Variability in Punitive Damages: Comment

by
DAVID A. JAEGER*

Eisenberg, Heise, and Wells (this issue) as well as Eisenberg, et al. (2006) examine the relationship between compensatory and punitive damages. EHW are particularly interested in exploring whether the Supreme Court of the U.S. was justified in limiting the punitive damages related to the Exxon Valdez case to be equal to the compensatory damages. Both studies find strong evidence of a positive relationship between compensatory damages and punitive damage – punitive damages are essentially proportional to the level of compensatory damages in those cases where punitive damages were awarded. Their putative question is whether punitive damages vary in systematically different ways across the range of compensatory damages.

The evidence presented in EHW strongly suggests that a logarithmic transformation of both punitive and compensatory damages is necessary to appropriately estimate an econometric relationship. The paper examines several specifications using ln and $\log_{10}$, which are econometrically equivalent.[1] The basic specification in EHW is of the form

$$\ln(\text{punitive}) = \alpha + \beta f[\ln(\text{compensatory})] + \varepsilon. \tag{1}$$

When $f(\cdot)$ is linear function, β can be interpreted as the elasticity of punitive damages with respect to compensatory damages.[2] EHW also examine specifications of the form

$$\ln(\text{punitive})/\ln(\text{compensatory}) = \gamma + \delta \log_{10}(\text{compensatory}) + \xi, \tag{2}$$

but note that this is equivalent to

$$\ln(\text{punitive}) = \gamma \ln(\text{compensatory}) + \delta' \ln(\text{compensatory})^2 + \xi' \tag{3}$$

where δ'=2.30258509 δ. Thus, this is just equation (1) with a quadratic in ln(compensatory) and α=0. While this specification has some appeal on expository grounds, it seems more sensible to me to estimate a model that does not implicitly eliminate the constant term from the relationship between (log) punitive and (log) compensatory damages. Nevertheless, I present results from this specification below.

I first explore the functional form between (log) punitive damages and (log) compensatory damages. Figure 1 presents the estimated regression lines from 5 specifications of equation (1): (a) linear, (b) quadratic, (c) quadratic without a constant term (i.e. equation 3),

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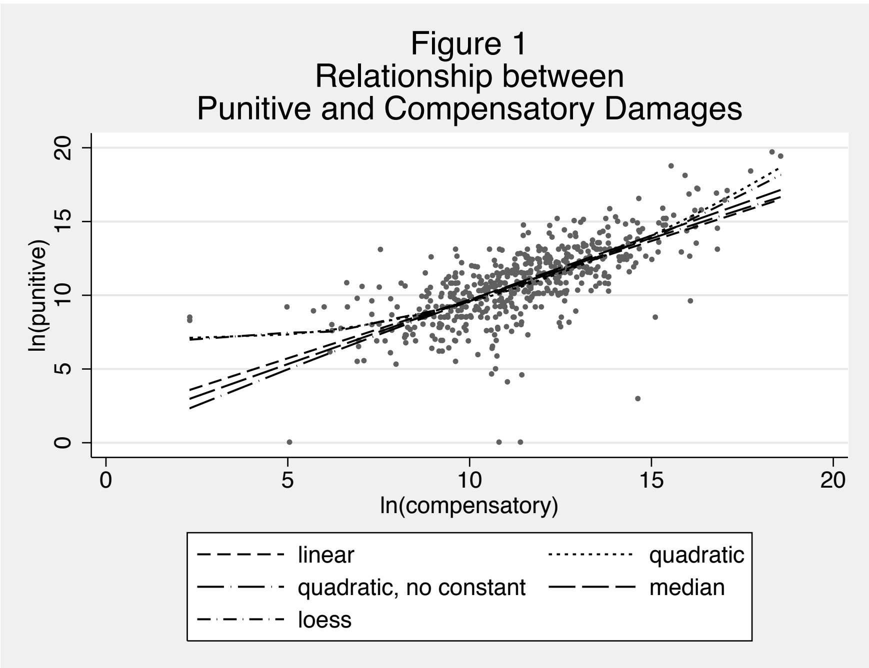
* I thank Ted Eisenberg for providing the data.

[1] To see this, note that ln(a)=2.30258509 · $\log_{10}$(a), so that corr[ln(a), $\log_{10}$(a)]=1. Thus, for example, a regression of ln(y) on $\log_{10}$(x) yields a slope coefficient that differs by a factor of 2.30258509 from the slope coefficient in a regression of ln(y) on ln(x).

[2] EHW apply a correction for inflation in their models, although this is unnecessary with a linear specification and makes little difference in practice. They also apply sample weights in their analysis. I do not apply weights in the results presented here, but these also make relatively little difference in practice.

(d) median regression (which is robust to outliers), and (e) the fit from a locally weighted smoothing regression (loess) with a bandwidth of .8. The results are highly comparable to one another, and above ln(compensatory)=9.25 all have a slope of around .8. That is, a doubling of compensatory damages would lead to an increase in punitive damages of around 80%. The quadratic (with constant) and loess predicted values are virtually identical, and deviate somewhat from the other specification, exhibiting some flattening out at lower levels of (log) compensatory damages. This flattening below about ln(compensatory)=9.25 (or about $10,00) is also noted by EHW. The the squared correlation coefficient between the predicted and observed values of ln(punitive) for the linear, quadratic without a constant, and median regression models range between 0.481 and .488 (with the quadratic, no constant model performing the worst) while the squared correlation coefficient for the quadratic and loess models are both .513. Thus, these last two models, which are not explicitly estimated by EHW, seem to perform very marginally better (in an R^2 sense) than the other models, although they may put more emphasis on the very few observations with ln(compensatory) below 5 (around $100) than is warranted. When compensatory damages exceed $10,000 or so, all of the models perform equally well – this is clearly the relevant portion of the relationship with regard to the Exxon Valdez case.



The evidence presented in EHW and in Eisenberg, et al. (2006) clearly shows a robust relationship between (log) compensatory and (log) punitive damages. A secondary question is whether punitive damages show a high degree of variability, *conditional* on compensatory damages. The evidence presented thus far suggests that (log) compensatory damages alone explain half of the variation in (log) punitive damages. But it is possible that punitive damages also exhibit higher variability as the level of compensatory damages increases. This might lend some credence to the assertion that possibly very high punitive damages could be awarded when compensatory damages are high.

One potential manifestation of differential variability in (log) punitive damages, conditional on (log) compensatory damages is hetereoskedasticity. Table 1 presents heteroskedasticity tests for the 5 models in Figure 1. Following White (1980), these are constructed through an auxiliary regression with the squared difference between the observed and predicted values of ln(punitive) as the dependent variable and a polynomial in ln(compensatory) as the regressors. For the linear and median specifications this means a quadratic in ln(compensatory). For the quadratic and loess specifications the regressors in the auxiliary regression are a quartic in ln(compensatory). For the quadratic, no constant specification, the regressors are the second through fourth polynomials of ln(compensatory). In all cases, the test statistic is given by nR^2 from the auxiliary regression, which is distributed asymptotically $\chi^2(j)$, where j is the number of regressors in the auxiliary regression. Results using the full sample are presented in column (1). In the linear, quadratic (no constant), and median regressions, the null hypothesis of homoskedasticity is rejected, while in the quadratic and loess regressions the null hypothesis cannot be rejected.

Given the results in Figure 1, it seems likely that the rejection of the null of homoskedasticity in the full sample may be driven by the three observations with ln(compensatory) < 5. Column (2) of Table 1 repeats the exercise from column (1), but deleting these three observations. The null hypothesis of homoskedasticity is now not rejected in any of the specifications. It seems safe to conclude, therefore, that the variance in (log) punitive damages is a function of (log) compensatory damages.

Table 1
White Tests for Heteroskedasticity
(*p*-value in parantheses)

	χ^2	
Model	**Full Sample (1)**	**ln(compensatory) > 5 (2)**
Linear	10.19	2.58
	(0.006)	(0.276)
Quadratic	1.75	1.75
	(0.781)	(0.781)
Quadratic, no constant	31.09	5.81
	(>0.001)	(0.214)
Median	12.20	1.90
	(>0.001)	(0.654)
Loess	1.65	5.76
	(0.901)	(0.352)
N	539	536

Taken together, these results suggest that a) compensatory damages are the primary determinant of the *level* of punitive damages if they are awarded, and b) there does not seem to be a systematic relationship between compensatory damages and the *variability* of punitive damages. There is some evidence that at low levels of compensatory damages, the relationship between (log) punitive damages and (log) compensatory damages is somewhat weaker and, but this is based on relatively few observations. This certainly *does not* occur at the level of compensatory damages in the case of the Exxon Valdez spill.

Whether the Supreme Court was justified in reducing the punitive award in *Exxon* is, of course, impossible to say on the basis of this analysis alone. Ideally, punitive damages would have the effect of reducing subsequent breaking of the law, and not only by the original defendant. Thus factors like wealth (as noted by EHW) and future profits should be taken into account when setting punitive damages. Evidence from the medical malpractice literature, however, suggests that changing caps on punitive damages does not alter the number of malpractice awards and settlements (Donohue and Ho 2007). This result is the net effect of potential increased malpractice of physicians and a potential decrease in demand for litigation due to reduced expected value of that litigation. Discerning the deterrent effect of punitive damages should therefore be an area of ongoing research.

DAVID A. JAEGER
Wirtschaftliche Staatswisschenschaften
Universität zu Köln
Albertus-Magnus-Platz
D-50923 Köln
Deutschland
jaegerd@uni-koeln.de
and IZA

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