Legal Studies* 1, 28–96.

Shavell, Steven. (1987). *Economic Analysis of Accident Law.* Cambridge: Harvard University Press.

Weiler, Paul C., et al. (1993). *A Measure of Malpractice*. Cambridge: Harvard University Press.