Internet Appendix for:

Assessing the Objective Function of the SEC against Financial Misconduct: A Structural Approach

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APPENDIX 1. CONCEPTUAL ILLUSTRATION OF PROPOSITION 1

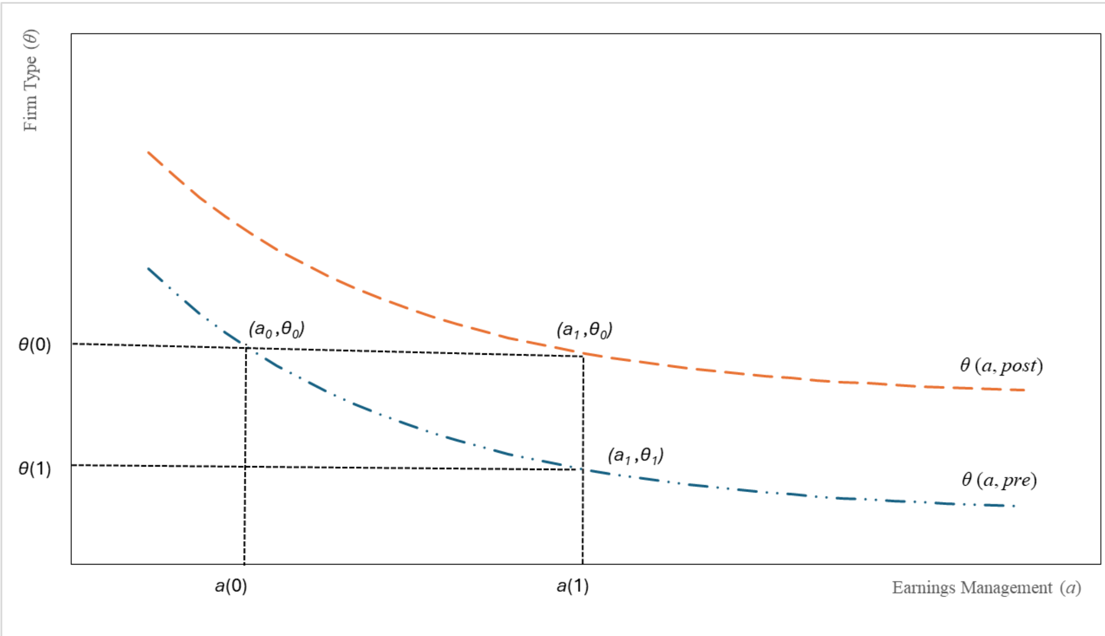
In what follows, we use Figure IA.1 to illustrate the intuition of Proposition 1, by demonstrating how the transformations $a_l = G_{pre}^{-1}\left[G_{post}(a_{l-1})\right]$ and $\theta_l = \left[e'_{post}(a_l)/e'_{pre}(a_l)\right]\theta_{l-1}$ provide partial identification of the model. In Panel A, the x-axis represents the level of earnings management a, and the y-axis corresponds to the firm type θ. The figure depicts the curves $\theta(a, pre)$ and $\theta(a, post)$, which are the inverse functions of $a(\theta, pre)$ and $a(\theta, post)$, respectively. Let us start with a normalized pair (a_o, θ_o), which is a point on the $a(\theta, pre)$ curve.[1] The identification strategy in Proposition 1 is to partially uncover the curves $\theta(a, pre)$ and $\theta(a, post)$. Specifically, starting from (a_o, θ_o), we uncover the curves $\theta(a, pre)$ and $\theta(a, post)$, at least for some values of a. This strategy is feasible because, although the earnings management levels $a(\tilde{\theta}, pre)$ and $a(\tilde{\theta}, post)$ for a given type $\tilde{\theta}$ generally differ, they occupy the same position in the *order* of earnings management levels set by all firms in the pre- and post-SOX periods, respectively. For example, if $\tilde{\theta}$ is such that $a(\tilde{\theta}, pre)$ lies in the α-percentile of the distribution of earnings management pre-SOX, then $a(\tilde{\theta}, post)$ would also be in the α-percentile of the distribution of post-SOX earnings management. With this insight, given an arbitrary level of earnings management in the pre period, we can determine the level of earnings management chosen by the same firm type in the post period. This provides the basis for the horizontal transform in the diagram, represented by $a_l = G_{pre}^{-1}\left[G_{post}(a_{l-1})\right]$ in Proposition 1. Applying this horizontal transform allows us to obtain the point (a_1, θ_0) on the $\theta(a, post)$ curve. Second, using the first-order condition of the firm's problem for any given $a(\tilde{\theta})$ in the pre period, we can identify the

[1] This normalization is without loss of generality because, both in the objective function of the firm and in that of the regulator, the firm type θ and the baseline benefit function $b(\cdot)$ interact with each other in a multiplicatively separable way. Thus, any initial normalization (a_o, θ_o) is fully compensated by the subsequent identification of a function $b(\cdot)$ that is consistent with the normalization criteria employed.

firm type that chooses the same level of earnings management in the post period. This gives us the vertical transform in the diagram, represented by the $\theta_l = \left[e'_{post}(a_l)/e'_{pre}(a_l)\right]\theta_{l-1}$ in Proposition 1. Using the vertical transform, from (a_1, θ_0) on the $\theta(a, post)$ curve, we can obtain (a_1, θ_1) on the $\theta(a, pre)$ curve. By iteratively applying the horizontal and vertical transforms, we achieve the partial identification of both the $\theta(a, pre)$ and $\theta(a, post)$curves, as illustrated in Panel B.

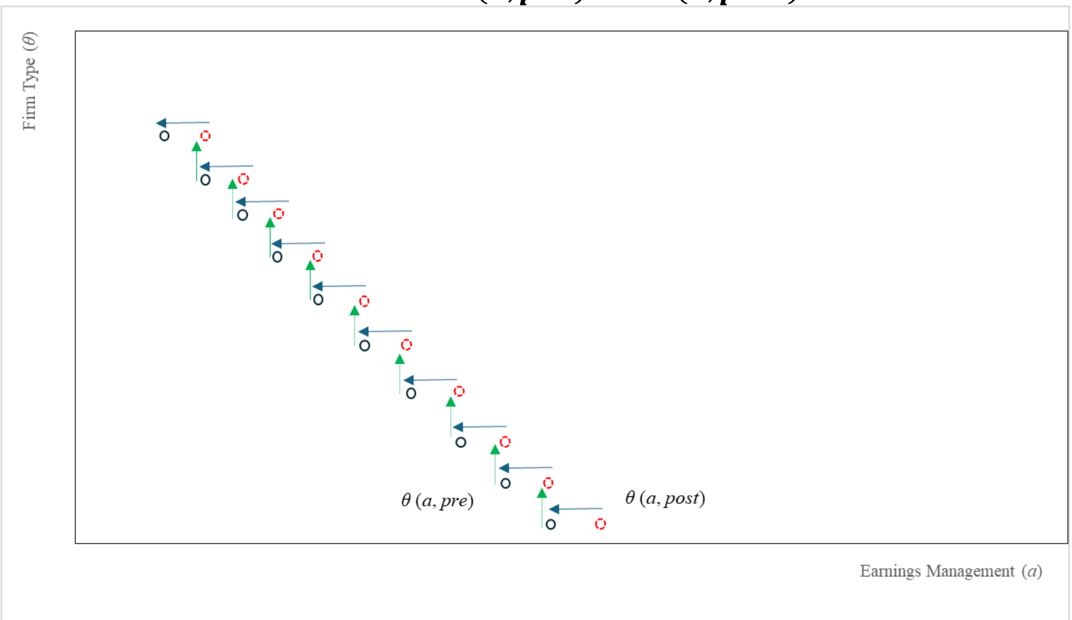
Figure IA.1: Conceptual Illustration of Proposition 1

Panel A: Horizontal and Vertical Transforms



This figure illustrates the intuition of Proposition 1. The curves $\theta(a, pre)$ and $\theta(a, post)$ are the inverse functions to $a(\theta, pre)$ and $a(\theta, post)$, respectively. Starting with a normalized pair (a_o, θ_o), we can obtain (a_1, θ_0) on the $\theta(a, post)$ curve by applying the horizontal transform. Then, using the vertical transform, from (a_1, θ_0) on the $\theta(a, post)$ curve, we can obtain (a_1, θ_1) on the $\theta(a, pre)$ curve.

Panel B: Partial Identification of $\theta(a, pre)$ and $\theta(a, post)$



This figure illustrates the partial identification of both the pre- and post- θ curves through iterative application of horizontal and vertical transforms.

Appendix 2. Estimation Procedure

Step 1. We estimate the expected penalties, $e_j(a|\mathbf{x})$ for $j = \{pre, post\}$, using the Tobit model specified in Section 5.2. Let $\hat{e}_j(a|\mathbf{x})$ denote the resulting estimated expected penalty function. We then calculate the marginal expected penalty, $\hat{e}'_j(a|\mathbf{x})$, by taking the derivative of $\hat{e}_j(a|\mathbf{x})$.

As for the distribution of earnings management, $G_j(\cdot|\mathbf{x})$ for $j = \{pre, post\}$, we estimate it parametrically, following the maximum-likelihood procedure presented in Section 5.3. Denote by $\hat{G}_j(\cdot|\mathbf{x})$ the estimate of $G_j(\cdot|\mathbf{x})$.

Step 2. Denote by $a(\theta, j|\mathbf{x})$ the mapping between the type of a company with observable characteristics $\mathbf{x}$ and its equilibrium level of earnings management under regime j. Proposition 1 shows that we can identify $a(\theta, j|\mathbf{x})$ for a discrete set of company types, $\theta_{l\in\{0,1,2,\ldots,L\}}$. We obtain estimates $\hat{a}(\theta, j|\mathbf{x})$ for $a(\theta, j|\mathbf{x})$ by directly following the steps in the proof of Proposition 1. Specifically, we begin by normalizing $\hat{\theta}(1, post) = 1$.[1] Given such a normalization, we let $\hat{a}_0(\mathbf{x}) = \hat{\theta}_0(\mathbf{x}) = 1$, and define recursively

$$\hat{a}_l(\mathbf{x}) \equiv \hat{G}_{pre}^{-1}\left[\hat{G}_{post}\left[\hat{a}_{l-1}(\mathbf{x})|\mathbf{x}\right]|\mathbf{x}\right],$$

$$\text{and} \qquad \hat{\theta}_l(\mathbf{x}) \equiv \frac{\hat{e}'_{post}\left[\hat{a}_l(\mathbf{x})|\mathbf{x}\right]}{\hat{e}'_{pre}\left[\hat{a}_l(\mathbf{x})|\mathbf{x}\right]}\hat{\theta}_{l-1}(\mathbf{x}),$$

for $l \in \{1, 2, \ldots, L\}$. We then define $\hat{\theta}_l^{post}(\mathbf{x}) \equiv \hat{\theta}_l(\mathbf{x})$; $\hat{\theta}_l^{pre}(\mathbf{x}) \equiv \hat{\theta}_{l-1}(\mathbf{x})$; $\hat{a}_l^{post}(\mathbf{x}) \equiv \hat{a}_l(\mathbf{x})$; and $\hat{a}_l^{pre}(\mathbf{x}) \equiv \hat{a}_l(\mathbf{x})$, for every l. Finally, we define $\hat{a}\left(\hat{\theta}_l^j(\mathbf{x}), j|\mathbf{x}\right) \equiv \hat{a}_l^j(\mathbf{x})$, for $j \in \{pre, post\}$ and any $l \in \{0, 1, 2, \ldots, L\}$.

Step 3. Abstracting away momentarily from variation in the model primitives driven by observable company characteristics (represented by the vector $\mathbf{x}$), let $\Psi_j = \frac{1-\psi_j}{\psi_j}$ and $\Gamma_j \equiv \frac{\gamma_j}{\psi_j}$. The goal of the third estimation step is to estimate Ψ_j and Γ_j, which will then allow us to easily obtain estimates for ψ_j and γ_j. To estimate Ψ_j and Γ_j, we take a minimum-distance approach, based on a distance function that we derive below in two parts.

To derive the first part of the distance function, let $Q(\alpha)$ be the α-quantile of $F(\cdot)$, the distribution of company types. Kang and Silveira (2021) show that we can rewrite (7) the first-order condition of the SEC, as

$$\frac{Q'(\alpha)}{Q(\alpha)} = \frac{\Gamma_j\left[G_j^{-1}(\alpha)\right]^{r-1} - e'_j\left[G_j^{-1}(\alpha)\right]\Psi_j}{e'_j\left[G_j^{-1}(\alpha)\right](1-\alpha)}, \tag{A.1}$$

[1] It is worth emphasizing that this normalization is without loss of generality. To see why, note that the company's objective function is $\theta b(a) - e(a)$. Thus, multiplying all values of θ by an arbitrary constant and dividing $b(a)$ by the same constant produces an observationally-equivalent model.

for $j \in \{pre, post\}$.[2] Integrating both sides of the equation above between arbitrary values $\underline{\alpha}$ and $\alpha \in [0,1]$ gives

$$\log \frac{Q(\alpha)}{Q(\underline{\alpha})} = \int_{\underline{\alpha}}^{\alpha} \left(\Gamma_j \frac{\left[G_j^{-1}(u)\right]^{r-1}}{e_j'\left[G_j^{-1}(u)\right]} - \Psi_j \right) \frac{1}{(1-u)} du. \tag{A.2}$$

Since $\underline{\alpha}$ and α are arbitrary, we can replace $Q(\alpha)$ and $Q(\underline{\alpha})$ in (A.2) by any pair of types from the discrete set $\theta_{l \in \{0,1,2,\ldots,L\}}$ that is identified according to Proposition 1. In particular, we have that

$$\log \frac{\theta_l}{\theta_0} = \Gamma_j \int_{G_j[a(\theta_0,j)]}^{G_j[a(\theta_l,j)]} \frac{\left[G_j^{-1}(u)\right]^{r-1}}{e_j'[G_j^{-1}(u)]\,(1-u)} du - \Psi_j \int_{G_j[a(\theta_0,j)]}^{G_j[a(\theta_l,j)]} \frac{1}{(1-u)} du, \tag{A.3}$$

for any $l \in \{1,2,\ldots,L\}$ and $j \in \{pre, post\}$. As the equation holds for any l, we have that

$$\sum_l \left\{ \log \frac{\theta_l}{\theta_0} - \Gamma_j \int_{G_j[a(\theta_0,j)]}^{G_j[a(\theta_l,j)]} \frac{\left[G_j^{-1}(u)\right]^{r-1}}{e_j'\left[G_j^{-1}(u)\right](1-u)} du + \Psi_j \int_{G_j[a(\theta_0,j)]}^{G_j[a(\theta_l,j)]} \frac{1}{(1-u)} du \right\}^2 = 0, \tag{A.4}$$

for $j \in \{pre, post\}$. Equation (A.4) constitutes the first part of the distance function.

For the second part, note that (A.1) holds for both $j = pre, post$. So, for any value $\alpha \in (0,1)$, we can write

$$\frac{\Gamma_{post}\left[G_{post}^{-1}(\alpha)\right]^{r-1}}{e_{post}'\left[G_{post}^{-1}(\alpha)\right]} - \frac{\Gamma_{pre}\left[G_{pre}^{-1}(\alpha)\right]^{r-1}}{e_{pre}'\left[G_{pre}^{-1}(\alpha)\right]} + \Psi_{pre} - \Psi_{post} = 0. \tag{A.5}$$

Considering a grid $\mathbf{U} = \{\alpha_1, \ldots, \alpha_{N_U}\}$ in the $(0,1)$ interval, (A.5) implies

$$\sum_{\alpha \in \mathbf{U}} \left\{ \frac{\Gamma_{post}\left[G_{post}^{-1}(\alpha)\right]^{r-1}}{e_{post}'\left[G_{post}^{-1}(\alpha)\right]} - \frac{\Gamma_{pre}\left[G_{pre}^{-1}(\alpha)\right]^{r-1}}{e_{pre}'\left[G_{pre}^{-1}(\alpha)\right]} + \Psi_{pre} - \Psi_{post} \right\}^2 = 0. \tag{A.6}$$

Given any vector of company characteristics $\mathbf{x}$, we obtain estimates of $\Gamma_{pre}(\mathbf{x})$; $\Psi_{pre}(\mathbf{x})$; $\Gamma_{post,r}(\mathbf{x})$; and $\Psi_{post}(\mathbf{x})$ using the sample analogues of (A.4) and (A.6). Specifically, we substitute $\hat{\theta}_l^j(\mathbf{x})$ and $\hat{a}_l^j(\mathbf{x})$ for θ_l and $a(\theta_l, j)$, respectively, in (A.4). Similarly, in (A.4) and (A.6), we substitute $\hat{G}_j^{-1}(\cdot|\mathbf{x})$ and $\hat{e}_j'(a|\mathbf{x})$ for $G_j^{-1}(\cdot)$ and $e_j'(\cdot)$, respectively. The estimates, denoted by $\hat{\Gamma}_{pre}(\mathbf{x})$; $\hat{\Psi}_{pre}(\mathbf{x})$; $\hat{\Gamma}_{post}(\mathbf{x})$; and $\hat{\Psi}_{post}(\mathbf{x})$, are chosen to minimize

[2] The steps for deriving (A.2) involve: first, substituting the quantile function of the company type distribution for the earnings management level in (7); and, second, using the well-known property that the derivative of the quantile function is equal to the reciprocal for the density function. See the proof of Proposition 3 in Kang and Silveira (2021) for details.

the objective function resulting from the sum of the sample analogues of (A.4) and (A.6)– that is, in our estimation procedure, we give equal weights to each one of the identifying equations.[3] We then obtain estimates of the primitives $\gamma_j(\mathbf{x})$ and $\psi_j(\mathbf{x})$ as

$$\hat{\psi}_j(\mathbf{x}) \equiv \frac{1}{1-\hat{\Psi}_j(\mathbf{x})} \quad \text{and} \quad \hat{\gamma}_j(\mathbf{x}) \equiv \hat{\Gamma}_j(\mathbf{x})\hat{\psi}_j(\mathbf{x}),$$

for $j \in \{pre, post\}$.

Step 4. Consider the empirical analogue to (A.2), and set $\underline{\alpha} = 0$. We estimate the quantile function associated with the distribution of firm types (conditional on the vector of company characteristics $\mathbf{x}$) as

$$\hat{Q}_j\left(\alpha|\mathbf{x}\right) \equiv \hat{\theta}_0^j(\mathbf{x}) \exp\left(\int_{\hat{G}_j\left[\hat{a}_0^j(\mathbf{x})|\mathbf{x}\right]}^{\alpha} \left[\hat{\Gamma}_j(\mathbf{x})\frac{\left[\hat{G}_j^{-1}(u|\mathbf{x})\right]^{r-1}}{\hat{e}_j'\left[\hat{G}_j^{-1}(u|\mathbf{x})|\mathbf{x}\right]} - \hat{\Psi}_j(\mathbf{x})\right]\frac{1}{(1-u)}du\right),$$

for $j \in \{pre, post\}$. $\hat{F}_j(\cdot|\mathbf{x})$, the estimate of the distribution function $F(\cdot|\mathbf{x})$, is then the inverse of $\hat{Q}_j\left(\cdot|\mathbf{x}\right)$.

Finally, consider the following estimate of the marginal benefit function, $b'(\cdot|\mathbf{x})$:

$$\hat{b}_j'\left(a|\mathbf{x}\right) \equiv \hat{e}_j'\left(a|\mathbf{x}\right)/\hat{Q}_j[\hat{G}_j\left(a|\mathbf{x}\right)|\mathbf{x}],$$

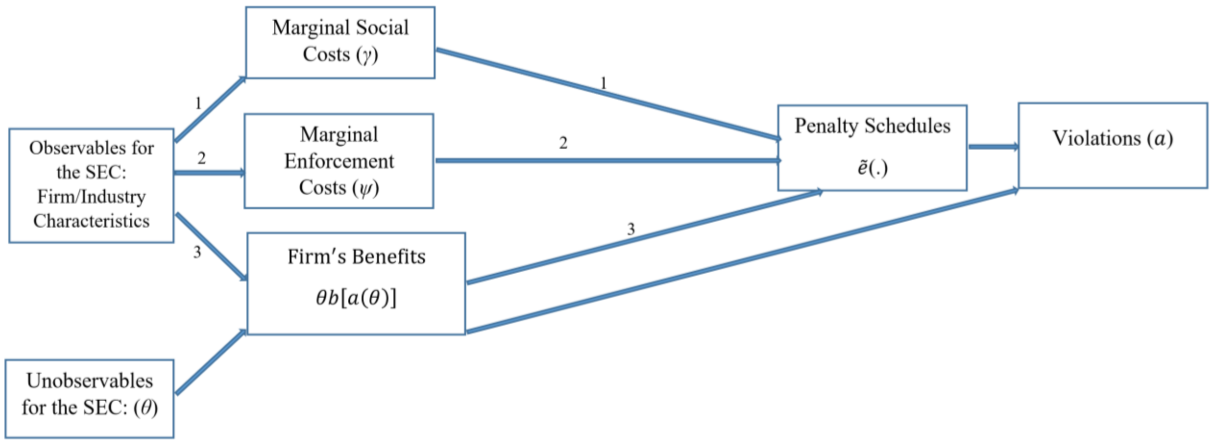
for $j \in \{pre, post\}$. Our preferred estimate of the benefit function is the average between $\hat{b}_{pre}'\left(a|\mathbf{x}\right)$ and $\hat{b}_{post}'\left(a|\mathbf{x}\right)$, that is

$$\hat{b}'\left(a|\mathbf{x}\right) \equiv \frac{1}{2}\hat{b}_{pre}'\left(a|\mathbf{x}\right) + \frac{1}{2}\hat{b}_{post}'\left(a|\mathbf{x}\right).$$

By numerically integrating $\hat{b}'\left(a|\mathbf{x}\right)$ over a, we obtain an estimate $\hat{b}(\cdot|\mathbf{x})$ of the benefit function, $b(\cdot|\mathbf{x})$.

[3] In solving this optimization problem, we constrain the solution to ensure that, for any $\mathbf{x}$, the estimated regulator parameters are positive.

APPENDIX 3. FLOWCHART: MODEL PRIMITIVES DRIVE EQUILIBRIUM PENALTIES VIOLATIONS



This diagram illustrates the three channels via which observed firm characteristics can affect the equilibrium level of penalty schedule: the marginal social costs of earnings management; the SEC's marginal enforcement costs; and the firm's benefits of earnings management.

APPENDIX 4. NUMERICAL EXAMPLES FOR EVALUATING THE SEC'S PREFERENCES

We provide numerical examples to further assess the economic significance of each marginal cost component (as presented in Table 3) by focusing on the post-SOX period, where the medians of the marginal firm benefits, marginal enforcement costs, and marginal social costs are 0.017, 0.324, and 0.010, respectively.

Regarding marginal firm benefits, for a firm with a median level of firm type θ and a median level of discretionary accruals (*DA*), if the level of *DA* increases by 0.1 (10% of total assets), then the firm's benefits increase by 0.17% (0.1*0.017) of market capitalization, which translates into $2.52 million (0.17% *$1,480 million) based on the median market capitalization of $1,480 million in the post period.

For marginal enforcement cost, the average is 0.324 in the post-SOX period. We assess its economic magnitude as follows. First, the first-order condition yields that the marginal increase in firm benefits equals the marginal penalties. Based on the previous calculation that an increase of *DA* by 0.1 is associated with an increase of firm benefits of $2.52 million, it can be inferred that this increase in *DA* corresponds to an increase in penalties of $2.52 million. Second, enforcement costs (in millions) are computed as $\psi * e(a)$ * market capitalization, so an increase in *DA* by 10% of total assets results in an increase in enforcement costs of $0.82 million (0.324*$2.52 million).

The marginal social cost associated with an increase in *DA* by 0.1 is calculated as follows. Social costs (in millions) are computed as $\gamma * a$* market capitalization. Thus, an increase in *DA* by 0.1 is associated with an increase in social costs of $1.48 million (0.01*0.1*$1,480 million).

APPENDIX 5. HETEROGENEITY OF VIOLATIONS AND REGULATOR PREFERENCES

In this appendix, we examine how case attributes (e.g., cooperation) correlate with regulatory preferences. In our paper, we model the “ex-ante” game between a firm and the SEC, and the SEC’s preferences are determined by firm characteristics. This game occurs before the actual investigation and enforcement, as illustrated in Figure 1. Consistent with the real-world setting that we study, information on case attributes (e.g., cooperation) is likely unknown to the SEC before it initiates the investigation. Therefore, the relation between case attributes and the SEC’s preferences is mediated by the association between case attributes and firm characteristics. Given that case attributes are only available for firms that receive SEC enforcement, we end up with a small sample, approximately 100 observations. Note the small sample size likely limits the power of our analysis.

We conduct the analyses using simple correlations. Specifically, we examine the relation between six violation attributes and regulator preferences (i.e., ψ and γ). Panel A of IA Table 1 presents the correlations among the six violation attributes. Panel B of IA Table 1 presents the correlations between violation attributes and firm characteristics. Lastly, Panel C of IA Table 1 presents the correlations between violation attributes and regulator preferences (i.e., ψ and γ). Below are inferences emerged from this analysis.

1. *Impeded* and *Misled*

Impediment of investigation and acts of misleading auditors tend to go hand in hand among sanctioned firms, as evidenced by the significantly positive correlation (0.207) in Panel A of IA Table 1. In addition, in Panel B of IA Table 1, we observe significant positive correlations between *Loss* and *Imped*ed (*Misled*). Combined with the evidence in Table 4 that loss firms have lower ψ

and γ, we hypothesize that sanctioned cases involving impediment of investigation and acts of misleading auditors tend to have lower ψ and γ. Consistent with this prediction, we find the significantly negative correlations between *Impeded* (*Misled*) and regulator preferences in Panel C of IA Table 1.

2. *Bribe* and *Cooperate*

Sanctioned firms that were convicted of bribery often overlap with those that cooperated with the regulator during the investigation, as evidenced by the significant positive correlation (0.423) in Panel A of IA Table 1. Panel B of IA Table 1 indicates that these firms tend to be large. As firm size is positively correlated with ψ and γ, sanctioned firms involved in bribery and cooperation during the investigation are expected to have high ψ and γ. The evidence of the positive correlations between *Bribe* (*Cooperate*) and regulator preferences in Panel C of IA Table 1 is consistent with our expectation.

3. *Whistle-blow/Self-dealing*

We do not find enforced firms involving *Whistle-blow*/*Self-dealing* to differ in the SEC's preferences. In Panel C of IA Table 1, the magnitude of the correlations between *Whistle-blow* (*Self-dealing)* and regulator preferences (i.e., ψ and γ) are all less than 0.1. This is likely because these two case attributes are not highly correlated with firm characteristics that affect the SEC preferences except for the positive relation between *Self-dealing* and firm *ROA*.

IA Table 1. Heterogeneity of Violation and Regulator Preferences

Panel A: Correlations Among Violation Attributes

	Cooperate	*Impeded*	*Misled*	*Whistle-blow*	*Self-dealing*	*Bribe*
Cooperate	1.000					
Impeded	**-0.181**	1.000				
Misled	0.041	**0.207**	1.000			
Whistle-blow	0.015	0.119	-0.124	1.000		
Self-dealing	-0.057	-0.067	0.079	**-0.186**	1.000	
Bribe	**0.423**	**-0.173**	**-0.336**	0.055	-0.068	1.000

This table presents the Pearson correlations among six violation attributes. *Cooperate* equals one if the regulatory enforcement documents indicate that the firm cooperates with the SEC during the investigation process. *Impeded* equals one if the SEC acknowledges deliberate deception and/or includes charges for lying to investigators. *Whistle-blow* equals one if a whistleblower is involved in the enforcement action. *Misled* equals one if the charges involve acts of misleading auditors. *Self-dealing* equals one if charges include acts of self-dealing such as embezzlement and theft committed by respondents. *Bribe* equals one if the enforcement actions include bribery of a foreign official under the Foreign Corruption Practices Act. Bold correlations are significant at the 0.1 level.

Panel B: Correlations between Violation Attributes and Firm Characteristics

	Cooperate	*Impeded*	*Misled*	*Whistle-blow*	*Self-dealing*	*Bribe*
Lev	-0.080	-0.140	**-0.295**	-0.004	-0.032	-0.139
MTB	0.032	-0.131	0.098	0.041	-0.007	-0.080
Size	0.112	-0.021	-0.044	**0.352**	-0.071	**0.190**
ROA	0.122	**-0.222**	-0.115	-0.119	**0.175**	**0.228**
Loss	-0.101	**0.214**	**0.248**	-0.110	0.084	-0.099
Ind_mtb	**0.165**	**-0.223**	0.028	0.114	0.015	0.086
Ind_roa	-0.022	-0.044	-0.070	-0.058	0.148	0.045
ClassAction	-0.091	0.067	-0.009	0.031	0.122	-0.159

This table presents the Pearson correlations between violation attributes and firm characteristics. Bold correlations are significant at the 0.1 level.

Panel C: Correlations between Violation Attributes and Regulator Preferences

	log(ψ)	log(γ)
Cooperate	0.127	**0.183**
Impeded	**-0.309**	**-0.266**
Misled	**-0.221**	**-0.214**
Whistle-blow	-0.023	0.027
Self-dealing	-0.040	-0.062
Bribe	0.137	0.172

This table presents the Pearson correlations between violation attributes and regulatory preferences. The marginal enforcement cost is ψ and the marginal social cost is γ. Bold correlations are significant at the 0.1 level.

APPENDIX 6: EXPLAINING BENEFITS OF EARNINGS MANAGEMENT AND SEC PREFERENCES (PRE-SOX)

VARIABLES	(1) log(ψ)	(2) log(γ)	(3) log(*Benefit*)
Lev	0.000	0.355***	2.077***
	(0.017)	(12.263)	(72.650)
	[-0.256 0.383]	[-0.427 1.306]	[1.313 8.833]
MTB	0.001	-0.010	0.191***
	(0.557)	(-1.124)	(29.485)
	[-0.018 0.042]	[-0.453 0.084]	[-0.181 1.322]
Size	0.036***	0.307***	-0.549***
	(20.896)	(73.963)	(-62.700)
	[-0.272 0.134]	[-3.326 0.439]	[-4.131 -0.341]
ROA	-0.820***	-2.835***	-1.205***
	(-13.424)	(-7.207)	(-5.317)
	[-1.271 0.446]	[-4.624 1.486]	[-4.049 5.968]
Loss	-2.388***	-20.980***	-19.473***
	(-188.273)	(-378.527)	(-395.376)
	[-3.176 0.100]	[-24.890 1.459]	[-25.527 2.781]
Ind_MTB	-0.085***	-0.032	0.809***
	(-10.708)	(-1.249)	(32.925)
	[-0.130 0.029]	[-0.186 0.241]	[-0.327 1.086]
Ind_ROA	0.007	1.038***	-12.944***
	(0.072)	(3.654)	(-53.691)
	[-1.862 1.666]	[-4.564 6.065]	[-40.255 -8.650]
ClassAction	-1.866***	6.344***	13.379***
	(-7.050)	(7.628)	(20.006)
	[-3.250 -0.489]	[-2.525 14.096]	[-37.610 18.809]
Constant	-0.456***	-7.530***	-2.246***
	(-18.577)	(-114.735)	(-24.706)
	[-3.746 1.116]	[-13.645 -3.035]	[-8.950 12.632]
R-squared	0.976	0.996	0.996

This panel presents the OLS regressions of the logarithm of the marginal benefits of earnings management estimated at the median value of earnings management (*Benefit*), marginal enforcement costs (ψ), and marginal social costs (γ) on firm and industry attributes in the pre-SOX period. The regressions are estimated for each of the 3,039 firms active in 1997. *t* -statistics based on robust standard errors are reported in parentheses. Bootstrap 90% confidence intervals are presented in brackets. ***, **, and * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively, on a two-tailed basis using robust standard errors.

APPENDIX 7. NUMERICAL EXAMPLES: FIRM SIZE

To further sharpen the inferences on firm size, we provide some numerical examples: a small firm with a median market capitalization of \$668 million and a large firm with a market capitalization of \$89 billion. For ease of comparison, we hold the level of earnings management constant between these two firms by evaluating the model at the median value of abnormal accruals ($\bar{a}$ =0.046). Under these conditions, the expected penalties for the small and large firms from managing earnings are 0.001% and 0.011% of the market capitalization, respectively. In addition, the estimated ψ is 0.365 for the small firm and 0.651 for the large firm. We find that the SEC perceives enforcement costs to be higher when imposing penalties on the large firm; specifically, enforcement costs are \$6 million for the large firm (0.651*0.011%* \$89 billion) compared to \$0.003 million (0.365*0.001%*\$668 million) for the small one. This result is attributed to both higher expected penalties and higher marginal enforcement costs, as evidenced by the positive coefficient on *Size* in column (1) of Table 4.

The estimated γ of the small firm is 0.0007, while, for the large firm, it is 0.011. Given the abnormal accruals level evaluated at $\bar{a}$ =0.046, the large firm imposes much higher social costs for financial misconduct: \$46 million (0.011*0.046*\$89 billion) for the large firm vs. \$0.023 million (0.0007*0.046*\$668 million) for the small one. This result is consistent with the SEC perceiving higher marginal social costs for large firms (Table 4, column (2)). Lastly, the small firm obtains benefits equal to 0.354% of the market capitalization, which is a higher ratio than that of the large firm (0.188%).

APPENDIX 8: COUNTERFACTUAL ANALYSES (PRE-SOX)

	Earnings Management		Penalties		Welfare	
(1) High enforcement costs	0.0006		-0.0003		-34.34	
	[-0.0003	0.0007]	[-0.0007	0.0000]	[-59.77	-0.00]
(2) Low enforcement costs	-0.0006		0.0002		50.70	
	[-0.0015	-0.0002]	[-0.0000	0.0009]	[0.00	84.60]
(3) Zero enforcement costs	-0.0103		0.0154		752.82	
	[-0.0413	-0.0023]	[0.0000	0.0907]	[0.00	1,337.48]
(4) High social costs	-0.0008		0.0002		-328.00	
	[-0.0017	-0.0005]	[-0.0000	0.0010]	[-529.25	-0.00]
(5) Low social costs	0.0009		-0.0004		346.64	
	[0.0001	0.0012]	[-0.0008	0.0000]	[0.00	558.78]
(6) Maximum social costs	-0.0363		0.0684		-35,250.95	
	[-0.0611	-0.0270]	[0.0000	2.2562]	[-385,439.51	0.00]
(7) Uniform penalty	0.0345		0.0386		-1,197.94	
	[-0.0743	0.0916]	[0.0029	7.4182]	[-30,182.53	-24.31]

This panel presents results of seven counterfactual scenarios based on the estimates from the pre-SOX period. The changes, compared to the baseline scenarios, for the means of earnings management, penalties (in percentage points), and total welfare (in millions) are reported. Welfare is the negative of total costs, where total costs are calculated as the sum of social costs and enforcement costs, minus firm benefits. We measure changes in penalties in terms of percentage points of firm market value and changes in welfare in millions of dollars. In row (1), the marginal enforcement costs increase by 10%. In row (2), the marginal enforcement costs decrease by 10%. In row (3), the marginal enforcement costs are set to zero for all firms. In row (4), the marginal social costs increase by 10%. In row (5), the marginal social costs decrease by 10%. In row (6), the marginal social costs are set to be the maximum across all firms. In row (7), the SEC imposes the same penalty schedule across all firms. Bootstrap 90% confidence intervals are presented in brackets.

APPENDIX 9: COUNTERFACTUAL ANALYSES—COST COMPONENTS

Panel A: Post-SOX

	Enforcement Costs		Social Costs		Compliance Costs		Total Costs	
	(1)		(2)		(3)		(1)+(2)+(3)	
(1) High enforcement costs	19.91		95.41		-30.17		85.15	
	[0.00	33.97]	[0.00	207.96]	[-46.70	-0.00]	[0.00	192.40]
(2) Low enforcement costs	-61.02		-98.19		28.93		-130.27	
	[-119.51	-0.00]	[-215.12	0.00]	[0.00	51.19]	[-283.02	-0.00]
(3) Zero enforcement costs	-1,049.70		-1,485.00		842.88		-1,691.82	
	[-2,245.16	-0.00]	[-3,423.06	-0.00]	[0.00	1,829.11]	[-7,101.44	-0.00]
(4) High social costs	69.12		774.80		43.40		887.32	
	[0.00	146.13]	[0.00	1,382.50]	[0.00	68.49]	[0.00	1,585.26]
(5) Low social costs	-107.82		-784.31		-48.88		-941.02	
	[-236.27	-0.00]	[-1,398.28	-0.00]	[-71.36	0.00]	[-1,673.61	-0.00]
(6) Maximum social costs	3,371.90		31,724.00		1,725.14		36,821.04	
	[0.00	40,907.71]	[0.00	418,682.22]	[0.00	31,008.73]	[0.00	420,890.79]
(7) Uniform penalty	75,231.00		27,837.00		844.66		103,912.66	
	[-551.27	98,416.59]	[-24.66	31,473.54]	[-367.26	985.36]	[45.77	127,610.45]

This panel presents results of seven counterfactual scenarios based on the estimates from the post-SOX period. The changes, compared to the baseline scenarios, for enforcement costs, social costs, compliance costs (negative firm benefits), and total costs are reported. The total costs (in millions) are computed as the sum of social costs, enforcement costs, and compliance costs. In row (1), the marginal enforcement costs increase by 10%. In row (2), the marginal enforcement costs decrease by 10%. In row (3), the marginal enforcement costs are set to zero for all firms. In row (4), the marginal social costs increase by 10%. In row (5), the marginal social costs decrease by 10%. In row (6), the marginal social costs are set to be the maximum across all firms. In row (7), the SEC imposes the same penalty schedule across all firms. Bootstrap 90% confidence intervals are presented in brackets.

Panel B: Pre-SOX

	Enforcement Costs	Social Costs	Compliance Costs	Total Costs
	(1)	(2)	(3)	(1)+(2)+(3)
(1) High enforcement costs	4.31	37.41	-7.39	34.34
	[0.00 8.43]	[0.00 90.61]	[-9.91 -0.00]	[0.00 59.77]
(2) Low enforcement costs	-19.83	-39.08	8.21	-50.70
	[-31.87 -0.00]	[-100.18 0.00]	[0.00 13.88]	[-84.60 -0.00]
(3) Zero enforcement costs	-402.40	-673.60	323.19	-752.82
	[-713.70 -0.00]	[-1,919.44 -0.00]	[0.00 548.78]	[-1,337.48 -0.00]
(4) High social costs	27.10	291.30	9.60	328.00
	[0.00 46.85]	[0.00 644.01]	[0.00 17.30]	[0.00 529.25]
(5) Low social costs	-42.09	-294.24	-10.31	-346.64
	[-76.40 -0.00]	[-676.88 -0.00]	[-16.66 0.00]	[-558.78 -0.00]
(6) Maximum social costs	3,486.84	30,589.48	1,154.63	35,230.95
	[0.00 33,891.52]	[0.00 607,244.87]	[0.00 26,334.82]	[0.00 385,439.51]
(7) Uniform penalty	1,077.29	170.36	-49.71	1,197.94
	[-31.77 4,452.05]	[-298.91 4,459.10]	[-55.82 1,163.99]	[24.31 30,182.53]

This panel presents results of seven counterfactual scenarios based on the estimates from the pre-SOX period. The changes, compared to the baseline scenarios, for enforcement costs, social costs, compliance costs (negative firm benefits), and total costs are reported. The total costs (in millions) are computed as the sum of social costs, enforcement costs, and compliance costs. In row (1), the marginal enforcement costs increase by 10%. In row (2), the marginal enforcement costs decrease by 10%. In row (3), the marginal enforcement costs are set to zero for all firms. In row (4), the marginal social costs increase by 10%. In row (5), the marginal social costs decrease by 10%. In row (6), the marginal social costs are set to be the maximum across all firms. In row (7), the SEC imposes the same penalty schedule across all firms. Bootstrap 90% confidence intervals are presented in brackets.

APPENDIX 10: ADDITIONAL DISCUSSION ON THE MAGNITUDE OF THE WELFARE IMPACT IN COUNTERFACTUAL ANALYSES

In this appendix, we provide further discussion of the reasonableness of the welfare impact in the two counterfactual analyses: the hawkish regulator scenario and uniform penalty policy. We begin by establishing the reasonableness of the estimated changes in compliance costs due to the transition to the hawkish regulator scenario by comparing them to external data on observed changes in compliance costs due to SOX. As we discuss below, the change in the level of earnings management is found to be comparable between these two scenarios, so using SOX compliance costs to assess the reasonableness of total costs under the hawkish regulator regime seems appropriate. After establishing reasonable cost estimates under the hawkish regulator scenario, we then compare the changes in estimated total costs between the uniform penalty policy and the hawkish regulator policy. This comparison provides further insight into the reasonableness of the former.

First, we focus on the hawkish regime. As shown in Panel A of Internet Appendix 9, the increase in total costs under the hawkish regime is \$36.821 billion. The majority of this increase comprises social costs, at \$31.724 billion, with compliance costs contributing \$1.725 billion. The substantial rise in social costs is largely mechanical, because it results from applying the hawkish regulator's preferences (i.e., maximum γ) for computing the counterfactual social costs; in contrast, the baseline scenario uses the original values of γ for each firm. Meanwhile, compliance costs are not mechanically affected by the use of the maximum γ. Therefore, assessing the reasonability of the \$1.725 billion changes in compliance costs due to the transition to the hawkish regime is a useful check on the reasonability of this counterfactual exercise.

The passage of SOX provides a pertinent reference point for assessing the change in compliance costs due to the hawkish regime. This is so because, as shown in Figure 4, the decrease in earnings management by 0.0274 in the transition from the baseline scenario to the hawkish regime is comparable to the earnings management reduction from the pre-SOX to the post-SOX periods. Intuitively, these similar effects on earnings management suggest that the changes in compliance costs due to hawkish regime and SOX should also be comparable. Conveniently, there are previous studies measuring the impact of SOX on regulated firms' compliance costs. A KPMG survey found that an average firm spends $1.6 million on SOX compliance programs.[2] With our sample size of 3,039 firms, this figure implies a total increase in compliance costs of $4.862 billion due to SOX – which is more than twice the $1.725 billion increase under the hawkish regulator regime. This evidence suggests that our estimates of total costs increase under the hawkish regulator regime do not appear too large.

As we have established the reasonable estimate of total costs under the hawkish regulator regime, we now compare that with the uniform penalty regime. Under the uniform penalty counterfactual, the magnitude of the average increase in earnings management (0.0621) is more than twice as large as the magnitude of the decrease under the hawkish regulator scenario (-0.0274). Meanwhile, the total costs under the uniform penalty increase by $104 billion, which is an effect about 2.8 times larger than the change in total costs under the hawkish regulator scenario ($37 billion). This comparison suggests that the change in total costs under the uniform penalty scenario appears reasonable, using the hawkish regulator regime as a benchmark. Next, to further understand the magnitude of total costs under the uniform penalty, we also analyze the three cost components separately. We find in Panel A of Internet Appendix 9 that the majority of cost changes come from the increase in enforcement costs and social costs. Because the post-SOX period is characterized by high enforcement intensity, removing the regulator's

[2] <https://kpmg.com/us/en/articles/2023/kpmg-sox-report.html>

discretion by imposing the same penalty schedule across all firms would lead to a large number of firms being subject to less strict penalty schedules. In other words, given any arbitrary level of violations, $e_{baseline}(a) > e_{uniform}(a)$ for numerous firms. Consequently, these firms would engage in more violations, leading to an increase in penalties under the uniform penalty scenario, compared to the baseline scenario ($e_{baseline}(a_{baseline}) < e_{uniform}(a_{uniform})$). This is why enforcement costs and social costs both increase when transitioning from the baseline scenario to the uniform penalty scenario. Considering these findings, along with the reasonable estimate of total costs under the hawkish regulatory regime, we can conclude that the total costs under the uniform penalty scenario are reasonable and not excessively large.