Criminalizing Price-fixing

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Abstract

We assess whether recent US DOJ price-fixing cases exhibit characteristics that are associated theoretically with optimal use of criminal law. We take our welfare standard from Posner and Shavell's seminal work on optimal legal design. Optimal legal design recognizes the private and public elements present in all areas of the law. The mixed results show that the characteristics to be expected in criminal cases are not all present in the DOJ cases. Criminal sanctions applied in these collusive antitrust cases do however show significant responsiveness to some of the variables derived from the economic analysis of criminal law.

Introduction

There is a growing awareness of the potential for increasing the use of criminal-law sanctions in antitrust law on both sides of the Atlantic (Abrantes-Metz and Sokol 2014; Ducci 2018; Sokol 2018-19). In the US, antitrust violations can be felonies and the US Department of Justice (DOJ) seeks criminal-law sanctions in antitrust cases involving collusion, including fines applied to firms and executives, and jail time for executives. In Europe, the authorities use measures conventionally described as administrative fines, but these in fact share many of the characteristics of penalties in criminal law regardless of the labeling and. Injured parties in many cases may also pursue civil actions for recovery of damages alongside such "criminalized" cases. Is the current use of criminal sanctions under regulatory law appropriate in deterring monopolistic behavior, or has it gone too far? We should be able to detect at least some case characteristics suggesting appropriate use of criminalization relative to a welfare benchmark given long-term establishment of criminal penalties. Otherwise, criminalization may *already* have gone too far, and we should consider whether greater reliance on private-law sanctions such as damages claims in tort law, including class actions, would sufficiently control monopolistic behavior. One concern is that interest groups, such as domestic manufacturers, may influence the state to impose criminal sanctions simply to avoid the cost of taking civil action, which could reflect rent-seeking regulatory capture (Stigler 1971) rather than efficient regulation.

We apply statistical methods to assess whether major US DOJ price-fixing cases exhibit characteristics that have been associated theoretically with optimal use of criminal law. The welfare benchmark comes from work on optimal legal design (Posner 1985; Shavell 1993; Dnes and Seaton 1997 and Dnes 2009). The theory of optimal legal design recognizes the private and public law elements present in all areas of the law (Calabresi 2014) based on an underlying utilitarian approach to regulation.[1] The theory has influenced work on antitrust law, for example Katsoulacos and Ulph's (2009) comparison of per se and rule of reason approaches in antitrust case law, and Sokal's (2018) comparison of collusive and non-collusive antitrust cases.[2] There are already empirical applications of economics to assess the optimality of antitrust law in terms of

[1]That is, the welfare benchmark assesses increases in total social welfare, rather than focusing solely on consumer welfare as is often the case in antitrust law. In many instances focusing on consumer welfare is a sufficient basis for general welfare improvement.

[2] The per se and rule of reason approaches are rules of construction, not substantive legal rules.

setting corporate fines (Cohen 1996; Connor and Miller 2010, 2011 and 2013), and mixing corporate and individual penalties (Connor and Lande 2012).

This article examines the presence, in an original micro-data set of cases, of key characteristics that should be there if the DOJ is making appropriate use of criminal sanctions. Among existing work, Connor and Miller (2010, 2011 and 2013) also make explicit use of the benchmark of optimal legal design. Like Connor and Miller, our work uses a distinct original data base, and appears to be consistent with several of Connor and Miller's findings, but, among other distinctions, clarifies an interactive effect between the wealth levels of firms and the amount of harm from a cartel. This article is not directly concerned with predicting or calculating the cost-effective application of different penalties on the assumption that they should be used.

We make a retrospective assessment of whether antitrust law used criminalization in cases where we can find characteristics that have been thought likely to require enhanced penalties to create deterrence. Other authors also recognize the need to identify the appropriate role of criminal sanctions in regulatory law (United States Sentencing Commission 2014; Abrantes-Metz and Sokol 2014; Sokal 2018; Wardaugh 2014; Connor and Miller 2010, 2011 and 2013). Our approach also is relevant in considering Wils' (2006) question, whether it would in fact be possible to calculate precisely optimal penalties given the amount of work that such calculation would require. It may be possible to assess antitrust law's targeting of criminal sanctions, but not possible to expend the resources for a precise calculation of exactly deterring penalties.

We give a brief explanation of the thinking behind appropriate criminalization before moving on to describe our data methods and results.

Legal Design and Antitrust Law

Why have criminal law at all? If you were to save $19 throwing trash over your neighbor's wall, but it would cost the neighbor $20 to clean up, throwing the trash lowers social welfare by $1. But we can deter the harm by requiring you to compensate the neighbor with any sum greater than your $19 benefit, e.g. requiring compensation of $19.01, relying entirely on the private use of tort law. You would stop, and there is no apparent reason to make such dumping of trash a criminal offense. There must be some wider social concern, such as a public nuisance exhibiting diffuse harm (Calabresi and Melamed, 1972) for criminalizing . Even then, there is no automatically

compelling case for the state's stepping in because a class action could recover damages for multiple victims of harm and thereby create the required deterrence. It is also important to recognize that optimal use of criminal sanctions may require their application in addition to private recovery of damages as a top up, but this again requires a compelling case that private action would be inadequate. An overlap between criminal and private deterrence, as is present in major-case antitrust, does *not* undermine the inquiry in this paper, where we investigate criminalizing factors in cases that have added criminal sanctions.

Generally, we need to show a specific advantage for state action to be confident that its coercive power is not being unnecessarily applied. Case characteristics favoring criminalization of harmful acts include dispersion of harm, the hidden nature of actions, and inadequacy of monetary compensation in deterring the wrongdoer (Dnes 2009; Posner 1985; Shavell 1993; Ray et al 2017). For example, if you are detected throwing trash into your neighbor's garden only one out of four times, the $19.01 penalty must be increased to establish deterrence. The penalty would need to be 4 x 19.01 to deter you. Also, if a misfeasor had too few resources to pay compensation, we would need to impose non-monetary sanctions like jail time to create deterrence. With dispersion of harm, at some point state action may be a lower-cost approach to deterrence compared with relying on individual suits, or even class actions, the procedural rules for which interestingly typically require a demonstration of cost advantage over other approaches.[3]

If antitrust cases do not have characteristics indicating that criminal sanctions are appropriate, then it is possible that adding criminal law sanctions to private remedies such as class actions may lower social welfare by devoting resources unnecessarily to pursuing criminal cases and resulting in over deterring harm.

The approach suggested by Posner (1985) and Shavell (1993) in their seminal theoretical work on the boundary of criminal law is consistent with a Kaldor-Hicks test for welfare improvement, as indeed is much legal economics.[4] Both Posner and Shavell suggested that dispersion of harm, hidden actions and wealth constraints would imply that penalty regulation

[3] Federal Rules of Civil Procedure, Rule 23.

[4] Kaldor-Hicks requires gain to a beneficiary to outweigh any welfare loss imposed, where compensation may be either assumed or paid.

beyond mere compensation for harm would be required to maintain deterrence.[5] The need for more scientific inquiry into the criminalization of cartel offenses has been raised by the United States Sentencing Commission in its request in 2014 for public-interest comments on sentencing, and by a focus on welfare effects in the academic literature (Blair and Sokal 2014).

If the law governing price fixing is optimally structured, we should be able to find evidence of dispersion of harm, hidden actions and wealth constraints in price-fixing cases pursued successfully by the DOJ, since all these cases apply criminal sanctions. If factors favoring use of private law dominate then there is a strong argument for reconsidering the role of the DOJ. Were the damages limited to small groups, favoring private law, or were they dispersed with economies of scale in pursuing the harm? Was the cartel's behavior well hidden, requiring detection efforts? Was damage so high that firms became effectively judgment proof? Such factors favor criminalization and, indeed, applying some sanctions to executives rather than to the firm, which has no "body to kick" (Coffee 1981). Was it just a handful of firms that were affected by price fixing, where each might be expected to use private law to recover fully the economic harm suffered? That would suggest keeping criminal law out and adjusting current practices.

If an efficiency basis cannot be shown for criminalization of sanctions in antitrust, the question arises as to what does drive the legal pursuit of harm. A likely alternative is pressure from interest-groups; competitors may try to leverage state action for their own protectionist purposes as a matter of strategy (Choi & Storr 2019; Conner and Lande 2012), particularly with competing firms importing from overseas, as with car-component suppliers. An efficiency basis is broadly consistent with protecting consumers, whereas a protectionist alternative is consistent with protecting competing firms, although sometimes the customers – for, say, a power steering component – are other firms. When we do find a small number of corporate consumers, which is often the case with the car-component suppliers forming part of the sample of cases used in this paper, this might be the very circumstance in which relying on civil action, rather than criminal sanctions, would make sense.

Methodology

We assessed whether price-fixing cases are correctly classified as suitable for criminal-law sanctions (here in a regulatory framework) by building regression models containing independent

[5] Another criminalizing factor in general is where early detection is of net benefit, as in the case of a building inspectorate, but this factor is unlikely to be relevant for antitrust.

variables measuring dispersed damage, hidden actions and applicable wealth constraints, that should support criminalization. We also included variables reflecting the capacity of offending firms to compensate fully for the damage done, which would favor a private-law solution. We applied regression methods on data extracted from inspecting 105 major DOJ price-fixing actions pursued between 1998 and 2015. The cases were selected for completeness and are listed in an appendix below. The independent variables were quantified or identified as categorical variables by careful reading of the DOJ cases and any associated documents, for example noting details such as the size of fines and whether the firm had sufficient assets to pay the fine. Summary details of the variables obtained from inspecting the cases are recorded in Table 1 below, and the full set of data is available upon request from the authors (as a Stata file). The research design follows Dnes and Seaton (1997), who compared private negligence and criminal gross-negligence cases across a tort-criminal boundary, and subsequent studies of content-dependent legal categories (Hall 2008; Turner 2012). The null hypothesis is that regression models will fail to classify the cases as criminal in nature (the dependent category) with an acceptable degree of accuracy.

Model and estimation

The underlying model takes the form S = f(X,Y,Z), where S is a criminal sanction and X, Y, and Z are criminalizing characteristics. Fines and sentence-length variables are continuous data and amenable to least squares and related estimation, although censored (Wooldridge, 2016, p.525) and suggesting Tobit or Cragg-type models (Tobin, 1958; Cragg, 1971). Other data such as numbers of executives charged and jailed are count-data amenable to the Poisson-distribution family of models. To cope with the data, we ran instrumental-variable, negative-binomial and Tobit regressions to examine relationships between price fixing and criminal penalties imposed on the firms and executives.

[Insert Table 1 about here]

We began estimation with least-squares estimators in conjunction with a link test (Pregibon 1980) to confirm (linear) specification and goodness of fit of the model.[6] Tests for endogeneity using Durbin–Wu–Hausman augmented regression confirmed the suitability of using an

[6] Results of least-squares regressions are not reported in the interest of brevity but are available upon request.

instrumental variable (IV) estimator in place of the least-squares estimator (Baum, et al. 2003; Deaton, 1995; Davidson and MacKinnon, 1993; Stock and Watson, 2015).

$$\ln(Ffines_i) = \mathbf{X}_i'\boldsymbol{\beta} + \varepsilon_i \tag{1}$$

Where $\mathbf{X}_i'\boldsymbol{\beta} = \beta_0 + \beta_1 ExChrg_i + \beta_2 ExJail_i + \beta_3 DamEst_i + \beta_4 DamDisp_i + \beta_5 DamVis_i$
$+\beta_6 WelCon_i + \beta_7 WhiBlo_i + \beta_8 SepLegAc_i + \beta_{8+c} Interactions_i$

Where, $\ln(Ffines_i)$ denotes the logarithm of fines on the firms, β and $\mathbf{X}$ are $k \times 1$ vectors of parameters and covariates in the structural equation, *Interactions* denotes interactions between variables in the model, $8+c=k$ is the total number of coefficients, and ε_i denotes error terms.

The data on personal fines *(Pfine*) and jail times (*Jtime*) imposed on executives are censored for several reasons. First, 63 firms had executive jail time equivalent to zero while the remaining 42 firms had non-zero values for jail time. Second, 66 firms had executive fines of zero while 39 had non-zero executive fines. Finally, the observed minimum for personal fines levied on executives was $20,000. These features tend to produce a non-zero conditional mean of error terms and endogeneity problems, resulting in non-convergence in parameters and rendering an OLS estimator inconsistent even in large samples. Hence, we used a Tobit model to study the penalties on executives, to obtain robust parameter estimates (Tobin, 1958):

$$\left.\begin{array}{l} Pfine_i \\ \text{or} \\ Jtime_i \end{array}\right\} = y_i = \max(0, y_i^*) \left| \begin{array}{ll} y_i^* = \mathbf{X}_i'\boldsymbol{\beta} + \varepsilon_i & \text{if } y_i > 0 \\ = 0 & \text{if } y_i \le 0 \end{array} \right. \tag{2}$$

where y_i and y_i^* denote observed and latent values of our outcome variables, namely personal fines (*Pfines*) and executive jail time (*Jtime*) respectively. The empirical justification for using a Tobit model concerns the presence of a censoring process. Firms and/or executives in breach of competition were subject to fines with a range of zero to $20,000. This truncation of the data is addressed using a Tobit model (Wooldridge, 2010, p. 667).

The data on the number of executives charged (*ExChrg*) and number of executives jailed (*ExJail*) are count variables with some pileup at zero, which typically conform to a Poisson

distribution[7]. Consequently, the estimates of ExChrg and ExJail follow a Poisson distribution with conditional mean, μ , described by the structural equation:

$$\mu_i = E[Ex(.)\mathbf{X}_i] = \exp(\mathbf{X}_i'\beta) \quad (3)$$

where the function with density $Pr[\#Ex(.) \mid X_i] = \frac{\exp(-\mu)\mu^{\#Ex(.)}}{Ex(.)!} \quad Ex(.)! = 1, 2, \ldots$

Inspecting the variances and means of both variables, *ExChrg* and *ExJail,* there was evidence of over-dispersion. Applying Chi-square and Vuong (1989) tests for goodness of fit to eliminate any related models, we found the negative binomial regression (NBR) model to be a good fit for our analysis (Greene, 2012).[8] Following Long (1997) and Long and Freese (2014), we model the mean observed frequencies of *ExChrg* and *ExJail* variables, Ex(.), as a function of the covariates and a random component as follows:

$$\tilde{\mu}_i = \exp(\mathbf{X}_\mathbf{i}'\beta + \varepsilon_i) \quad (4)$$

where $\tilde{\mu}$ is a μ with random component ε_i expressed as: $Pr[\#Ex(.) \mid X_i, \varepsilon_i] = \frac{\exp(-\tilde{\mu})\tilde{\mu}^{\#Ex(.)}}{Ex(.)!}$

Empirical Results

Preliminary analyses

Tables 2-3 contain preliminary statistics and summary inferences on the relationship between outcome and independent variables in our model. Table elements are explained in comments on the right of each table; further details of variables, details of locations and of the sectors (S&P-MSCI classification) in which firms operate are also given.

[Insert Table 2 about here]

[Insert Table 3 about here]

[7] Sixty percent of the observations for the number of executives jailed were zero and over 17 percent of observations for executives charged were zero.

[8] Unconditional mean and unconditional variance of number of executives charged for firms with non-zero values were 20.31 and 438.50 respectively, but the mean and variance number of executives jailed for firms with non-zero values were 0.90 and variance is 2.00 respectively. Therefore, as a preliminary test for over dispersion, we examined unconditional means and variances of the *ExChrg* and *ExJail* variables to confirm the violation of the inherent equal-dispersion assumption of the Poisson estimator and proceeded to formal tests proposed by Caremon and Trivedi, (1990) to confirm over dispersion.

Fining Firms

In Table 4, we report the results of models based on two estimators and three outcome variables. Column 1 shows results of an IV estimator using the natural logarithm of fines imposed on the firms as the outcome variable, with number of executives jailed per firm as an instrument for jail time, based on Bound et al's (1995) instrumental-variable selection criteria. Columns 2 and 4 of Table 4 contain results of negative binomial regressions (NBR) of the number of executives charged in the investigation and executives sentenced to jail terms as outcome variables respectively. Columns 3 and 5 report estimates of incidences rates (IRR) obtained from NBR models in columns 2 and 4 respectively.[9] The covariates reflect factors related to the desirability of using criminal sanctions. We used number of executives charged and the number jailed as measures of DOJ intent to prosecute executives because the two measures reflect different factors; for example, number jailed is likely to be more sensitive to the size of the firm.

Therefore, examining the fine on the firms in the IV model in Table 4, both the amount of executive jail time and the level of personal fine imposed on executives are significantly positively associated with the fine imposed on a firm. We interpret these results to be consistent with imposing criminal penalties on the firms, ultimately targeting shareholders, and on officers within the firm who make decisions and benefit from them. It is not the case that penalizing officers is substituted for penalizing firms, and nor should that be expected. We should expect and do see the use of both fines and imprisonment for executives because their firms might well be paying the personal fines, giving a sound reason for using a non-monetary penalty on decision makers. Our results here are consistent with Connor and Miller (2011) who note complementarity between fining firms and penalizing executives.

The IV regression results show that deviation of the case-reported DOJ estimate of the cartel's economic damage from the base value calculated according to US Sentencing Guidelines §2R1.1 resulted in variations in fining firms.[10] The cases record whether the DOJ considers damages to be above or below the base calculation established in sentencing law. For estimates below the base value the coefficient on the damage estimate is 0.48, and for estimates above base rate the coefficient is 1.08. Both coefficients are of the expected positive sign and are significant.

[9] The IRR shows the incidence rate of each covariate relative to the reference category.
[10] §2R1.1 – Bid-Rigging, Price Fixing or Market-Allocation Agreements among Competitors.

This result implies that the fine responds to higher levels of damage, as predicted by the theory of optimal legal design in relation to the simple creation of deterrence. In the DOJ cases, factors inhibiting the level of the fine are often put forward by a firm's defense lawyers during settlement negotiations as mitigating factors. These can vary the fine from a base calculation carried out by the DOJ, and typically include whether the fine would bankrupt the firm. Thus, there are limits applying to fining,[11] but we still see the fine responding to damage levels. In practice, the DOJ rarely estimates damages precisely, but tends to plea bargain; it may know approximately what the damages are and is likely to press for a fine affected by numerous procedural issues, such as saving prosecutorial resources. But, again, we should still expect the fine to be influenced by damages and it is. However, bear in mind that simple deterrence could also result from private legal action, so responsiveness of the fine to damage levels is not a test of criminalization.

Dispersion of damages is not a significant influence on a firm's fine, which may be contrary to the predictions of the theory. The cases show whether there were just a few, or many, customers for the cartelizing firms. The dispersal range is not high within the data, since many of these cartels arise in industries such as auto components, which tend to have oligopoly buyers. There simply may not be sufficient dispersal to pick up an effect, but anyway it would be ambiguous because dispersion of damage could be dealt with through a class action for example. The fine may simply be one way to collect damages, which could be collected by alternative means so that dispersion is not the driving influence on the fine in this data set.

All cartels hide the damage they do to some extent. The hidden damage variable here reflects evidence in the DOJ cases that a cartel held secret meetings and covered up its pricing agreements and made it very difficult for detection of evidence in the case. Not all cartels in the sample were like this because the cases show that, once challenged, firms sometimes cooperated with the DOJ, as in the pharma cases for example. Hidden damage is anyway not a significant variable influencing the fine. This result is contrary to the theory of optimal legal design since enhanced difficulty in detection requires augmented penalties to sustain deterrence. A similar result was reported by Connor and Miller (2011). A caution: high damage is not necessarily indicative of a need for added deterrence because a wealthy firm could pay adequate compensation.

[11] Congress has authorized an alternative maximum fine of "not more than the greater of twice the gross gain or twice the gross loss" from the offense. 18 U.S.C. § 3571(d)

Whether the fined firm could easily pay the DOJ's calculation of a base fine, judged by comparing the firm's assets against the base fine is a significant negative influence on the size of the finally applied fine as suggested by theory.[12] This variable is a measure of the wealth constraint operating on the firm in relation to damage it has caused. The negative sign is consistent with the firm's being able to pay for its damage in response to private action recovering the harm necessitating less involvement by the regulatory authority. The negative sign is also maintained for the statistically significant interaction variable between "can pay" and the estimate of damage lying above the base fine. The two variables suggest that fines are set lower for firms that can repay high damages. The result on the interaction clarifies the theoretical ambiguity over the role of high damage: high damage can be dominated by the firm's ability to pay for damage.

The emergence of a whistle blower in a case, which reduces the hidden nature of cartel harm, has a significant negative association with the fine on the firm. This result is consistent with the theory, which implies reduced criminalization as detection becomes easier. Interacting the presence of a whistle blower with the existence of separate legal action has no significant association with the level of the fine imposed on firms. In fact, apart from the interaction of wealth effects and the higher damage level, the interactions give no significant results on the IV regression.

The existence of separate, private legal action by cartel victims does not have a statistically significant effect on the firm's fine. If separate action were significant, it would really support the reasoning just given. Nonetheless, the sign is negative in line with the suggestion that wealthy firms can be left to pay fines.

Pursuing Executives.

Turning now to the charging and jailing of executives, the negative binomial regressions of columns 2-5 in Table 4, the impact of personal fines is negative on the number of executives charged and positive on the number jailed but is statistically insignificant. Among executives, personal fines and eventual jailing may be substitutes in deterring officer involvement with price fixing, albeit imperfectly. Evidence does not really exist either way in these data However, jail

[12] The base fine is 20% of the volume of commerce, pursuant to U.S.S.G. § 2R1.1(d)(1) and §8C2.4(a) and (b). It is varied by a weighting system reflecting cooperation with the investigation and the extent of willful involvement of senior personnel and similar considerations. See US v. British Airways plc, Criminal No. 07-183 JDB, 2007 for details of the administrative calculation. We judged "can pay" relative to the firm's assets reported in the cases.

time does have a significant positive association with number of executives charged, which may be an effect to be expected in large cases.

A below base-level damage estimate gives a significantly lower coefficient for number of executives charged in the inquiry, according to the binomial regression in column 2. The statistically significant effect from low damage in reducing the numbers charged is consistent with theory since low damage levels are usually seen as a reason for containing criminalization. However, dispersal of damage has a significant negative relationship with the number of executives charged, which is contrary to theory. Dispersal should give a reason to increase criminalization. This has not happened in the sample of cases and tends to reject the idea that dispersion may be too restricted to give an effect. One of the possible measures of criminalization clearly has shown a negative effect. Furthermore, comparisons below for *imposed* sentences on executives shown in Table 5 also suggest that dispersion is not increasing criminal sanctions in the cases, contrary to theory.

Separate private legal action, which typically cites the executives as well as the firm, significantly reduces the number of executives charged and increases the number jailed. This result is consistent with a reduced DOJ perception of the need to pursue executives. It may also be consistent with convictions being used as evidence in private damages claims mounted after criminal cases have concluded. Hidden damage seems to increase the number of jailed executives.

There is a significant positive association between the interaction of the firm's ability to pay the fine with a damage estimate set below the base-level and the number of executives charged. However, there is no significant association when damage is above the base. These results may simply reflect a DOJ perception that a firm can easily pay a fine and there is not much of a deterrent; so, it charges officers. The results do not tell us much about containing "criminalization" in relation to wealth constraints operating on firms. In addition, there is a significant positive interaction effect between separate legal action with the presence of a whistle blower and the number of executives charged, which probably just reflects lower costs in taking the charging action. The IRR in columns 3 and 5 report incidences rates relative to reference groups in each variable. For example, looking at number of executives charged outcome variable, the result show that the incidence rate of executives charged is 0.37 times lower than reference point (i.e. DOJ

base rate") when damage estimate is below the DOJ base rate, but 1.3 times higher when damage estimate is above base rate.

Penalties on Executives

Corporations have no body to kick and no soul to damn (Coffee (1981). Deterrence of price fixing may well imply a need to impose personal penalties on decision makers within a cartel. We examined the factors influencing two penalties, the level of personal fines and the average executive jail time imposed in the 105 DOJ cases, bearing in mind that the fines are truncated data with an apparent minimum value of $20k and would anyway be left-censored at zero, whereas jail time is left censored. Therefore, we used a Tobit approach in obtaining the results reported in Table 5.

In the first two columns of Table 5, the imposed average executive fine has a significant positive association with the level of jail time imposed. The positive link is consistent with augmenting deterrence, and with the complementarity of penalties noted earlier: the DOJ does not appear to substitute jail for fines on executives. The most likely reason is that firms are expected to defray the cost of fines for executives. In the cases, there are no examples of reliance *purely* on fines for executives, which supports the suggestion that the DOJ sees jail as necessary to deter individual wrong doing.

In Table 4, the existence or otherwise of high damages had little association with the charging or conviction of executives, and there is similarly no association with the level of fines and amount of jail time in the Tobit modeling of Table 5. We should expect to find an association between the level of damage and a non-monetary penalty like executive jail time. The logic here is that executives could be made personally responsible for levels of damage that they would be unable to compensate for if pursued in civil courts.[13] The results here imply that the DOJ is not acting against executives when broad economic considerations suggest it should. The incidence rate for number of executives jailed is four times higher than when the damage caused by a firm's actions are hidden than when they are visible.

[13] Pursuing executives for damage in civil courts is possible based on the generally applicable common-law doctrine that we are all responsible for our intentional torts, or that management was negligent. Such cases would pierce the corporate veil and be costly, suggesting that high damage should generate more criminal pursuit of executives.

The variable for dispersal of damage is significant but of unanticipated sign in columns 3 and 4 of Table 5 in relation to jail time. However, dispersal is an ambiguous variable since dispersed damages could be adequately addressed by civil procedure, such as a class action, in some instances. Hidden damage has no significant effects on executive penalties, contrary to theoretical expectations.

The measure of the wealth constraint, that the firm can pay the DOJ base fine, has a significant negative association with executive fines in Table 5. A possible explanation for this result is that the DOJ and courts have a perception that the firms will pay the personal fines anyway. The same negative relationship is picked up in Table 4 for number of executives charged and jailed, although not with statistical significance. It was picked up as negative with statistical significance for the impact on company fines in Table 4. The results are consistent with a theoretical expectation that ability to pay damages indicates there is no need to consider other penalties. Of course, if the firm could not pay damages, nor could it pay a fine. Therefore, the observation that *additional* fines for executives are less frequently applied when the firm can pay damages helps to weigh the evidence in favor of its supporting the theoretical expectation that ability to pay by the firm results in less resort to criminal penalties.

The existence of a whistle blower is significantly negatively associated with executive fines in Table 5, and has a negative, but not significant, effect on jail time. We should expect this result since the whistle blower is most likely a cooperating executive whose fine will be reduced. There may be several such cooperative witnesses in a case. The results from the binomial regression in Table 4 picked up a negative effect on executives charged that was not statistically significant. Whistle blowers appear to be incentivized in the current DOJ leniency program.

The existence of a separate legal action, which typically cites the executives as well as the firm,[14] has a significant positive association on the scale of executive fines in Table 5. It also increased the number of executives jailed in Table 4 and has the anticipated positive sign without statistical significance for jail time in Table 5. The most likely explanation for these results is that private claimants are awaiting the result of DOJ actions to strengthen the evidence for a private claim. Inspection of the cases did show that private actions were usually outstanding at the close of the DOJ case. Thus, the impact of the variable for private action is more of a test of civil procedure considerations than of optimal legal design from a social perspective.

No interaction term is significant for the impact of variables on executive fines or jail time in Table 5.

Discussion and Conclusions

Looking over the statistical evidence from these DOJ cases, we can assess the impact of criminalizing variables on the criminal-law sanctions (i) fines on firms, (ii) charging executives, (iii) jailing executives, (iv) fining executives and (v) jail time for executives. The results in Tables 5 and 6 point out a firm's ability to pay off its anticompetitive damage as a key factor in explaining whether criminal-law sanctions are applied to enhance penalties beyond those available to private citizens in civil cases. The ability to pay "base" damages is a significant reducer of the fine on a firm, and of fines applied to its executives. We also find weaker evidence that the more hidden damage is, then the more likely it is that executives will be jailed. The effect of "ability to pay" is consistent with a theoretical expectation that the presence of a wealth constraint, giving difficulty in compensating for damage in tort, would require criminalization to enhance deterrence; its absence makes criminalization less relevant. Similarly, we would expect more hidden damage to make detection difficult so that deterrence of harm would require enhancement of penalties. We can conclude that some sanctions in our data respond to important criminalizing variables.

Some possibly criminalizing variables are ambiguous in their impact. The level of damage has a significant impact on the level of fines. However, a sufficiently wealthy firm can pay high damages in tort, so high damage is not a clear driver of criminalization. In these case data, the interaction of high damage with "ability to pay" shows a significant reduction in the level of fines on the firm, which does give support to an interactive role that is not ambiguous. This result from interacting wealth constraints and level of harm is distinctive compared with earlier work (Connor and Miller 2010, 2011, and 2013). It is also consistent with the weak evidence that the more hidden damage is, then the more likely it is that executives will be jailed.

The case data also suggest that two variables that are of theoretical interest, the presence of a whistleblower and the existence of separate private legal action, are better regarded as control variables. In the current legal environment, private action will follow regulatory enforcement since private litigants routinely use the evidence of the regulatory action. Thus, private action follows regulatory action but does not provide evidence over the desirability of either. In these

case data, we see a significant positive association with the level of executive fines (Table 5) and with the number of executives charged (Table 4). The other more control-like variable is the presence of a whistleblower. This presence reduces the cost of pursuing firms and executives, which shows up in the significant negative effects on fine levels for executives and the firms.

In conclusion, we have shown that the criminal sanctions applied in these antitrust cases shows significant responsiveness to variables derived from the economic analysis of criminal law. The results are reassuring given the growing question concerning criminalization trends in modern antitrust enforcement. However, lest this conclusion seems over sanguine, we point out that Section 4 of the Clayton Act allows any person injured because of conduct prohibited by antitrust laws may bring federal suit to recover treble damages, but that the final judgment in the "criminalized" case will neither impair nor assist the bringing of such actions. This approach seems to be wrong in economic logic. Criminalization needs to augment private action and should not be considered separately. Also, statistically, we picked up the fact that private action does interact with criminalized sanctions.

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Table 1: Variables used in estimation (DOJ Sherman Anti-trust Act violation)

Variable name & abbreviation	Variable name denotations	Description	Classification and scale of data
Firm fines	FFines		
Number of Executives Charged (exechrg)	ExChrg	Number of firm's executives charged in enquiry	0= no form executives charged, actual integer number of executives charged (count variable integers). Ratio scale.
Number of Executives Jailed	ExJail	Number of firm's executives sentenced to jail	0= no form executives jailed, actual integer number of executives charged (count variable integers). Ratio scale.
Jail time (exejail)	JTime	Length of custodial sentence (months) imposed on firm's executives	0= no jail term imposed on firm executive, positive real numbers for actual number of calendar months firm executives were sentenced to jail terms. Ratio scale, continuous.
Personal Fines (pfines)	PFines	Total amount of personal financial fines imposed on executives ('000 US$). Actual amount of financial penalty in US dollars	Polytomous; 0 = no financial fines, $ 20k minimum where fines were imposed. Ratio scale, continuous.
DOJ Damage Estimate (DOJdamest)	DamEst	Gradation levels of damage caused by the offence	Dichotomous variable; 0 = at base, 1 = below base, 2= above base. Ordinal scale.
Damage Dispersal (damdisp)	DamDisp	Characterization of spread of damaged caused by offence	Dichotomous; 0= damage local, 1 damage dispersed. Nominal scale, Categorical scale.
Damage Visibility (damvis)	DamVis	Characterization of visibility of damage caused by firm's activity	Dichotomous; 0 = damage visible, 1 damage hidden. Nominal scale, Categorical scale
Wealth Constraint (weltconst)	WelCon	Characterization of firm's ability to pay DOJ base damage charge	Dichotomous; 0 =cannot pay DOJ base charge, 1 can pay DOJ base charge. Nominal scale, Categorical variable.
Whistle-blower (whisblo)	WhiBlo	Involvement of whistle-blower(s) in the case	Dichotomous; 0 =no whistle-blower involved, 1 =whistle-blower involved. Nominal scale, Categorical variable.
Separate Legal Action (seplegact)	SepLegAc	Whether a separate legal action(s) associated with case	Dichotomous; 0 =no separate legal action, 1= no separate legal action. Nominal scale, Categorical variable.

Table 2: Fines imposed on firms by DOJ (× $10 million)

Firm fines	Summary statistics							
	Mean	SD	Min	Max	CV	IQR	N	Comments
Executives Charged per firm								Average fine imposed on firm:
Firms with exec. charged	96.75	116.7	10.40	500	1.207	97.89	87	Larger for firms with execs charged than
Firms with no exec. charged	34.37	24.75	10	100	0.720	25.50	18	firms with no execs charged
Jail time								
Firms with exec jailed	138.3	144.7	11	500	1.046	156	40	Larger for firms with execs jailed than
Firms with no exec jailed	53.87	62.05	10	350	1.152	42.30	65	firms with no execs jailed
Personal fines								
Firms with exec fined	141.1	145.7	11	500	1.033	160	39	Larger for firms with execs fined than
Firms with no exec fined	53.55	61.48	10	350	1.148	50.80	66	firms with no execs fined
DOJ damage estimate								
Base	69.42	112.3	10.40	470	1.618	38.50	45	Largest for firms above base damage
Below	87.53	86.11	10	500	0.984	86.50	43	estimate than firms below above base
Above	126.4	144.4	15.70	500	1.143	96	17	estimate
Damage dispersal								
Local	98.81	119.4	10.50	500	1.208	94	55	Larger for firms locally dispersed damage
Dispersal	72.02	96.02	10	500	1.333	53.30	50	than firms with widely dispersed damage
Damage visibility								
Visible	84.93	112.8	10	500	1.328	64	97	Larger for firms with hidden damage than
Hidden	99.63	50.40	43	185	0.506	79.50	8	firms with dispersed damage
Wealth constraint								
Cannot pay DOJ base	97.58	122.8	10.40	500	1.258	88.89	54	Larger for firms which cannot pay DOJ
Can pay DOJ base	73.85	92.36	10	470	1.251	64.10	51	base fine than firms which can pay
Whistle-blower								
No whistle-blower	80.85	96.51	10	470	1.194	75.90	48	Larger for firms with cases involving a
Whistle-blower	90.44	119.5	10.40	500	1.322	87.90	57	whistle-blower than firms without
Separate Legal Action								
No separate legal action	80.82	100.8	10	470	1.247	81.83	60	Larger for firms with cases involving
Separate legal action	93.03	120.4	10.40	500	1.294	54	45	separate legal than firms without
USA (Domestic) vs Int. firms								
Domestic	22.30	9.758	15.40	29.2	0.438	13.80	2	Larger for non-US registered firms than
Foreign	88.71	110.5	10	500	1.246	82.17	101	US registered firms
Puerto Rico	15.60	1.980	14.20	17	0.127	2.800	2	
Continent of firm								
Asia	91.30	114.6	10.40	500	1.256	85.58	64	Larger for European firms followed by
Australia	61	.	61	61	.	0	1	Asian firms than US-based firms
Europe	93.90	124.6	10	500	1.327	99.30	25	
North America	48.21	34.13	14.20	110	0.708	66.60	14	
South America	109	.	109	109	.	0	1	
S&P-MSCI GICS (Sectors)†								
Consumer Discretionary	109.0	135.6	11	500	1.244	104.5	36	Larger for in IT sector, followed by firms
Healthcare	114.5	170.8	14	500	1.491	128.5	8	in healthcare, and Consumer
Industrials	66.53	82.13	10.40	350	1.235	47.15	36	Discretionary (Automobiles &
Information Technology	150.0	105.8	21.10	300	0.705	101	5	Components) than other firms in other
Materials	52.52	39.38	10	135	0.750	46.15	20	sectors.

Notes: Standard deviation (SD), Minimum (Min), Maximum (Max), Coefficient of Variation (CV), Interquartile range (IQR), Number of observations (N). †Firm sector classification based on Standard & Poor's and MSCI joint Global Industry Classification Standard (GICS).

Table 3: Jail time imposed on firm executives by DOJ (months)

Jail time	Summary statistics							Comments
	Mean	SD	Min	Max	CV	IQR	N	Average executive jail time
Jail time by:								
DOJ damage estimate								
Base	12.59	21.66	0	105	1.721	12	45	Largest for firms DOJ base damage
Below	8.791	15.44	0	69	1.756	13	43	estimate, followed by firms with below
Above	3.176	6.327	0	24	1.992	6	17	damage estimate
Damage dispersal								
Local	15.26	22.23	0	105	1.456	24	55	Larger for firms with local damage than
Dispersal	3.180	6.259	0	24	1.968	6	50	firms with widely dispersed damage
Damage visibility								
Visible	9.490	18.16	0	105	1.913	12	97	Larger for executives of firms with hidden
Hidden	9.750	10.54	0	26	1.081	18.5	8	damage than firms with visible damage
Wealth constraint								
Cannot pay DOJ base	4.713	10.24	0	49	2.173	6.50	54	Larger for executives of firms which can pay DOJ base fine than firms which
Can pay DOJ base	14.59	22.05	0	105	1.512	24	51	cannot
Whistle-blower								
No whistle-blower	15.14	22.43	0	105	1.482	24	48	Larger for executives of firms with cases
Whistle-blower	4.772	10.35	0	49	2.168	6	57	involving a no whistle-blower
Separate Legal Action								
No separate legal action	11.15	20.73	0	105	1.859	12	60	Larger for executives of firms with cases
Separate legal action	7.322	12.33	0	50	1.684	8	45	involving no separate legal action
USA (Domestic) vs Int. firms								
Domestic	20	28.28	0	40	1.414	40	2	Average jail time larger for executives of non-US registered firms than executives
International	9.490	17.67	0	105	1.862	12	101	of US registered firms
Puerto Rico	0	0	0	0	.	0	2	
Continent of firm								
Asia	12.81	21.00	0	105	1.639	22.5	64	
Australia	6	.	6	6	.	0	1	Average executive jail time largest for
Europe	3.420	6.573	0	24	1.922	6	25	Asian firms, followed by executives of
North America	6.214	11.50	0	40	1.851	9	14	US registered firms
South America	0	.	0	0	.	0	1	
S&P-MSCI GICS (Sectors)†								
Consumer Discretionary	15.08	23.81	0	105	1.578	22.5	36	Average executives jail time largest for
Healthcare	3.063	4.296	0	9	1.403	7.75	8	firms in IT sector , followed by firms in consumer discretionary sector
Industrials	4	10	0	45	2.500	0	36	
Information Technology	19.20	17.17	0	44	0.894	19	5	
Materials	9.550	15.85	0	50	1.660	16	20	

Notes: Same as Table 1.

Table 4 Instrumental variable and negative binomial regressions

	Dependent variable				
	Log(fines)	No. Execs Charged		No. Execs jailed	
Variables	IV-GMM	Neg. Binomial	IRR	Neg. Binomial	IRR
Exec Jail Time	0.122***	0.00711	1.007	0.190***	1.209
	(0.0250)	(0.0182)	(0.018)	(0.0320)	(0.039)
Personal Fines	0.112***	-0.0890	0.915	0.0941	1.099
	(0.0264)	(0.0753)	(0.0689)	(0.0815)	(0.090)
DOJ Damage Est					
Below	0.481*	-0.995**	0.370**	-0.131	0.878
	(0.263)	(0.398)	(0.147)	(0.511)	(0.448)
Above	1.081***	0.276	1.318	-0.372	0.689
	(0.310)	(0.378)	(0.499)	(0.655)	(0.272)
Damage Dispersal					
Dispersed	-0.113	-1.440***	0.237***	-0.406	0.666
	(0.248)	(0.331)	(0.078)	(0.408)	(0.272)
Damage Visibility					
Hidden	0.103	0.293	1.340	1.387**	4.001
	(0.430)	(0.774)	(1.036)	(0.683)	(2.730)
Wealth Constraint					
Can Pay DOJ Base	-1.012***	-0.755	0.470	-0.376	0.686
	(0.370)	(0.667)	(0.313)	(0.910)	(0.624)
Whistle-blower					
Whistle-blower	-0.625*	-0.794	0.452	0.160	1.173
	(0.332)	(0.583)	(0.264)	(0.922)	(1.081)
Legal Action					
Separate Legal Action	-0.245	-0.720*	0.487*	0.812**	2.253
	(0.259)	(0.408)	(0.198)	(0.409)	(0.921)
Interactions					
Damage Hidden #Whistle-blower	0.216	0.823	2.276	-0.500	0.606
	(0.560)	(0.958)	(2.180)	(0.999)	(0.606)
Can Pay Base # DOJ Est.(Below)	0.356	1.501***	4.486***	-0.143	0.867
	(0.360)	(0.510)	(2.288)	(0.615)	(0.532)
Can Pay Base & DOJ Est.(Above)	-1.328***	0.425	1.530	0.415	1.514
	(0.475)	(0.833)	(1.274)	(1.288)	(1.950)
Sep. Legal Action# Whistle-blower	0.173	1.193**	3.398**	-0.819	0.441
	(0.341)	(0.516)	(1.703)	(0.622)	(0.274)
Constant	3.867***	4.097***	60.137***	-1.393	0.248
	(0.442)	(0.667)	(40.137)	(0.974)	(0.242)
Log likelihood	-	-394.850		-96.18	
LR χ^2 (13)	301.49‡ [0.000]	46.14[0.000]		79.56[0.000]	
Pseudo -R^2		0.0552		0.2926	
ln(α)	-	-0.037 (0.164)		-1.291 (0.550)	
α		0.964 (0.158)		0.275 (0.151)	
LR test α=0 $\bar{\chi}^2$		776.42[0.000]		6.63[0.005]	
R^2	0.302				

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. IRR denotes incident rate. Probabilities of Chi-square tests and F-test in square brackets; IV-GMM: Number of executives jailed per firm used as instrument for Executive Jail Time. † indicates F (13, 91) test ‡ indicates Wald chi2 test.

Table 5 Censored regression of executive personal fines and jail time

	Tobit model			
	Execs fine		Execs jail time	
	Censoring points		Censoring points	
Covariates	LL=$0	LL=$20k	LL = 0	LL=median
Exec. Jail Time	0.269***	0.270***	-	-
	(0.0727)	(0.0840)		
Personal Fines	-	-	0.158	0.412
			(2.136)	(2.692)
DOJ Damage Est				
Below	-0.305	0.161	-18.42	-19.92
	(1.016)	(1.301)	(14.02)	(19.72)
Above	-0.409	-1.776	-1.088	-2.164
	(0.815)	(1.288)	(12.24)	(17.45)
Damage Dispersal				
Dispersed	-0.180	-0.608	-27.79***	-42.47***
	(0.461)	(0.770)	(9.887)	(14.61)
Damage Visibility				
Hidden	1.729	2.260	13.99	3.930
	(1.087)	(1.438)	(12.46)	(20.45)
Wealth Constraint				
Can Pay DOJ Base	-9.658***	-9.284***	-9.756	13.08
	(3.187)	(3.525)	(20.40)	(23.69)
Whistle-blower				
Whistle-blower	-8.097**	-7.278**	-25.86	-2.661
	(3.176)	(3.578)	(19.97)	(20.89)
Legal Action				
Separate Legal Action	1.705**	2.593**	1.952	3.589
	(0.749)	(1.001)	(12.93)	(13.23)
Interactions				
Damage Hidden #Whistle-blower	3.194	3.233	25.10	33.92
	(2.454)	(2.763)	(21.36)	(29.61)
Can Pay Base # DOJ Est.(Below)	0.336	-0.168	7.376	5.362
	(1.261)	(1.595)	(17.81)	(22.77)
Can Pay Base & DOJ Est.(Above)	1.369	-10.68	-3.314	-186.4
	(1.050)	(0.000)	(29.25)	(0)
Sep. Legal Action# Whistle-blower	-1.905	-3.214*	6.054	-3.703
	(1.319)	(1.836)	(17.19)	(20.41)
Constant	5.879*	4.559	21.75	3.633
	(3.166)	(3.575)	(20.93)	(24.28)
Sigma	2.022	2.497	11.368	4.298
	(0.022)	(0.450)	(1.046)	(0.141)
Observations	105	105	105	105

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix – Cases

Cases were accessed via the US Department of Justice, Antitrust Division, at https://www.justice.gov/atr/sherman-act-violations-yielding-corporate-fine-10-million-or-more. As the website suggests, we focused on larger cases, where a fine exceeding $10 million had been levied. We focused on 105 cases over the period 1999 to 2015 with sufficiently complete data for statistical purposes and followed up by reviewing press and DOJ announcements concerning numbers of executives involved and punishment variables.

Cases

1. AU Optronics Corporation of Taiwan (2012)
2. F. Hoffmann-La Roche, Ltd. (1999)
3. Yazaki Corporation (2012)
4. Bridgestone Corporation (2014)
5. LG Display Co., Ltd (2009)
6. Société Air France/Koninklijke Luchtvaart Maatschappij, N.V. (2008) (KLM)
7. Korean Air Lines Co., Ltd. (2007)
8. British Airways PLC (2007)
9. Samsung Electronics Company, Ltd./Samsung Semiconductor, Inc. (2006)
10. CHI MEI Optoelectronics Corporation (2010)
11. Furukawa Electric Co. Ltd. (2012)
12. Hitachi Automotive Systems, Ltd (2014)
13. Mitsubishi Electric Corporation (2014)
14. Hynix Semiconductor Inc. (2005)
15. Infineon Technologies AG (2004)

16. Mitsuba Corporation (2014)

17. Mitsubishi Corp. (2001)

18. Toyo Tire & Rubber Co., Ltd. (2014)

19. Sharp Corporation (2009)

20. Cargolux Airlines International S.A. (2009)

21. Japan Airlines International Co. LTD (2008)

22. Lan Cargo S.A./Aerolineas Brasileiras S.A. (2009)

23. JTEKT Corporation (2014)

24. Embraco North America (2011)

25. Elpida Memory, Inc. (2006)

26. Dupont Dow Elastomers L.L.C. (2005)

27. Denso Corporation (2012)

28. All Nippon Airways Co., Ltd. (2011)

29. Takeda Chemical Industries, Ltd. (1999)

30. Takata Corporation (2014)

31. NSK Ltd. (2014)

32. Kawasaki Kisen Kaisha, Ltd. (2015)

33. Bayer AG (2004)

34. Chunghwa Picture Tubes, Ltd. (2009)

35. Qantas Airways Limited (2008)

36. Cathay Pacific Airways Limited (2008)

37. Nippon Yusen Kabushiki Kaisha (2015)

38. Koito Manufacturing Co., Ltd. (2014)

39. Bilhar International Establishment (2002)

40. Daicel Chemical Industries, Ltd. (2000)

41. ABB Middle East & Africa Participations AG (2001)

42. NGK Spark Plug Co., Ltd. (2014)

43. SAS Cargo Group, A/S (2008)

44. Crompton (2004)

45. Haarmann & Reimer Corp. (1997)

46. Asiana Airlines Inc. (2009)

47. Panasonic Corporation (2011)

48. Singapore Airlines Cargo Pte Ltd. (2011)

49. Panasonic Corporation (2013)

50. Sotheby's Holdings Inc. (2001)

51. Nippon Cargo Airlines Co. Ltd. (2009)

52. Maxzone Vehicle Lighting Corp. (2012)

53. Odfjell Seachem AS (2003)

54. Martinair Holland N.V. (2008)

55. Solvay S.A. (2006)

56. Eisai Co., Ltd. (1999)

57. China Airlines Ltd. (2011)

58. Northwest Airlines, LLC (2010)

59. Hoechst AG (1999)

60. Aisin Seiki Co., Ltd. (2015)

61. Bayer Corporation (2005)

62. Akzo Nobel Chemicals International B.V. (2006)

63. Samsung SDI (2011)

64. Hitachi Displays Ltd. (2009)

65. Philipp Holzmann AG (2000)

66. Hannstar Display Corporation (2010)

67. Irving Materials, Inc (2005)

68. Arteva Specialties (2003)

69. Bridgestone Corporation (2012)

70. Toyoda Gosei Co., Ltd. (2015)

71. Epson Imaging Devices Corporation (2009)

72. Nippon Express Co., Ltd. (2013)

73. Hitachi-LG Data Storage, Inc. (2012)

74. Nippon Gohsei (1999)

75. Fujikura Ltd. (2012)

76. Showa Corporation (2014)

77. Bax Global Inc. (2012)

78. Jo Tankers, B.V. (2004)

79. Diamond Electric Manufacturing Corp. (2013)

80. Tokai Rika Co., Ltd. (2013)

81. Polar Air Cargo LLC (2011)

82. Crowley Liner Services, Inc. (2012)

83. EL AL Israel Airlines Ltd. (2009)

84. Yusen Logistics Co., Ltd (2013)

85. Horizon Lines, LLC (2011)

86. Dockwise N.V. (1998)

87. Mitsubishi Heavy Industries, Ltd. (2014)

88. Autoliv, Inc. (2012)

89. Sea Star Line LLC (2012)

90. Merck KgaA (2000)

91. T.RAD Co., Ltd. (2014)

92. Valeo Japan Co., Ltd. (2014)

93. Minebea Co., LTD (2015)

94. EVA Airways Corporation (2011)

95. Degussa-Huls AG (2000)

96. Akzo Nobel Chemicals, BV (2001)

97. Hoechst Aktiengesellschaft (2003)

98. Panalpina World Transport (Holding) Ltd. (2012)

99. Yamashita Rubber Co., Ltd. (2013)

100. Ueno Fine Chemicals Industry, Ltd. (2001)

101. Sanyo Electric Co., Ltd. (2013)

102. Zeon Chemicals L.P. (2005)

103. Kintetsu World Express (2013)

104. De Beers Centenary AG (2004)

105. Morganite, Inc. (2003)