SUPPLEMENTARY MATERIAL

Online Appendix B: Collective Apathy and Fatalism

The form of denial considered so far has been a collective "illusion of control" or overconfidence, leading to persistence in a costly course of action in spite of widely available evidence that it is doomed. The opposite case is collective apathy: rather than acknowledging a crisis that could be partly remedied through timely action, everyone pretends that things "could be worse" and that "nothing can be done" to improve them anyway. One can think of an ethnic group subject to discrimination or threat by another one, but whose members pessimistically deem it useless to fight back (Cialdini (1984), Hochschild (1996)). Another example is global-warning denial and a third one, examined below, is "tuning out" the distress of others. To capture these ideas, I simply extend (1) to

$$U_2^i = \theta\left[\alpha e^i + (1-\alpha)e^{-i} - \kappa\right], \quad \text{where} \quad \kappa \gtrless 0. \tag{B.1}$$

• When $\kappa < \min\{1, \theta_H/\Delta\theta\}$, state H remains (conditional on $e^j \equiv 1$) a more favorable state than L, and one can show that for κ below a certain threshold all the results of the case $\kappa = 0$ carry over with little change. In particular, if $-\kappa > 0$ it plays a role very similar to an individual's outstanding market position k^i in the Section 5.

• When $\kappa > \max\{1, \theta_H/\Delta\theta\}$, state H corresponds to a *crisis state:* action is called for, but even when carried out effectively ($e^j \equiv 1$) it will not suffice to offset the shock, leaving agents worse off than in state L. Intuition now suggests that an equilibrium in which agents respond appropriately to crises can coexist with one in which they systematically censor such signals, remaining passive and fatalistic even though they actually have individual agency.[70]

Indeed, this problem is closely related to the original one, once recast in terms of the relative effectiveness of *inaction.* Formally, let $\tilde{\theta}$ take values $\tilde{\theta}_{\tilde{H}} \equiv -\theta_L$ in state $\tilde{H} \equiv L$ and $\tilde{\theta}_{\tilde{L}} \equiv -\theta_H < 0$ in state $\tilde{L} \equiv H$, with respective probabilities $\tilde{q} \equiv 1-q$ and $1-\tilde{q}$; similarly, let $\tilde{c} \equiv -c$. Using these transformed variables, it is then easy to obtain "parallels"

[70] Furthermore, there is no equilibrium in which agents censor the signal $\sigma = L$ –just like when $\kappa = 0$ (or κ sufficiently below $\min\{1, \theta_H/\Delta\theta\}$ more generally) there is no equilibrium in which they censor $\sigma = H$. See Lemma 6 and the proof of Proposition 12 in online Appendix C, with $\Delta\gamma \equiv -\kappa\Delta\theta$.

to Propositions 2 to 9. In particular, condition (3) is replaced by

$$q\theta_H + (1-q)\,\theta_L < \frac{c}{\alpha\,(s+\delta)} < \frac{c}{\alpha\delta} < \theta_H, \tag{B.2}$$

and the equilibrium strategies and thresholds are obtained by replacing $\Delta\theta$ with $-\kappa\Delta\theta$ and $\theta_H,\ \theta_L,\ q$, and c with their "tilde" analogues. In online Appendix C, I thus prove:

Proposition 12. *Assume (B.2) and $\kappa > \max\{1, \theta_H/\Delta\theta\}$. All the results in Proposition 2 remain, but with denial ($\lambda < 1$) now occurring in state H only and leading to inaction. Facing up to crises and fatalistic inertia are both social equilibria if and only if $q\,(\kappa\Delta\theta) < (1-\alpha)\,\theta_H$.*

The left-hand side of this modified MAD condition reflects the action-independent gain from being in the no-crisis state, while the right-hand side measures the endogenous losses inflicted by all those who, denying that a crisis has occurred, *fail to act.*

• *Helping others or tuning out.* Studies of how people respond to the distress of others –victims of accidents, wars, natural disasters, famine, genocide, etc.– display two important puzzles. First, they show a greater willingness to help when the number of those perceived to be in need is small than when it is large. Slovic (2007) discusses many experiments documenting such "psychic numbing" (lowered affective reactions and donations) in response to even small absolute increases in the size of the at-risk group. A second regularity, common to most public-goods situations, is that people give and help more when they know or expect that others are doing so.[71]

The above results can help understand both phenomena. Let K be the number of people in need, or emphasized as being in need, and let θ be the severity of their situation. At cost c, each individual $i = 1, \ldots n$ can help ($e^i = 1$) up to a victims, and he experiences an empathic disutility equal to the total amount of suffering,

$$U_2^i = -\theta\left[K - a\Sigma_{j=1}^n e^j\right]. \tag{B.3}$$

[71] The first phenomenon is distinct from (but combines with) the "identifiable victim effect". Small et al. (2007) thus found that donations to a specifically identified Malawian child facing the risk of starvation decreased by more than a half when information about the child was complemented with background statistics documenting the scale of food shortages in Africa. An alternative explanation for the second set of findings is social norms; see, e.g., Bénabou and Tirole (2006a).

Note that this *does not assume* that people intrinsically undervalue "statistical lives" or actions that represent only "a drop in the ocean". Instead, *this will be a result.* Indeed, (B.3) corresponds to (B.1) with $\alpha = 1/n$, $\kappa = K/na$ and θ simply replaced by θna. Therefore, as K increases beyond a critical threshold:

(a) The loss in utility from acknowledging $\theta = \theta_H$ overtakes an individual's ability to remedy it, causing him to switch from helping to "tuning out" the problem by censoring from awareness and recall all painful evidence of the crisis: turning the page of the newspaper, switching the channel, rationalizing the situation as not so bad, etc.

(b) The level at which an individual switches from response to non-response depends on how many others he believes are helping or tuning out: what matters to i is $K - a\Sigma_{j \neq i}^{n} e^{j}$. Hence, within some range of K, both *collective generosity* and *collective apathy* –what Slovic terms the "collapse of compassion"– are social equilibria, even though charitable giving involves no increasing returns.

(c) Vivid, memorable images of the *intensity* of individual suffering θ (but not the number, K, which has the opposite effect) make the crisis more difficult to put "out of mind" and thus reduce the scope of apathy. In the multiplicity range, one small such example, widely publicized, can trigger a large equilibrium shift.

SUPPLEMENTARY MATERIAL

Online Appendix C: Additional Proofs

Proof of Proposition 4. To make things simple, let $m^1 = m^2$, $c^1 = c^2$, $\delta^1 = \delta^2$, $a_H^{11} = a_H^{22}$, $a_L^{11} = a_L^{22}$ and $a_H^{11} - a_L^{11} = a_H^{22} - a_L^{22} \equiv a > 0$; finally, set $b^{ij} = 0$ for all i, j. The asymmetry in roles is then captured by $X \equiv \left(a_H^{12} - a_L^{12}\right)/a > \left(a_H^{21} - a_L^{21}\right)/a \equiv x$ and, especially, $Y \equiv -\left(a_L^{12} - b_L^{12}\right)/a > -\left(a_L^{21} - b_L^{21}\right)/a \equiv y$. I shall first provide conditions ensuring

$$\text{(C.1)} \qquad \bar{s}^2(0) < \underline{s}^1(0) < \underline{s}^1(1) < \bar{s}^1(0) < \bar{s}^1(1) < \underline{s}^2(1),$$

which implies $[\underline{s}^1(1), \bar{s}^1(0)] \subset [\bar{s}^2(0), \underline{s}^2(1)] \equiv S$, as illustrated in Figure 4. From (18)-(19), the middle inequality is equivalent to $y < (1-q)(1+x)$, which can always be ensured given $q < 1$. The inequalities $\underline{s}^1(0) < \underline{s}^1(1)$ and $\bar{s}^1(0) < \bar{s}^1(1)$ hold for all $y > 0$ (complementarity). Turning finally to the two outer conditions, we have $\bar{s}^2(0) < \underline{s}^1(0)$ if

$$q\left(a_H^{12} - a_L^{12} + a_H^{22} - a_L^{22}\right) > a_H^{21} - a_L^{21} + a_H^{11} - a_L^{11},$$

or $qX > x + 1 - q$, while $\bar{s}^1(1) < \underline{s}^2(1)$ if

$$q\left[a_H^{21} - a_L^{21} + a_H^{11} - a_L^{11} + a_L^{21} - b_L^{21}\right] > a_H^{12} - a_L^{12} + a_H^{22} - a_L^{22} + a_L^{12} - b_L^{12},$$

or $Y > qy + X - qx + 1 - q$; both are clearly satisfied for X sufficiently larger than x and Y sufficiently larger than X. I can now prove the claims (a)-(c) made in the text.

(i) The result follows from the fact that $\bar{s}^2(0) \leq s \leq \underline{s}^2(1)$ and the definitions of these two thresholds in Proposition 1.

(ii) The same definitions imply that an equilibrium with $(\lambda^1, \lambda^2) = (1, 1)$ (respectively, $(\lambda^1, \lambda^2) = (0, 0)$) exists if and only if $s^2 \leq \underline{s}^2(1)$ and $s^1 \leq \underline{s}^1(1)$ (respectively, $s^2 \geq \bar{s}^2(0)$ and $s^1 \geq \bar{s}^1(0)$), which corresponds to the left (respectively, right) region in Figure 4. In the middle region one must therefore have $\lambda^1 = \lambda_1^*(s^1; \lambda^2) \in (0, 1)$, where λ_1^* is the mixed-strategy best-response characterized in Proposition 1. It is decreasing in s^1 and increasing (respectively increasing) in λ^2 since for $a_L^{21} - b_L^{21} = -ya < 0$.

(iii) Consider now the boundary loci within the middle region. An equilibrium with $(\lambda^1, \lambda^2) = (\lambda_1^*(s^1; 1), 1)$ exists if and only if $s^1 \in [\underline{s}^1(1), \bar{s}^1(1)]$ and $s^2 \leq \underline{s}^2(\lambda_1^*(s^1; 1))$. This is a decreasing function of s^1, which declines from $\underline{s}^2(\lambda_1^*(\underline{s}^1(1);1)) = \underline{s}^2(1)$ at $s^1 = \underline{s}^1(1)$ to $\underline{s}^2(\lambda_1^*(\bar{s}^1(0);1))$ at $s^1 = \bar{s}^1(0)$. For $|a_L^{21} - b_L^{21}|/a = y$ small enough, $\lambda_1^*(\bar{s}^1(0);\lambda_2)$ is very insensitive to the value of λ_2, so $\lambda_1^*(\bar{s}^1(0);1) \approx \lambda_1^*(\bar{s}^1(0);0)) = 0$ and hence $\underline{s}^2(\lambda_1^*(\bar{s}^1(0);1)) \approx \underline{s}^2(0) < \bar{s}^2(0)$. Therefore the curve $\underline{s}^2(\lambda_1^*(s^1;1))$ cuts the lower boundary of S_2 at a point $s_1 < \bar{s}^1(0)$, as on Figure 4.

Similarly, with $(\lambda^1, \lambda^2) = (\lambda_1^*(s^1;0), 0)$ exists if and only if $s^1 \in [\underline{s}^1(0), \bar{s}^1(0)]$ and $s^2 \geq \bar{s}^2(\lambda_1^*(s^1;0))$. This is a decreasing function of s^1, which declines to $\bar{s}^2(\lambda_1^*(\bar{s}^1(0);0)) = \bar{s}^2(0)$ at $s^1 = \bar{s}^1(0)$, from $\bar{s}^2(\lambda_1^*(\underline{s}^1(1);0)$ at $s^1 = \underline{s}^1(1)$. For y small enough, $\lambda_1^*(\underline{s}^1(1);\lambda_2)$ is very insensitive to the value of λ_2, so $\lambda_1^*(\underline{s}^1(1);0) \approx \lambda_1^*(\underline{s}^1(1);1) = 1$ and hence $\bar{s}^2(\lambda_1^*(\underline{s}^1(1);1)) \approx \bar{s}^2(1) > \underline{s}^2(0)$. Therefore, the curve $\bar{s}^2(\lambda_1^*(s^1;0))$ cuts the upper boundary of S_2 at a point $s_1 > \underline{s}^1(1)$, as in Figure 4. Finally, for $a_L^{21} - b_L^{21} = 0$,

$$\underline{s}^2(\lambda_1^*(s^1;1)) = \underline{s}^2(\lambda_1^*(s^1;0)) < \bar{s}^2(\lambda_1^*(s^1;0)) = \bar{s}^2(\lambda_1^*(s^1;1)), \tag{C.2}$$

since agent 1's behavior is independent of that of agent 2. For y small enough, it remains the case that $\underline{s}^2(\lambda_1^*(s^1;1)) < \bar{s}^2(\lambda_1^*(s^1;1))$, by continuity. These properties of the two curves imply that equilibria of the form $(\lambda^1, \lambda^2) = (\lambda_1^*(s^1;1), 1)$, $(\lambda^1, \lambda^2) = (\lambda_1^*(s^1;0), 0)$ and $(\lambda^1, \lambda^2) = (\lambda_1^*(s^1;\lambda_2), \lambda_2^*(s^2;\lambda_1))$ exist only in the three respective regions indicated in Figure 4. The equilibrium is therefore unique, except possibly in the middle region where both agents mix. But since it is unique for $x = y = 0$, by continuity it remains so for x and y small enough. ■

Lemmas for the proof of Proposition 10. I prove here the claims made following equation (A.25) in the paper's main appendix.

Lemma 3. *Under (44), there exists $\tilde{q}(K) < 1$ such that, for all $q \in [\tilde{q}(K), 1]$, $\bar{s}(0;q,K) < \underline{s}(1;K)$.*

Proof. By (A.17)-(A.19), $\bar{s}(0;q,K) < \underline{s}(1;K)$ means that

$$\begin{aligned} &\frac{m/\delta + [c - \delta P_L(K+E)]\,E}{q\,[P_H(K+E) - P_L(K+E)]\,(K+E) + P_L(K+E)E} \\ &< \frac{m/\delta + [c - \delta P_L(K)]\,E}{[P_H(K+E) - P_L(K)]\,(K+E) + P_L(K)E}. \end{aligned} \tag{C.3}$$

If (C.3) holds for $m = 0$, the first denominator must be greater than the second, as $P_L(K +$

$E) < P_L(K)$. Therefore, (C.3) holds for all $m \geq 0$ if and only if it holds for $m = 0$, or

$$\frac{c - \delta P_L(K+E)}{c - \delta P_L(K)} < \frac{q\left[P_H(K+E) - P_L(K+E)\right](K+E) + P_L(K+E)E}{P_H(K+E)(K+E) - P_L(K)K}$$
$$= \frac{P_H(K+E)(K+E) - P_L(K+E)K}{P_H(K+E)(K+E) - P_L(K)K} - (1-q)\frac{\left[P_H(K+E) - P_L(K+E)\right](K+E)}{P_H(K+E)(K+E) - P_L(K)K},$$

that is,

$$(1-q)\frac{\left[P_H(K+E) - P_L(K+E)\right](K+E)}{P_H(K+E)(K+E) - P_L(K)K}$$
$$< \frac{P_H(K+E)(K+E) - P_L(K+E)K}{P_H(K+E)(K+E) - P_L(K)K} - \frac{c - \delta P_L(K+E)}{c - \delta P_L(K)}.$$

Finally, the condition takes the form

$$\text{(C.4)} \qquad 1 - q < \left(\frac{cK/(K+E) - \delta P_H(K+E)}{c - \delta P_L(K)}\right)\left(\frac{P_L(K) - P_L(K+E)}{P_H(K+E) - P_L(K+E)}\right).$$

Condition (44) ensures that $cK/(K+E) > \delta P_H(K+E)$, hence the result. ■

Lemma 4. *Assume (44). For any $\eta \in (0, 1/2)$ define $s_\eta(0; 1, K) \equiv (1-\eta)\bar{s}(0; 1, K) + \eta \underline{s}(1; K)$. There exists $q^*_\eta(K) < 1$ such that, for all $q \in (q^*_\eta(K), 1]$ condition (A.25) holds for all s in the nonempty interval $S_{2\eta}(K) \equiv (s_{2\eta}(0; 1, K)), \underline{s}(1; K))$.*

Proof. For q close to 1 $\bar{s}(0; q, K)$ is close to $\bar{s}(0; 1, K)$, so there exists $\hat{q}_\eta(K) \in (\tilde{q}(K), 1]$ such that, for all $q \in (\hat{q}_\eta(K), 1]$:

$$\text{(C.5)} \qquad \bar{s}(0; q, K) < (1-\eta)\bar{s}(0; 1, K) + \eta \underline{s}(1; K) \equiv s_\eta(0; 1, K) < \underline{s}(1; K)$$

This implies, for any $s \in S_{2\eta}(K)$:

$$1 - \frac{\bar{s}(0; q, K)}{s} > \frac{s_{2\eta}(0; 1, K) - s_\eta(0; 1, K)}{\underline{s}(1; K)} = \eta\left(\frac{\underline{s}(1; K) - \bar{s}(0; 1, K)}{\underline{s}(1; K)}\right) = \eta\left(1 - \frac{\bar{s}(0; 1, K)}{\underline{s}(1; K)}\right).$$

Therefore, condition (A.25) holds provided that

$$1 - q \leq \eta\left(1 - \frac{\bar{s}(0; 1, K)}{\underline{s}(1; K)}\right)\left(\frac{\bar{P}_q(K+E)\,(K+E)}{m/\left[\delta\,(\delta+s)\right] + \left[c/(\delta+s) + \bar{s}(0; 1, K) - P_L(K+E)\right]E}\right),$$

which will be the case for all q in some nonempty subinterval $(q^*_\eta(K), 1]$ of $(\hat{q}_\eta(K), 1]$.

From Lemmas 3 and 4, the last step in the proof of Proposition 10 stated in the main Appendix follows: pick any $\eta \in (0, 1/2)$, e.g., $\eta > 0$ and very small, then define $S^*(K) \equiv S_{2\eta}(K)$ and $q^* = q^*_\eta(K)$. ■

Proofs for Proposition 12 and the restriction to $\lambda_H^i = 1$ in Proposition 1. A strategy profile for agent i at $t = 0$ (his "self 0") is a pair $\lambda^i = (\lambda_H^i, \lambda_L^i)$ of probabilities with which he truthfully encodes $\hat{\sigma}^i = \sigma$ in each state $\sigma^i = H, L$. A strategy profile for the same agent at $t = 1$ (his "self 1") is a pair $\xi^i = (\xi_H^i, \xi_L^i)$ of probabilities with which he chooses $e^i = 1$ in each recall state $\hat{\sigma}^i = H, L$. An *intrapersonal* equilibrium consists of a quadruplet $(\lambda_H^i, \lambda_L^i; \xi_H^i, \xi_L^i)$ and posterior beliefs (r_H^i, r_L^i) in each recall state that together constitute a Perfect Bayesian Equilibrium for agent i (keeping fixed the strategies of all $j \neq i$):

(i) The posterior beliefs (or "reliability") of each recall state are given by Bayes' rule:

$$r_H^i \equiv \Pr\left[\sigma^i = H \mid \hat{\sigma}^i = H\right] = \frac{q\lambda_H^i}{q\lambda_H^i + (1-q)(1-\lambda_L^i)}, \tag{C.6}$$

$$r_L^i \equiv \Pr\left[\sigma^i = L \mid \hat{\sigma}^i = L\right] = \frac{(1-q)\,\lambda_L^i}{(1-q)\,\lambda_L^i + q(1-\lambda_H^i)}. \tag{C.7}$$

(ii) Date-1 actions are optimal: $\xi_\sigma^i = 1$ if $\alpha E[\theta \mid \hat{\sigma}_i] > c$ and $\xi_\sigma^i = 0$ if $\alpha E[\theta \mid \hat{\sigma}_i] < 0$.

(iii) At $t = 0$, the agent in each state $\sigma = H, L$ optimally chooses (or randomizes between) which $\hat{\sigma} = H, L$ to encode, taking (i) and (ii) as given.

Lemma 5. *Let $m > 0$ and fix any strategies $(\lambda_H^{-i}, \lambda_L^{-i})$ (whether equilibrium or not) of players $j \neq i$. If $(\lambda_H^i, \lambda_L^i)$ is an intrapersonal equilibrium for i such that $\max\{\lambda_H^i, \lambda_L^i\} < 1$, then $(1, 1)$ is also an equilibrium and it makes him strictly better off in both states.*

Proof. I shall omit time-0 subscripts for simplicity. For any $(\sigma, \hat{\sigma}) \in \{L, H\}^2$, let $V_{\sigma\hat{\sigma}}^i$ denote the date-0 expected value of U_1^i that agent i could achieve in state σ by encoding it as $\hat{\sigma}$, *if* his behavior at date 1 was guided by "naive" posteriors, i.e. $\xi^i = 1$ when $\hat{\sigma} = H$ and $\xi^i = 0$ when $\hat{\sigma} = L$. The $V_{\sigma\hat{\sigma}}^i$'s do not depend on any actual or conjectured mixing probabilities used by the agent at $t = 0$. Next, define $U_{\sigma\hat{\sigma}}^i$ from the same encoding choices as $V_{\sigma\hat{\sigma}}^i$, but anticipating that beliefs at $t = 1$ will be derived from $(\lambda_H^i, \lambda_L^i)$ using (C.6)-(C.7). Finally, let U_σ^i be the date-0 expected utility achieved in state σ by following the mixing strategy $(\lambda_H^i, \lambda_L^i)$. Thus, for all $\sigma, \hat{\sigma}$ and $\tilde{\sigma} \neq \sigma$,

$$\text{(C.8)} \qquad U^i_{\sigma\hat{\sigma}} \equiv r^i_{\hat{\sigma}} V^i_{\sigma\hat{\sigma}} + (1 - r^i_{\hat{\sigma}}) V^i_{\sigma\tilde{\sigma}},$$

$$\text{(C.9)} \qquad U^i_{\sigma} = \lambda^i_{\sigma\sigma} U^i_{\sigma\sigma} + (1 - \lambda^i_{\sigma\sigma}) \left(U^i_{\sigma\tilde{\sigma}} - m\right).$$

For any alternative candidate strategy $(\lambda'^i_H, \lambda'^i_L)$ I use the same notations but with "primes" on all the variables. I first show that

$$\text{(C.10)} \qquad U^i_H = U^i_{HL} < U'^i_{HH} \iff \left(1 - r'^i_H - r^i_L\right)\left(V^i_{HH} - V^i_{HL}\right) < m,$$

$$\text{(C.11)} \qquad U^i_L = U^i_{LH} < U'^i_{LL} \iff \left(1 - r'^i_L - r^i_H\right)\left(V^i_{LL} - V^i_{LH}\right) < m.$$

In each case the equality comes from the fact that $\lambda^i_\sigma < 1$, so that denial is an optimal strategy in state σ, and the equivalence between inequalities then follows from (C.8) applied to both $(\lambda^i_H, \lambda^i_L)$ and $(\lambda'^i_H, \lambda'^i_L)$. Next, note that for $(\lambda^i_H, \lambda^i_L)$ to be a personal equilibrium the inequalities in (C.10)-(C.11) must be reversed when $(\lambda'^i_H, \lambda'^i_L) = (\lambda^i_H, \lambda^i_L)$, meaning that

$$\text{(C.12)} \qquad \left(1 - r^i_H - r^i_L\right) \min\left\{V^i_{HH} - V^i_{HL},\ V^i_{LL} - V^i_{LH}\right\} \geq m.$$

Suppose first that $r^i_L + r^i_H \leq 1$, implying $V^i_{HH} - V^i_{HL} > 0$ and $V^i_{LL} - V^i_{LH} > 0$. Consider then $(\lambda'^i_H, \lambda'^i_L) \equiv (1, 1)$, which by (C.6)-(C.7) leads to $(r'^i_H, r'^i_L) = (1, 1)$. Equations (C.10)-(C.11) are clearly satisfied, and the same is true if r^i_H and r^i_L are both replaced by 1. Therefore, systematic truthfulness leads to higher expected utility in each state than the original $(\lambda^i_H, \lambda^i_L)$ and it is also an equilibrium.

Suppose next that $r^i_L + r^i_H > 1$. From (C.6)-(C.7), we have

$$\text{(C.13)} \qquad r^i_L + r^i_H > 1 \Leftrightarrow \lambda^i_H + \lambda^i_L > 1.$$

Since $\max\{\lambda^i_H, \lambda^i_L\} < 1$, this implies $\left(\lambda^i_H, \lambda^i_L\right) \in (0,1)^2$: the agent mixes in both states, so $V^i_{HH} - V^i_{HL} = V^i_{LL} - V^i_{LH} = m/\left(1 - r^i_H - r^i_L\right) < 0$. However, by definition of the $V^i_{\sigma\hat{\sigma}}$'s,

$$\text{(C.14)} \qquad \left(V^i_{HH} - V^i_{HL}\right)/\delta = (s + \delta)(\alpha\theta_H - c) + s\left(W^i_H - W^i_L\right),$$

$$\text{(C.15)} \qquad \left(V^i_{LL} - V^i_{LH}\right)/\delta = \alpha(s\theta_H + \delta\theta_L) - c + s\left(W^i_H - W^i_L\right),$$

where $W^i_\sigma \equiv (1 - \alpha)\xi^{-i}_\sigma \theta_\sigma + \gamma_\sigma$ is the true final payoff that agent i will receive in state σ

from the (aggregate) effort decisions ξ_σ^{-i} of the other players, and exogenously (last term). The two expressions differ by $\alpha\delta\left(\Delta\theta\right) > 0$, so $(\lambda_H^i, \lambda_L^i)$ cannot be an equilibrium. ■

Intuitively, any strategy with distortion or memory censoring in both states represents an inefficient way of encoding information, wasting $m > 0$ with positive probability. It does not corresponds to a best response to others' behavior since the agent can, *on his own,* improve upon it (under the very weak assumption that he can coordinate his "self 0" and "self 1" on a Pareto-superior intrapersonal equilibrium, which always exists). I therefore restrict attention, throughout the paper, to *efficient encoding strategies*, meaning that $\lambda_H^i = 1$ or $\lambda_L^i = 1$ for every i. This also implies, by (C.6)-(C.7),

$$r_H^i \geq q \geq 1 - r_L^i \quad \text{and} \quad \xi_H^i = 1 \geq \xi_L^i. \tag{C.16}$$

Finally, as explained in footnote 27, I generally restrict attention to *symmetric equilibria* (except in Section 2.4, or when there is a large number ($n \to +\infty$) of identical agents, as in Section 5). These two conditions will be implicit in the use of the word "equilibrium".

Lemma 6. *(1) For $\Delta\gamma \geq -(1-\alpha)\min\{\theta_H, \Delta\theta\}$ there can be no equilibrium with $\lambda_H = 0$, and no profitable individual deviation to $\lambda_H^i < 1$ from any equilibrium in which $\lambda_H = 1$.*
(2) For $\Delta\gamma > -\min\{(1-\alpha)\theta_H, (1-\alpha)\Delta\theta, \kappa^*(s)\Delta\theta)\}$, where $\kappa^*(s) > 0$ is given by (C.21) below, there can be no equilibrium with $\lambda_H < 1$. Thus, the results of Propositions 2-9 remain unchanged, up to the substitution of $\Delta\gamma + \Delta\theta$ for $\Delta\theta$ everywhere.

Proof. Following the same reasoning as in text (or directly from (C.8)-(C.9)) and omitting time subscripts to lighten the notation, the incentive to misinterpret or misremember H as L (gross of the cost m) is given by

$$\begin{aligned}\left(U_{HL}^{i,} - U_{HH}^{i,} + m\right)/\delta = {} & s\left(1 - r_L^i - r_H^i\right)\left(\gamma_H - \gamma_L\right) + \left(\xi_H^i - \xi_L^i\right)\left[c - \delta\alpha\theta_H\right] \\ & + s\alpha\left\{\left[\left(1 - r_L^i\right)\xi_L^i - r_H^i\xi_H^i\right]\theta_H - \left[\left(1 - r_H^i\right)\xi_H^i - r_L^i\xi_L^i\right]\theta_L\right\} \\ & + s\left(1-\alpha\right)\left(1 - r_L^i - r_H^i\right)\left\{\left[\lambda_H^{-i}\xi_H^{-i} + \left(1 - \lambda_H^{-i}\right)\xi_L^{-i}\right]\theta_H\right. \\ & \left. - \left[\lambda_L^{-i}\xi_L^{-i} + \left(1 - \lambda_L^{-i}\right)\xi_H^{-i}\right]\theta_L\right\}.\end{aligned} \tag{C.17}$$

The incentive to miscode L as H is given by the same expression, with H and L switched:

$$\text{(C.18)}\quad \left(U^{i,}_{LH} - U^{i,}_{LL} + m\right)/\delta = s\left(1 - r^i_H - r^i_L\right)(\gamma_L - \gamma_H) + \left(\xi^i_L - \xi^i_H\right)[c - \delta\alpha\theta_L]$$
$$+ s\alpha\left\{\left[\left(1 - r^i_H\right)\xi^i_H - r^i_L\xi^i_L\right]\theta_L - \left[\left(1 - r^i_L\right)\xi^i_L - r^i_H\xi^i_H\right]\theta_H\right\}$$
$$+ s(1-\alpha)\left(1 - r^i_H - r^i_L\right)\left\{\left[\lambda^{-i}_L\xi^{-i}_L + \left(1 - \lambda^{-i}_L\right)\xi^{-i}_H\right]\theta_L\right.$$
$$\left. - \left[\lambda^{-i}_H\xi^{-i}_H + \left(1 - \lambda^{-i}_H\right)\xi^{-i}_L\right]\theta_H\right\}.$$

From Lemma 5 and (C.16) we know that $\lambda^i_H = 1$ or $\lambda^i_L = 1$ and that in either case, $\xi^i_H = 1$, so in a symmetric equilibrium, $\xi^{-i}_H = \xi^i_H = 1$.

1. Equilibria with $\lambda_H = 1$. This implies $r^i_L = 1$, so $\xi^i_L = 0 = \xi^{-i}_L$ and (C.17) becomes

$$\left(U^{i,}_{HL} - U^{i,}_{HH} + m\right)/\delta = -sr^i_H(\gamma_H - \gamma_L) + [c - \delta\alpha\theta_H]$$
$$- s\alpha\left[r^i_H\theta_H + \left(1 - r^i_H\right)\theta_L\right] - sr^i_H(1-\alpha)\left[\theta_H - \left(1 - \lambda^{-i}_L\right)\theta_L\right]$$
$$= -[(\delta + s)\alpha(r^i_H\theta_H + (1 - r^i_H)\theta_L) - c] - sr^i_H\Delta\gamma$$
$$- \Delta\theta[\delta\alpha(1 - r^i_H) + sr^i_H(1-\alpha)] - sr^i_H(1-\alpha)\lambda^{-i}_L\theta_L.$$

The first term is negative since $r^i_H \geq q$, so it suffices that

$$\text{(C.19)}\qquad sr^i_H\Delta\gamma \geq -\Delta\theta[\delta\alpha(1 - r^i_H) + sr^i_H(1-\alpha)] - sr^i_H(1-\alpha)\lambda^{-i}_L\theta_L.$$

This inequality is linear in r^i_H and holds for $r^i_H = 0$. For $r^i_H = 1$, it takes the form $\Delta\gamma \geq -(1-\alpha)\left[\Delta\theta + \lambda^{-i}_L\theta_L\right]$, which holds whatever the sign of θ_L when $\Delta\gamma \geq -(1-\alpha)\min\{\Delta\theta, \theta_H\}$. Thus, an individual deviation to miscoding H as L is never profitable. As to miscoding L as H, (C.18) becomes

$$\left(U^{i,}_{LH} - U^{i,}_{LL} + m\right)/\delta = -[c - \delta\alpha\theta_L] + s\alpha\left[\left(1 - r^i_H\right)\theta_L + r^i_H\theta_H\right]$$
$$+ s(1-\alpha)r^i_H\left[\theta_H - \left(1 - \lambda^{-i}_L\right)\theta_L\right] + sr^i_H(\gamma_H - \gamma_L)$$
$$= -[c - (\delta + s)\alpha\theta_L] + sr^i_H\left[\Delta\theta + \Delta\gamma + (1-\alpha)\lambda^{-i}_L\theta_L\right],$$

which is identical to (9) except that $\Delta\theta$ is replaced by $\Delta\theta + \Delta\gamma$. Therefore, all the previous results and formulas shown for $\Delta\gamma = 0$ and imposing $\lambda^i_H \equiv 1$ remain the same, provided $\Delta\theta + \Delta\gamma >$ replaces $\Delta\theta$ wherever it appears.

2. Ruling out equilibria with $\lambda_H < 1 = \lambda_L$. If $\lambda_H^i < 1$ then $\lambda_L^i = 1$ by Lemma 5, so $r_H^i = 1$ and hence $\xi_H^i = 1 = \xi_H^{-i}$. Therefore, (C.17) simplifies to:

$$\left(U_{HL}^{i,} - U_{HH}^{i,} + m\right)/\delta = -\left(1-\xi_L^i\right)\left[\left(\delta+s\right)\alpha\theta_H - c\right]$$
$$- sr_L^i\left\{\Delta\theta\left[\alpha\xi_L^i + \left(1-\alpha\right)\xi_L^{-i}\right] + \Delta\gamma + \left(1-\alpha\right)\lambda_H^{-i}\left(1-\xi_L^{-i}\right)\theta_H\right\}.$$

In (symmetric) equilibrium $\xi_L^i = \xi_L^i$ and $\lambda_H^i = \lambda_H^{-i}$, so this expression is strictly negative and no equilibrium with $\lambda_H^i < 1$ exists, when

$$\text{(C.20)} \qquad \xi_L^i\Delta\theta + \left(1-\xi_L^i\right)\lambda_H^i\left(1-\alpha\right)\theta_H + \Delta\gamma \geq 0.$$

For $\Delta\theta + \Delta\gamma \geq 0$, we can rule out any equilibrium with $\xi_L^i = 1$, and in particular any equilibrium with $\lambda_H^i = 0$ (which implies $r_L^i = 1-q$, so $\xi_L^i = 1$). As to an equilibrium with $\xi_L^i < 1$, given $\lambda_L^i = 1$ this requires that λ_H^i not be below the critical value that makes an agent indifferent to working or not, given $\hat{\sigma}^i = L : \theta_L + \left[1 - r_L\left(\lambda_H, 1\right)\right]\Delta\theta \leq c/\alpha\left(s+\delta\right)$, or

$$\text{(C.21)} \quad \lambda_H^i\left(1-\alpha\right)\left(\frac{\theta_H}{\Delta\theta}\right) \geq \left(1-\alpha\right)\left(\frac{\theta_H}{\Delta\theta}\right)\left[1 - \left(\frac{1-q}{q}\right)\left(\frac{c/\alpha\left(s+\delta\right)-\theta_L}{\theta_H - c/\alpha\left(s+\delta\right)}\right)\right] \equiv \kappa^*(s).$$

Therefore, by (C.20), any equilibrium with $\xi_L^i < 1$ is ruled out for $\Delta\gamma \geq -\Delta\theta\min\{1, \kappa^*(s)\}$; hence the result. Note, moreover, that since $\kappa^*(s)$ is increasing, if the second inequality in (3) is strengthened to $q\theta_H + \left(1-q\right)\theta_L > c/\alpha\delta$, then $\kappa_H^*(0) > 0$ and such equilibria are ruled out for *any* s if $\Delta\theta\min\{1, \kappa^*(0)\} + \Delta\gamma > 0$. ■

Proof of Proposition 12. I again show the result for the more general specification (A.1), under which $\kappa \geq \max\{1, \theta_H/\Delta\theta\}$ is a special case of $\Delta\gamma \leq -\max\{\Delta\theta, \theta_H\}$.Note first that since $1 - r_L^i \leq q$, (B.2) implies that $\xi_L^i = 0$ and thus, in a equilibrium, $\xi_L^{-i} = \xi_L^i = 0$.

1. Ruling out equilibria with $\lambda_L^i < 1 = \lambda_H^i$. If $\lambda_L^i < 1$ then $\lambda_H^i = 1 = \lambda_H^{-i}$ in equilibrium by Lemma 5 and symmetry, so $r_L^i = 1$ and $\xi_L^i = 0 = \xi_L^{-i}$. Therefore, (C.18) simplifies to:

$$\begin{aligned}
\left(U_{LH}^{i,} - U_{LL}^{i,} + m\right)/\delta &= sr_H^i\Delta\gamma - \xi_H^i\left[c - \delta\alpha\theta_L\right] + s\alpha\xi_H^i\left[\left(1-r_H^i\right)\theta_L + r_H^i\theta_H\right] \\
&\quad + sr_H^i\left(1-\alpha\right)\xi_H^{-i}\left[\lambda_H^{-i}\theta_H - \left(1-\lambda_L^{-i}\right)\theta_L\right] \\
&= -\xi_H^i\left[c - (s+\delta)\alpha\theta_L\right] + sr_H^i\Delta\gamma + \xi_H^i\left[\Delta\theta + \left(1-\alpha\right)\lambda_L^i\theta_L\right]
\end{aligned}$$

Since $\Delta\gamma + \xi_H^i \left[\Delta\theta + (1-\alpha)\lambda_L^{-i}\theta_L\right] \leq \Delta\gamma + \xi_H^i \left[\Delta\theta + \max\{0, \theta_L\}\right] < 0$, the previous expression is strictly negative, and no equilibrium with $\lambda_L^i < 1$ exists.

2. Equilibria with $\lambda_L = 1$. This implies $r_H^i = 1$, so $\xi_H^i = 1 = \xi_H^{-i}$ and (C.18) becomes

$$\begin{aligned}
\left(U_{LH}^{i,} - U_{LL}^{i,} + m\right)/\delta &= -sr_L^i(\gamma_L - \gamma_H) - [c - \delta\alpha\theta_L] + s\alpha\theta_H + sr_L^i(1-\alpha)\lambda_H^{-i}\theta_H \\
&= -[c - (\delta + s)\alpha(r_L^i\theta_L + (1-r_L^i)\theta_H)] \\
&\quad + sr_L^i\Delta\gamma - (1-r_L^i)\delta\alpha\Delta\theta + sr_L^i\left[\alpha\Delta\theta + (1-\alpha)\lambda_H^{-i}\theta_H\right].
\end{aligned}$$

The first term is negative since $r_L^i \leq 1-q$, so it suffices that

$$sr_L^i\Delta\gamma \leq (1-r_L^i)\delta\alpha\Delta\theta - sr_L^i\left[\alpha\Delta\theta + (1-\alpha)\lambda_H^{-i}\theta_H\right]. \tag{C.22}$$

This inequality is linear in r_L^i and holds for $r_L^i = 0$. For $r_L^i = 1$, it takes the form $\Delta\gamma \leq -\left[\alpha\Delta\theta + (1-\alpha)\lambda_H^{-i}\theta_H\right]$, which holds for all λ_H^i if $\Delta\gamma \leq -[\alpha\Delta\theta + (1-\alpha)\theta_H]$. This expression is greater than $-\max\{\Delta\theta, \theta_H\}$ whatever the sign of θ_L, hence the result ruling out any profitable individual deviation to $\lambda_L^i < 1$. As to (C.17), it becomes

$$\begin{aligned}
\left(U_{HL}^{i,} - U_{HH}^{i,} + m\right)/\delta &= -sr_L^i(\gamma_H - \gamma_L) + [c - \delta\alpha\theta_H] - s\alpha\theta_H - s(1-\alpha)r_L^i\lambda_H^{-i}\theta_H \\
&= -[(s+\delta)\alpha\theta_H - c] - sr_L^i\left[\Delta\gamma + (1-\alpha)\lambda_H^{-i}\theta_H\right].
\end{aligned}$$

Since $-\Delta\gamma - \theta_H > 0$, $\lambda_H^i = 1$ is an equilibrium (implying $r_L^i = 1$) if and only if

$$s \leq \frac{m/\delta + \delta\alpha\theta_H - c}{-\Delta\gamma - \theta_H} \equiv \underline{s}(1). \tag{C.23}$$

Similarly, $\lambda_H^i = 0$ is an equilibrium (implying $r_L^i = 1-q$) if and only if

$$s \geq \frac{m/\delta + \delta\alpha\theta_H - c}{(1-q)(-\Delta\gamma) - \alpha\theta_H} \equiv \bar{s}(0), \tag{C.24}$$

if $-\Delta\gamma > \alpha\theta_H/(1-q)$, otherwise, let $\bar{s}(0) \equiv +\infty$. Multiple equilibria occur for $\bar{s}(0) < \underline{s}(1)$, i.e. $q(-\Delta\gamma) < (1-\alpha)\theta_H$. The treatment of the mixed-strategy equilibrium is similar to that in Proposition 2. ■

SUPPLEMENTARY MATERIAL

Online Appendix D: Patterns of Denial

This appendix highlights certain patterns (in both words and deeds) that recur across most instances of organizational and market meltdown, from the Space Shuttle disasters to the recent financial crisis.[72]

1. Preposterous probabilities. In his contribution to the Rogers Commission Report (1986) on the Challenger disaster, Nobel physicist Richard Feynman noted that:

"It appears that there are enormous differences of opinion as to the probability of a failure with loss of vehicle and of human life. The estimates range from roughly 1 in 100 to 1 in 100,000. The higher figures come from the working engineers, and the very low figures from management. What are the causes and consequences of this lack of agreement? Since 1 part in 100,000 would imply that one could put a Shuttle up each day for 300 years expecting to lose only one, we could properly ask 'What is the cause of management's fantastic faith in the machinery?' "

Feynman's simple reasoning makes clear that NASA management's risk estimates –one thousand times lower than those of their own engineers– made no statistical sense. The housing-related bubble and buildup to the current financial crisis abound in even more extreme statements of confidence –nothing short of probability one. In an August 2007 conference with analysts, Joseph Cassano, head of AIG. Financial Services, asserted

"It is hard for us, without being flippant, to even see a scenario within any kind of realm of reason that would see us losing one dollar in any of those transactions...".[73]

As late as 2008, in a meeting with investors,

"Lehman's chief financial officer, Erin Callan,... exuded confidence... With firms like Citigroup and Merrill raising capital, an investor asked, why wasn't Lehman following suit? Glaring at her questioner, she said that Lehman didn't need more money at the time –after all, it had yet to post a loss during the credit crisis. The company had industry veterans in the executive suite who had perfected the science of risk management, she said. "This company's leadership has been here so

[72] In what follows, all the quotes concerning NASA come from The Rogers Commission Report (1986) and the Columbia Accident Investigation Board Final Report (2003).

[73] Cited in Morgenson (2008). Not coincidentally, this is the London unit (which he founded) that sank the company after selling over $500 billion in credit default swaps that could not be covered.

long that they know the strengths and weaknesses... We know when we need to be worried, and when we don't." (Anderson and Duhig (2008))

Are such statements by top executives only cynical attempts to deceive investors and analysts about the quality of their balance sheet? While there is surely an element of moral hazard, this explanation falls short on several counts. First, absurd claims of *zero risk* in highly turbulent times are simply not credible, and thus more likely to be read as negative signals about the executive's grasp of reality than reassurance about fundamentals. In fact, they typically do nothing to bolster a company's share price, credit rating or prevent a run (see Sorkin (2008) for many examples).

Second, knowingly deceiving investors often leads to criminal prosecution and prison, as well as ruinous civil lawsuits and loss of reputation. A key aspect of self-delusion in such cases involves the expectation of "getting away" with fraud and cover-up, rather than ultimately sharing the fate of predecessors at Drexel Burnham Lambert, Enron, Worldcom, and many others.[74] Even abstracting from legal liability, selective blindness and collective rationalizations about the unethical nature of an organization's practices are key elements in the process that leads otherwise respectable citizens to take part in those practices (e.g., Sims (1992), Cohan (2002), Tenbrunsel and Messick (2004), Anand et al. (2005), Schrand and Zechman (2008), Bazerman and Tenbrunsel (2011)).

Third, identical claims of zero risk are made in settings where no large financial gain is involved and the downside can be truly catastrophic –as with NASA mission managers and financial regulators. Asked in a 2007 Congressional testimony whether he was "at all concerned... that if one of these huge institutions fails, it will have a horrendous impact on the national and global economy", former FED Chairman Alan Greenspan replied:[75]

"No, I'm not," "I believe that the general growth in large institutions have occurred in the context of an underlying structure of markets in which many of the larger risks are dramatically –I should say, fully– hedged." (Goodman (2008))

[74] In 2007 alone the FBI made over 400 arrests in subprime-related cases (including top fund managers at Lehman Brothers) and had ongoing criminal investigations into 26 major financial companies including Countrywide Financial, A.I.G., Lehman Brothers, Fannie Mae and Freddie Mac. These companies and their top executives (e.g., most of those cited in this appendix) are also being sued by several State attorney generals, in addition to countless shareholders groups, investors and borrowers.

[75] For other instances of blindness to red flags and active information-avoidance by financial regulators, see SEC (2008, 2009).

His absolute certainty then turned to “shocked disbelief” when the disaster scenario materialized a few months later.

2. New paradigms: this time is different, we are smarter and have better tools. Every case also displays the typical pattern of hubris, based on claims of superior talent or human capital. For AIG.’s Joseph Cassano, losses being simply unimaginable (as seen above),

“The question for us is, where in the capital markets can we gain the best opportunity, the best execution for the business acumen that sits in our shop?”.

What Feynman termed “fantastic faith in the machinery” is also often vested in computer models and statistical data. Subprime lenders and the banks purchasing the derived CDO’s could thus rely on the fact that

“We have a wealth of information we didn’t have before,” “We understand the data and can price that risk.” (2005 interview of Joe Anderson, then a senior Countrywide executive, cited in BusinessWeek, “Not So Smart,” August 2007)

This trove of information was then fed to sophisticated computer programs:

“ ‘It’s like having a secret sauce; everyone had their own best formulas,” says Edward N. Jones, CEO of ARC Systems, which sold [underwriting and risk-pricing] technology to HSBC... and many of their rivals.” (BusinessWeek (2007))

Closely related is the argument that previous rules of accounting, risk management or economics no longer apply, due to some radical shift in fundamentals. Thus,

“I don’t think it’s a bubble, David M. Rubenstein of Carlyle Group told the Financial Times in December 2006. I think really what’s happening now is that people are beginning to use a different investment technique, and this investment technique, private equity, adds real value.” (Business-Week, 2007)

Shiller (2005) documents how such “new era thinking”, variously linked to railroads, electricity, internet, demography or deregulation, was involved in nearly all historical episodes of financial bubbles and manias. One can also see it at work in government:

“The [senior White House] aide said that guys like me were “in what we call the reality-based community,” which he defined as people who “believe that solutions emerge from your judicious study of discernible reality.” I nodded and murmured something about enlightenment principles and

empiricism. He cut me off. "That's not the way the world really works anymore," he continued." We're an empire now, and when we act, we create our own reality. And while you're studying that reality – judiciously, as you will – we'll act again, creating other new realities, which you can study too, and that's how things will sort out." (Suskind (2004))

3. Escalation, failure to diversify, divest or hedge. Wishful beliefs show up not only in words but also in deeds. Enron's CEO Ken Lay resisted selling his shares throughout the long downfall, pledging other assets to meet collateral requirements, even buying stock back later on and ending up ruined well before his legal troubles began (Eichenwald (2005), Pearlstein (2006)). The company's employees, whose pension portfolios had on average 58% in Enron stock, could have moved out at nearly any point, but most never did (Samuelson (2001)). At Bears Stearns, 30% of the stock was held until the last day by employees – with presumably good access to diversification and hedging instruments– who thus lost their capital together with their job. CEO James Cayne alone owned an unusually high 6% and went from billionaire to small millionaire in the process (spending most of the intervening months away playing golf and bridge). The pattern is similar at Lehman Brothers and other financial institutions.

Without looking to such extremes, Malmendier and Tate (2005, 2008) document many CEO's tendency to delay exercising their stock options and how this measure of overconfidence is a predictor of overinvestment. Studying individual investors, finally, Karlsson, et al. (2009) find that many more go online to check the value of their portfolios on days when the market is up than when it is down.

Some of the most interesting evidence comes from cases in which an official inquiry or trial was conducted following a public- or private-sector disaster. Extensive records of meeting notes, memos, emails and sworn depositions reveal how key participants behaved, in particular with respect to information.

4. Information avoidance, repainting red flags green and overriding alarms. The most literal case of willful blindness occurred after the Columbia mission sustained a large foam strike to its wing's thermal shield:

"At every juncture of [the mission], the Shuttle Program's structure and processes, and therefore the managers in charge, resisted new information. Early in the mission, it became clear that the

Program was not going to authorize imaging of [damage to] the Orbiter because, in the Program's opinion, images were not needed. Overwhelming evidence indicates that Program leaders decided the foam strike was merely a maintenance problem long before any analysis had begun."

Similar "head-in the sand" behavior was extensively documented at the Securities and Exchange Commission, even before its decade-long ignorance of Bernard Madoff's giant Ponzi scheme was revealed. The Inspector General's Report (S.E.C. (2008)) thus states:

"The audit found that [the Division of] Trading and Markets became aware of numerous potential red flags prior to Bear Stearns' collapse, regarding its concentration of mortgage securities, high leverage, shortcomings of risk management in mortgage-backed securities and lack of compliance with the spirit of Basel II standards, but did not take actions to limit these risk factors."

Instead, as reported in Labaton (2008), "the commission assigned [only] seven people to examine [the major investment banks] –which last year controlled... combined assets of $4 trillion. Since March 2007, the office has not had a director. And as of last month, the office had not completed a single inspection since it was reshuffled by Mr. Cox [the SEC chairman] more than a year and a half ago."

Similarly, at the FED...

"Edward M. Gramlich, a Federal Reserve governor... warned nearly seven years ago that a fast-growing new breed of lenders was luring many people into risky mortgages they could not afford. But when Mr. Gramlich privately urged Fed examiners to investigate mortgage lenders affiliated with national banks, he was rebuffed by Alan Greenspan... Mr. Greenspan and other Fed officials repeatedly dismissed warnings about a speculative bubble in housing prices... The Fed was hardly alone in not pressing to clean up the mortgage industry. When states like Georgia and North Carolina started to pass tougher laws against abusive lending practices, the Office of the Comptroller of the Currency successfully prohibited them from investigating local subsidiaries of nationally chartered banks." (Morgenson and Fabrikant (2007))

... and the Treasury:

"In 1997, the Commodity Futures Trading Commission,... led by a lawyer named Brooksley E. Born... was concerned that unfettered, opaque trading could "threaten our regulated markets or, indeed, our economy without any federal agency knowing about it," she said in Congressional testimony. She called for greater disclosure of trades and reserves to cushion against losses. Ms. Born's views incited fierce opposition from Mr. Greenspan and Robert E. Rubin, the Treasury secretary

then. Treasury lawyers concluded that merely discussing new rules threatened the derivatives market... In the fall of 1998, the hedge fund Long Term Capital Management nearly collapsed, dragged down by disastrous bets on, among other things, derivatives. Despite that event, Congress froze the Commission's regulatory authority for six months. The following year, Ms. Born departed. In November 1999, senior regulators –including Mr. Greenspan and Mr. Rubin– recommended that Congress permanently strip the C.F.T.C. of regulatory authority over derivatives." (Goodman (2008))

To avoid having to override alarms systems, it is sometimes simplest to turn them off from the start:

"The Commission was surprised to realize after many hours of testimony that NASA's safety staff was never mentioned... No one thought to invite a safety representative or a reliability and quality assurance engineer to the [prelaunch] January 27, 1986, teleconference between Marshall [Space Center] and Thiokol. Similarly, there was no representative of safety on the Mission Management Team that made key decisions during the countdown on January 28, 1986. The Commission is concerned about the symptoms that it sees."

Similarly, at Fannie Mae:

"Between 2005 and 2007, the company's acquisitions of mortgages with down payments of less than 10% almost tripled... For two years, Mr. Mudd operated without a permanent chief risk officer to guard against unhealthy hazards. When Enrico Dallavecchia was hired for that position in 2006, he told Mr. Mudd that the company should be charging more to handle risky loans. In the following months to come, Mr. Dallavecchia warned that some markets were becoming overheated and argued that a housing bubble had formed... But many of the warnings were rebuffed... Mr. Dallavecchia was among those whom Mr. Mudd forced out of the company during a reorganization in August." (Duhig (2008))

The cavalier misuse of computerized models and simulations beyond their intended purposes is also mirrored between the engineering and financial worlds. Thus,

"Even though [Columbia's] debris strike was 400 times larger than the objects [the computer program] Crater is designed to model, neither Johnson engineers nor Program managers appealed for assistance from the more experienced Huntington Beach engineers, who might have cautioned against using Crater so far outside its validated limits. Nor did safety personnel provide any additional

oversight."

In the subprime-credit boom,

"Some trading desks [at major banks] took the most arcane security, made of slices of mortgages, and entered it into the computer as if it were a simple bond with a set interest rate and duration... But once the mortgage market started to deteriorate, the computers were not able to identify all the parts of the portfolio that might be hurt." (Hansell, 2008)

5. Normalization of deviance, changing standards and rationales.

How do organizations react when what was not supposed to happen does, with increasing frequency and severity?

"This section [of the report] gives an insider perspective: how NASA defined risk and how those definitions changed over time for both foam debris hits and O-ring erosion. In both cases, engineers and managers conducting risk assessments continually "normalized" the technical deviations they found... Evidence that the design was not performing as expected was reinterpreted as acceptable and non-deviant, which diminished perceptions of risk throughout the agency... Engineers and managers incorporated worsening anomalies into the engineering experience base, which functioned as an elastic waistband, expanding to hold larger deviations from the original design. Anomalies that did not lead to catastrophic failure were treated as a source of valid engineering data that justified further flights... NASA documents show how official classifications of risk were downgraded over time."

The same pattern of normalizing close calls with disaster shows up as a precursor to corporate scandals and financial meltdowns. Several years before Ken Lay failed to heed V.P. Sherron Watkins' urgent plea that he and the CAO "sit down and take a good, hard, objective look at what is going to happen to Condor and Raptor [ventures] in 2002 and 2003", lest the company "implode in a wave of accounting scandals", he had refused to fire two high-revenue-generating oil traders after learning that they had stolen millions from the company and forged financial documents to hide it. A year later, those very same "rogue" traders used again falsified books to make huge unauthorized bets on oil prices, which went sour and exposed the company to several hundred millions dollars of potential losses (Eichenwald (2005)). In a near repeat scenario, in 2004 AIG Financial Services caused the parent company to be fined \$126 million for helping clients engage in tax and accounting fraud. Yet the same manager (J. Cassano) remained in charge and was even put on the newly formed committee in charge of quality and risk control –until his unit blew up the company four years later.

6. Reversing the burden of proof. At the Beech-Nut Corporation in late 1970's, tests by the main food scientist suggested that the apple concentrate from a new (and cheaper) major supplier was probably adulterated. Top management responded by telling scientists that the company would not switch suppliers unless they could absolutely prove that it was. At the same time, they made it more difficult for them to conduct inspections.[76] Similarly, at NASA,

"When managers... denied the team's request for imagery, the Debris Assessment Team was put in the untenable position of having to prove that a safety-of-flight issue existed without the very images that would permit such a determination... Organizations that deal with high-risk operations must always have a healthy fear of failure – operations must be proved safe, rather than the other way around. NASA inverted this burden of proof..."

Similar reversals of evidentiary standards and shifting rationales were also documented in the decision process leading to the second Iraq war, particularly on the issue of weapons of mass destruction (Hersh (2004), Isikoff and Corn (2007)).

7. Malleable memories: forgetting the lessons of history. The commission investigating the Columbia accident was struck by how the same patterns had repeated themselves six years after Challenger:

"The Board found that dangerous aspects of NASA's 1986 culture, identified by the Rogers Commission, remained unchanged... Despite the constraints that the agency was under, prior to both accidents NASA appeared to be immersed in a culture of invincibility, in stark contradiction to post-accident reality. The Rogers Commission found a NASA blinded by its "Can-Do" attitude... which bolstered administrators' belief in an achievable launch rate, the belief that they had an operational system, and an unwillingness to listen to outside experts."

In the financial and regulatory worlds, the lessons of LTCM were also quickly forgotten, as were those of the internet bubble a few years later. Such failures of individual and collective

[76] The product was later shown to be 100% artificial. Beech-Nut was convicted and paid several million in fines and class-action settlements, while the CEO and the former Vice-President of manufacturing were sentenced to jail (Sims (1992)).

memory are recurrent. They were even pointed out (and then forgotten...) by a key observer and participant:

"An infectious greed seemed to grip much of our business community... The trouble, unfortunately, is that the shock of what has happened will keep malfeasance down for a while. But human nature being what it is –and memories fade– it will be back. And it is important that at that time appropriate legislation be in place to inhibit activities that we would perceive to be inappropriate." (Greenspan (2002)).

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