The Rat Race at Work: Technology and Burnout

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Abstract

Technological progress can raise employee productivity, yet empirical evidence suggests it may also lead employees to work more. This paper studies how productivity-enhancing technology impacts employee welfare through two channels: employees' strategic work decisions and their risk of burnout. We develop a model in which employees' productivity increases in both technology quality and their chosen work intensity. A high work intensity causes employee strain to accumulate more quickly, raising the hazard rate of burnout. A burnout event ends an employee's production, making burnout costly for the firm through reduced productive capacity. We show that when employees' pay is sufficiently sensitive to their performance relative to peers, better technology can lead to a competitive "rat race" that induces more work. As a result, employee welfare can initially decrease in technology quality as competition intensifies, but eventually recover as competition cools and employees reap the productivity benefits of the technology. For the firm, the possibility of burnout can lead to decreasing marginal returns to technology; firm profit is otherwise convex in technology quality. When the firm chooses employee performance incentives, a reduction in the underlying burnout hazard can lead to higher actual burnout and lower employee welfare in equilibrium. Finally, when technology quality is low, a profit-maximizing firm may invest more in burnout mitigation than a social welfare-maximizing firm, which instead promotes welfare by suppressing workplace competition through weaker performance incentives.

1. Introduction

Productivity-enhancing technologies like generative artificial intelligence (AI) are transforming the workplace. AI assistance has been shown to increase either the quality or volume of employee output in professional writing, management consulting, customer support, and software development (Noy and Zhang, 2023; Dell'Acqua et al., 2023; Brynjolfsson et al., 2025; Cui et al., 2025). These findings show that AI has the potential to boost employee productivity across several types of knowledge work.

Improvements in workplace technology, however, need not translate into lighter workloads for employees. In fact, recent empirical evidence suggests AI may be having precisely the opposite effect: Using U.S. time-diary data, Jiang et al. (2025) find that workers in occupations with greater AI exposure work longer hours, with stronger effects when AI complements employee work. Similarly, Ranganathan and Ye (2026) find that employees at a technology firm took on more tasks and worked longer hours

following the adoption of AI, often without being asked, and a study of workplace activity data from 10,000 AI users finds that digital activity (e.g., email, messaging) increased dramatically after AI adoption (ActivTrak Productivity Lab, 2026).

Why might technological progress lead to *more* work? One possible explanation is competition: When employees are evaluated based on their performance relative to peers, better technology can make production easier for everyone, leading employees to work harder for the same rewards.[1] This type of strategic overwork can create a "rat race" in which employees work harder to preserve their position relative to coworkers, even though they would collectively prefer a less demanding equilibrium (Nalebuff and Stiglitz, 1983; Landers et al., 1996). OpenAI CEO Sam Altman makes a similar prediction about how AI will affect work: "It's like a relative game. People are very focused on how they're doing relative to other people . . . I think we're all going to be much busier than we thought we were supposed to be in a post-superintelligence world" (Altman, 2026).

Relative-performance evaluations of employees are common in practice, particularly in the technology sector. In 2025, Meta set a target for teams with at least 150 employees to place 15 to 20 percent of employees in the lowest performance category, and described the review process as an opportunity to make exit decisions (Dixit and Mann, 2025). Microsoft and Amazon have also used similar ranking systems (Eichenwald, 2012; Soper, 2022). However, ranking-based systems are not necessary for employees to compete: Bonuses, raises, and promotions are often limited, so employees may recognize that compensation and career advancement implicitly depend on how their performance compares with coworkers'. In such settings, an across-the-board productivity gain from technology can heighten workplace competition, even when the firm leaves its formal evaluation system unchanged.

Whether technological improvements compel employees to work more is consequential because higher workloads impose costs on both firms and employees. In particular, excessive work may lead to employee *burnout*, which refers to the exhaustion and reduced effectiveness caused by chronic workplace stress (World Health Organization, 2019; Maslach et al., 2001). For the firm, burnout can reduce productive capacity through lower work quality, increased sickness absence, or employee departures (Corbeanu et al., 2023; Schaufeli et al., 2009; Salvagioni et al., 2017). Recent estimates place the annual cost of burnout at approximately $5 million for an average U.S. company with 1,000 employees, largely through missed work (Martinez et al., 2025). Technological progress can therefore create an operational tradeoff: It raises individual employee productivity, but can also intensify work and increase burnout, reducing the firm's productive capacity.

In recognition of the costs imposed by burnout, many firms explicitly invest in employee well-being, with

[1] Nalebuff and Stiglitz (1983) note this possibility; we analyze it formally and show how burnout risk can change the result.

workplace wellness programs now covering more than 50 million U.S. workers (Jones et al., 2019). For example, HubSpot combines coaching, therapy, and meditation in what it calls a "long-term framework to prevent and battle burnout" (HubSpot, 2021), and Salesforce and Adobe reimburse employees for activities that support mental well-being (Hyder, 2022; Adobe, 2026). Many companies view employee well-being as a strategic priority: In a Deloitte survey, 83 percent of executives said well-being should be discussed by the board (Fisher et al., 2023). Beyond wellness programs, firms can also reduce burnout by changing the work environment itself, for example, by giving employees greater flexibility over their work schedules (Moen et al., 2016; Kelly and Moen, 2020). Changes to organizational culture, such as improved support from supervisors and coworkers, may also weaken the link between job demands and burnout (Bakker et al., 2005). Whether through wellness programs or changes to the work environment, burnout mitigation may become increasingly important if technological improvements indeed intensify work.

Although a rich literature examines how relative-performance evaluation shapes workplace competition (Lazear and Rosen, 1981; Connelly et al., 2014), less is known about how the effects of such evaluation systems on employees are altered by technological progress, especially when high workloads are costly to well-being. This paper therefore asks two questions. First, how does productivity-enhancing technology affect employee welfare in competitive workplaces? Second, if better technology reduces employee welfare, to what extent can improved work conditions protect employees?

1.1. Summary of Model and Results

We develop a single-period, continuous-time model of a firm in which n identical employees simultaneously choose their work intensities at the start of the period. Employee output increases in their work intensity, duration of work, and technology quality. Employees face relative-performance incentives, which reward them based on their absolute output and output relative to the group average. We model employee burnout through a time-to-failure process in which greater work intensity raises the hazard rate of burnout, and a burnout event imposes a fixed cost on the employee and ends their production for the remainder of the period. The firm's payoff is total output less employee payments, making burnout costly for the firm through reduced production, in addition to a fixed cost. We consider three settings: one in which the strength of the relative-performance incentive is fixed, one in which the firm chooses it, and one in which the firm jointly chooses the incentive and invests in burnout mitigation.

We first examine how technology affects employee welfare when relative-performance incentives are fixed. At low technology quality, an improvement creates a "rat race effect" that erodes employee welfare: Employees work more intensely to keep up with coworkers who they anticipate will become more productive, and the resulting strain on all employees outweighs the direct benefit of better technology.

However, when technology quality is high, employees may benefit from further improvements in technology. Intuitively, better technology amplifies the performance advantage of the employees who remain productive when a coworker burns out, allowing them to earn large relative-performance rewards simply by avoiding burnout. This "strategic survival" behavior weakens the marginal incentive to work intensely, leading equilibrium work intensity to rise more slowly or decline in technology quality. This cooling of workplace competition allows the direct productivity benefit of better technology to dominate, and employee welfare to rise.

We next consider how the firm's returns to technology are shaped by employees' risk of burnout and relative-performance incentives, both of which influence their strategic work decisions. Without burnout, better technology both raises the value of completed work and induces employees to work more intensely. These direct and strategic effects reinforce one another, making firm profit convex in technology quality. With the possibility of burnout, however, the strategic survival behavior described above can moderate work intensity, making the firm's marginal return to technology decrease at high technology quality if it is sufficiently strong. This result provides additional theoretical support for the idea that the extent to which a firm benefits from technological progress depends on its organizational environment (Brynjolfsson and Hitt, 2000).

Naturally, better work conditions ought to protect employees. However, we show that when performance incentives are endogenous (i.e., chosen by the firm), a reduction in the underlying burnout hazard can lead to higher expected burnout and lower employee welfare in equilibrium. The intuition is that a lower burnout hazard makes employees safer, which benefits the firm by making its productive capacity more secure. The firm's response is then to demand even more work from employees, which it does by strengthening the relative-performance incentive to intensify competition. When the burnout hazard is sufficiently low, the resulting increase in employee work intensity more than offsets the direct reduction in burnout risk, causing an increase in the equilibrium burnout probability. The change in expected compensation does not offset these costs, so employee welfare falls despite the improvement in work conditions. This highlights a risk that improvements in working conditions (e.g., flexible work hours) can leave employees worse off than before, because it is optimal for the firm to strengthen incentives to the point that it "overshoots" on employees' work intensity.

Finally, we consider a setting where the firm jointly chooses the employees' relative-performance incentive alongside an investment in burnout mitigation that lowers the hazard rate. We compare the optimal designs of a profit-maximizing firm and a social welfare-maximizing firm. When technology quality is low, the profit-maximizing firm invests *more* in burnout mitigation than the social welfare-maximizing firm, which instead chooses a weaker incentive to suppress employee competition and limit burnout. Because moderating competition sacrifices output, this result arises at low technology

levels, where the output loss is limited; when technology quality is high, we find numerically that the social welfare-maximizing firm invests more in mitigation than the profit-maximizing firm. This result suggests that mitigation spending alone can be a misleading indicator of how well a workplace protects its employees, and that for a welfare-conscious firm, it may be more cost-efficient to change its performance evaluation system than to spend aggressively on mitigation (e.g., through wellness programs).

1.2. Related Literature

This paper relates to the people-centric operations literature, which studies how employee behavior shapes operational performance (Boudreau et al., 2003; Roels and Staats, 2021). Corbett (2024) highlights how operational choices, including work pace and payment systems, shape individual well-being. This literature has shown that workers adjust their pace to the load on the system and to their coworkers' pace (Schultz et al., 1998; KC and Terwiesch, 2009; Delasay et al., 2016), but these adjustments can be difficult to sustain. For example, KC and Terwiesch (2009) find that hospital workers speed up as load increases, but that prolonged periods of high load slow them down and are associated with worse patient outcomes, a pattern that Delasay et al. (2016) capture in a queueing model that distinguishes load effects from overwork effects. More broadly, beyond a point, high workloads reduce productivity and service quality (Tan and Netessine, 2014; Kuntz et al., 2015; Berry Jaeker and Tucker, 2017) and may also increase absenteeism (Green et al., 2013).

This paper also draws on research on employee burnout, which identifies workload and job demands as its central drivers (Cordes and Dougherty, 1993; Maslach et al., 2001; Schaufeli and Bakker, 2004). Burnout is costly for both employees and firms and is associated with worse job performance (Corbeanu et al., 2023). Goh et al. (2016) estimate that workplace stressors are associated with more than 120,000 deaths and 5–8% of healthcare spending each year in the United States. However, the same job demands need not lead to the same level of burnout. Job resources such as employee autonomy and strong supervisor relationships can buffer the effect of job demands on burnout (Bakker et al., 2005). The model captures this distinction by separating employees' chosen work intensity from an underlying burnout exposure, which the firm can lower by investing in employee well-being. Improvements in employee health have been linked to higher productivity (Gubler et al., 2018), but the effects of workplace interventions also depend on how firms respond. For example, Jiao et al. (2026) show that interventions intended to reduce excessive overtime in global supply chains can backfire once firms adjust their monitoring behavior. We build on this literature by studying how firms should design incentives and mitigation as technology changes the demands placed on employees.

This paper also relates to the operations management literature on how firms organize work around

AI. This literature shows that the benefits of AI depend on how tasks are allocated between humans and AI, how their interaction is designed, and their relative capabilities (Fügener et al., 2026; Fang et al., 2026; Hu et al., 2026). Working with AI can also be demanding: AI assistance can increase the cognitive effort and time pressure that workers face (Boyacı et al., 2024, 2026; Legros and de Véricourt, 2026). Other work studies how AI interacts with worker incentives. Dai and Taylor (2025) examine how firms jointly design AI and employee incentives, and Lu and Tomlin (2026) and Guan et al. (2025) show that limiting the information or precision of AI can motivate workers to acquire information themselves. Bastani and Cachon (2025) show that more reliable AI can make human oversight more costly to induce, and Siderius et al. (2026) show that better AI can weaken workers' incentives to check its output, causing skill atrophy.

A growing empirical literature also examines how new workplace technologies affect employee welfare. AI assistance has been shown to improve task satisfaction and lower employee attrition (Noy and Zhang, 2023; Brynjolfsson et al., 2025), but new technologies can also raise work demands, leading to more overtime and greater work intensity (Giebel and Lammers, 2025), expectations of constant availability (Mazmanian et al., 2013), and longer workdays with less leisure, particularly in more competitive labor and product markets (Jiang et al., 2025). We complement this work with a theoretical model of how AI interacts with employees' performance incentives to shape welfare.

This paper connects to a rich literature on the use of relative performance evaluation to motivate employee effort, including rank-order tournaments (Lazear and Rosen, 1981; Green and Stokey, 1983) and more general incentive contracts (Nalebuff and Stiglitz, 1983; Mookherjee, 1984). Performance pay has been found to raise worker output (Lazear, 2000), and feedback on relative performance can change how much employees work (Casas-Arce and Martínez-Jerez, 2009; Song et al., 2018). This paper is closest to studies of the unintended consequences of performance incentives, which can encourage workers to undermine coworkers (Lazear, 1989), increase stress and burnout (Habel et al., 2021), or push workers to overexert (Landers et al., 1996; Greiner et al., 2026). Waiser et al. (2025) model burnout as an intertemporal effort-cost spillover, and show that strong incentives can lead employees to overwork and eventually quit. Our model differs in that we study how productivity-enhancing technology changes competition among employees, and thus burnout risk.

2. Model

2.1. Work and Burnout

Consider a firm with $n \geq 3$ ex ante identical employees, indexed by $i \in \mathcal{N} \equiv \{1, \ldots, n\}$. There is one period, normalized to unit length, with continuous time $t \in [0, 1]$. At the beginning of the period,

employees simultaneously choose sustained work intensities $x_i \in [0, \infty)$, which remain fixed while they are productive. Let $\mathbf{x} = (x_1, \ldots, x_n)$ denote the intensity profile and $\mathbf{x}_{-i}$ the profile excluding employee i. Work intensity captures the pace at which the employee accepts and completes work during a performance evaluation cycle or a long project.

Let $\tau_i(x_i) \in (0, 1]$ denote the time for which employee i remains productive during the period. If employee i does not burn out during the period, then $\tau_i(x_i) = 1$. Continued work generates strain, which raises burnout risk. We assume a power-law relationship between cumulative work and strain: After working for time t, accumulated strain is $(x_i t)^\alpha/\alpha$, with accumulation rate $x_i^\alpha t^{\alpha-1}$. Conditional on remaining productive until time $t \in [0, 1)$, employee i's burnout hazard rate is $\rho x_i^\alpha t^{\alpha-1}$.

Here, $\rho > 0$ denotes underlying burnout *exposure*: It scales the hazard rate at a given work intensity, reflecting the prevailing work conditions. For example, two teams may sustain the same pace of work while differing in employees' control over their work schedules (Moen et al., 2016) or in the support available from coworkers and supervisors (Cordes and Dougherty, 1993; Demerouti et al., 2001; Bakker et al., 2005). We represent the effect of these conditions through ρ, which is common across employees. Treating ρ as common reflects that work conditions apply at the level of the team or firm rather than at the individual level.

The parameter $\alpha > 2$ is the burnout work *sensitivity* and determines how sharply the hazard rises with work intensity. The hazard rises as strain accumulates, and is higher at greater work intensity for a given strain level. The restriction $\alpha > 2$ is a technical condition that ensures that the firm's optimal induced work intensity in Sections 5 and 6 is finite.

For $t \in [0, 1]$, integrating the hazard rate from 0 to t gives

$$\begin{aligned} \Pr(\tau_i(x_i) < t \mid x_i) &= 1 - \exp\left\{ - \int_0^t \rho x_i^\alpha s^{\alpha-1}\, ds \right\} \\ &= 1 - e^{-\rho x_i^\alpha t^\alpha/\alpha}. \end{aligned} \tag{1}$$

This is a Weibull time-to-failure model, censored at the end of the period (Weibull, 1951).[2] Figure 1 shows the cumulative burnout probability for different levels of exposure, sensitivity, and work intensity.

If $\tau_i(x_i) < 1$, employee i stops producing for the rest of the period, with no recovery or reassignment of work. This captures episodes such as extended sickness absence or disengagement (Schaufeli et al., 2009; Cordes and Dougherty, 1993).[3] Completed work is therefore $x_i \tau_i(x_i)$. The variables $\tau_i(x_i)$ are independent across employees conditional on work intensity x_i. The burnout hazard and all model

[2] This specification has parallels in reliability engineering, where machine failure depends on cumulative strain through a power-law relationship (Miner, 1945; Manson, 1953).

[3] We conjecture that milder forms of burnout, in which an employee continues to produce at reduced quality, would temper the main results but not change them qualitatively.

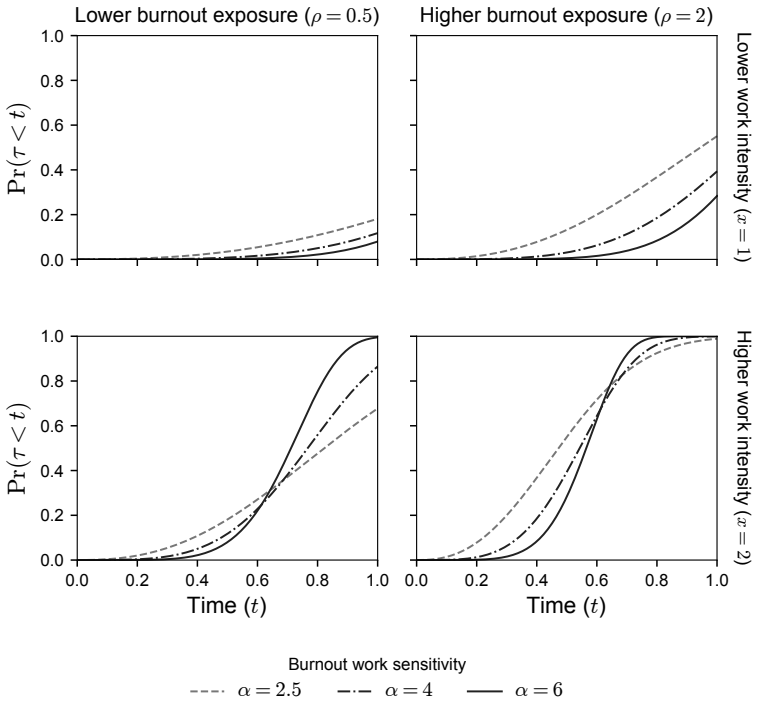


Figure 1: Burnout probability over the performance period. Left panels: Lower burnout exposure ($\rho = 0.5$). Right panels: Higher burnout exposure ($\rho = 2$) raises burnout probability at a given work intensity. The top and bottom panels use $x = 1$ and $x = 2$, respectively. Comparing these rows shows how higher burnout work sensitivity α amplifies the effect of work intensity. Line types distinguish $\alpha \in \{2.5, 4, 6\}$.

parameters are common knowledge.

An active employee bears the instantaneous work cost $x_i^\alpha t^{\alpha-1}$ (i.e., work cost is linear in accumulated strain, with cost per unit of strain normalized to one). Burnout imposes an employee cost $\phi^w > 0$, which captures its health and career consequences (Goh et al., 2016; Salvagioni et al., 2017). A burnout episode also imposes an employer burnout cost $\phi^f > 0$, which captures additional expenses such as employer-funded counseling.

2.2. Technology Quality and Performance Incentives

All employees use a common technology of quality $\theta \in [1, \theta^m]$, where $\theta^m > 1$ is an upper bound on technology quality. We assume throughout that θ is determined by external forces (e.g., market-wide advances in AI), and is thus exogenous. Technology multiplies the output produced by work: Employee i's realized output as a function of work intensity is $y_i(x_i) \equiv \theta x_i \tau_i(x_i)$, and $\mathbf{y}(\mathbf{x}) = (y_1(x_1), \ldots, y_n(x_n))$ is the realized output profile across workers. This multiplicative specification follows Nalebuff and Stiglitz (1983) and is also consistent with an O-ring production technology (Kremer, 1993), which has been widely used to model productivity gains from AI (Gans and Goldfarb, 2025).

The employee is paid for their realized output y_i; we normalize payment per unit of output to

one. The firm values each unit of output at $v > 1$. Motivated by the tournament and multi-agent contracting literature, we also allow compensation to depend on performance relative to coworkers (Lazear and Rosen, 1981; Nalebuff and Stiglitz, 1983; Mookherjee, 1984). We do so by including a relative-performance adjustment, r_i, so the firm's total payment to the employee is $y_i(x_i) + r_i$.

To define r_i, for any $z \in \mathbb{R}$, write $(z)_+ \equiv \max\{z, 0\}$. Let $\bar{y} = n^{-1} \sum_j y_j$ denote average output, and let $\gamma \geq 0$ denote the strength of the relative-performance incentive, equivalently the relative-output advantage at which the reward reaches its maximum. Employee i's relative-performance adjustment is then

$$r_i(\mathbf{y}, \gamma) = \int_0^{y_i - \bar{y}} (\gamma - z)_+ \, dz. \tag{2}$$

We use (2) as a tractable approximation to relative pay schedules used by firms – it rewards performance relative to the group average and reaches a maximum payout that depends on γ; a larger γ rewards high performers more aggressively. For simplicity, we refer to γ as the *incentive*. All parties are risk neutral.

3. Preliminaries

This section derives the expected payoffs of employees and the firm and characterizes the equilibrium of the work-intensity game. Setting $t = 1$ in (1), the probability that burnout ends production during the period is $\psi(x_i, \rho) \equiv \Pr(\tau_i(x_i) < 1 \mid x_i) = 1 - e^{-\rho x_i^\alpha/\alpha}$. The remaining probability mass is at $\tau_i = 1$. Then, because the instantaneous work cost is $x_i^\alpha t^{\alpha-1}$, an employee's total expected work cost over the period is

$$\begin{aligned} \mathbb{E}\left[\int_0^{\tau_i(x_i)} x_i^\alpha t^{\alpha-1} \, dt \,\middle|\, x_i\right] &= \int_0^1 x_i^\alpha t^{\alpha-1} e^{-\rho x_i^\alpha t^\alpha/\alpha} \, dt \\ &= \frac{1}{\rho}\left(1 - e^{-\rho x_i^\alpha/\alpha}\right) \\ &= \frac{1}{\rho}\psi(x_i, \rho). \end{aligned}$$

Incorporating the burnout cost ϕ^w, the employee's total expected cost is

$$c(x_i, \rho) \equiv \left(\frac{1}{\rho} + \phi^w\right) \psi(x_i, \rho). \tag{3}$$

Taking coworkers' intensities $\mathbf{x}_{-i}$ as given, employee i chooses x_i to maximize $u_i(x_i, \mathbf{x}_{-i}) = \mathbb{E}[y_i(x_i) + r_i(\mathbf{y}(\mathbf{x}), \gamma) \mid \mathbf{x}] - c(x_i, \rho)$, the expected compensation net of the cost in (3). An intensity that maximizes this expected payoff is a best response to $\mathbf{x}_{-i}$. Total expected employee welfare for an arbitrary intensity

profile is then

$$\sum_{i=1}^{n} u_i(x_i, \mathbf{x}_{-i}). \tag{4}$$

Let $L(\mathbf{x}, \rho)$ denote the total expected work completed by employees during the period:

$$L(\mathbf{x}, \rho) \equiv \sum_{i=1}^{n} \mathbb{E}[x_i \tau_i(x_i) \mid \mathbf{x}] = \sum_{i=1}^{n} x_i \int_0^1 \Pr(\tau_i(x_i) > t \mid \mathbf{x})\, dt = \sum_{i=1}^{n} \int_0^{x_i} e^{-\rho k^\alpha/\alpha}\, dk.$$

This includes work completed by employees who later burn out. Expected aggregate output is then $\theta L(\mathbf{x}, \rho)$. Incorporating payments to all employees, the firm's expected profit is

$$\pi(\mathbf{x}, \theta, \rho, \gamma) \equiv \underbrace{(v-1)\theta L(\mathbf{x}, \rho)}_{\text{Net value of labor output}} \underbrace{- \mathbb{E}\left[\sum_{i=1}^{n} r_i(\mathbf{y}(\mathbf{x}), \gamma) \,\middle|\, \mathbf{x}\right]}_{\text{Incentive payments}} - \underbrace{\phi^f \sum_{i=1}^{n} \psi(x_i, \rho)}_{\text{Employer burnout cost}}. \tag{5}$$

A pure-strategy Nash equilibrium is an intensity profile in which every employee's intensity is a best response to coworkers' intensities. Formally, $\mathbf{x}^*$ is an equilibrium if $u_i(x_i^*, \mathbf{x}_{-i}^*) \geq u_i(z, \mathbf{x}_{-i}^*)$ for all $z \geq 0$ and $i \in \mathcal{N}$. Intensities are chosen before burnout is realized, so outputs and payoffs remain random at the time of choice.

Lemma 1 (Best responses and Nash equilibrium)**.** *(i) For each profile of coworkers' intensities, each employee has a unique best response. (ii) The work-intensity game has a unique Nash equilibrium, and this equilibrium is symmetric. The equilibrium intensity x^* is the unique positive solution to*

$$(1 + \rho\phi^w)(x^*)^{\alpha-1} = \theta \left[1 + \frac{n-1}{n} \mathbb{E}\left[\left(\gamma - \frac{\theta x^*}{n} \sum_{j=1}^{n-1} [1 - \tau_j(x^*)]\right)_+\right]\right]. \tag{6}$$

The equilibrium condition balances the rewards from additional work against its strain and burnout costs. The term $x^*[1 - \tau_j(x^*)]$ captures the work lost when coworker j burns out. This lost work gives employees who remain productive a relative-performance advantage. Because the marginal reward from relative performance declines as this advantage grows, coworker burnout can weaken the incentive to work more.

We write the symmetric equilibrium profile as $\mathbf{x}^* = \mathbf{x}^*(\theta, \rho, \gamma) = (x^*, \ldots, x^*)$, and the equilibrium burnout probability as $\psi^* = \psi(x^*, \rho)$. Evaluating (4) and (5) at this profile gives equilibrium employee welfare $W(\theta, \rho, \gamma) \equiv \sum_{i=1}^{n} u_i(x_i^*, \mathbf{x}_{-i}^*)$ and firm profit $\Pi(\theta, \rho, \gamma) \equiv \pi(\mathbf{x}^*, \theta, \rho, \gamma)$. For fixed ρ, write $L(x) \equiv L((x, \ldots, x), \rho)$. Holding ρ and γ fixed, equilibrium expected total work is $L(x^*(\theta))$, and expected aggregate output is $\theta L(x^*(\theta))$.

4. Technology, Employee Welfare, and Firm Profit

We begin by considering how improvements in technology quality θ influence employees' work intensity (Section 4.1), employee welfare (Section 4.2), and firm profit (Section 4.3). In what follows, we hold the incentive γ fixed, which captures a setting where technology progresses but the firm does not change how it evaluates and rewards employees.

4.1. Impact of Technology on Work Intensity

How employees adjust their work intensity is central to how technology affects both employees and the firm. Work intensity determines not only how much employees produce, but also how quickly they accumulate strain and how likely they are to burn out. Lemma 2 characterizes how employees' work-intensity response to improving technology depends on relative-performance incentives.

Lemma 2. *Let $\bar{\gamma}_R \equiv n/(n-1)$. The following statements hold.*

(i) If $\gamma \in [0, \bar{\gamma}_R]$, then equilibrium work intensity x^* and burnout probability ψ^* strictly increase in technology quality θ on $[1, \theta^m]$.

(ii) Suppose $\theta^m > 1+\bar{\gamma}_R$. For each $\gamma \in (\bar{\gamma}_R, \theta^m - 1)$, there exists an exposure threshold $\bar{\rho} > 0$ such that if $\rho > \bar{\rho}$, there are burnout-cost thresholds $0 \leq \underline{\phi}^w < \overline{\phi}^w$ with the following property: If $\phi^w \in (\underline{\phi}^w, \overline{\phi}^w)$, then both x^* and ψ^* strictly decrease in θ on $[\bar{\theta}, \theta^m]$ for some $\bar{\theta} \in (1, \theta^m)$.

To understand Lemma 2, it is helpful to consider the two effects induced by an increase in technology quality θ. The first is a "rat race effect": Each employee anticipates that better technology will raise their coworkers' output, which creates an incentive to work more intensely to avoid falling behind (and being penalized through the relative-performance component of pay). However, better technology can also induce a "competition cooling effect": When coworker j burns out, they lose $\theta x[1 - \tau_j(x)]$ units of output, which lowers the group average and gives employees who remain productive a relative-performance advantage. Better technology magnifies this advantage and reduces the payoff from working harder. In other words, employees can benefit simply by remaining productive and avoiding burnout, and this "strategic survival" behavior leads them to moderate their work intensity.

The difference between parts (i) and (ii) of Lemma 2 depends on which of the two effects dominates. When relative-performance incentives are weak ($\gamma \leq \bar{\gamma}_R$), relative pay is too small a component of compensation for the competition cooling effect to offset the higher return to work, so work intensity increases in θ (Lemma 2(i)). In contrast, when incentives are strong ($\gamma > \bar{\gamma}_R$) and burnout exposure is high ($\rho > \bar{\rho}$), coworker burnout meaningfully affects each employee's work decision. The bounds on ϕ^w further keep work intensity high enough for coworker burnout to create a meaningful relative-

performance advantage, but low enough that relative rewards remain below their maximum payout amount. The net result is that the competition cooling effect dominates at high technology levels, and work intensity decreases in θ (Lemma 2(ii)). In both cases, the equilibrium burnout probability ψ^* moves in the same direction as x^* because $\psi(x, \rho)$ increases in x.

Lemma 2 may help explain recent evidence that AI is associated with longer working hours and more tasks (Jiang et al., 2025; Ranganathan and Ye, 2026). Better technology can create a rat race: Employees work more intensely in anticipation of being compared against more productive coworkers. However, the result also suggests that this effect may not continue as technology improves further. In highly competitive workplaces where burnout is common, employees may instead reduce their work intensity, because they stand to benefit by simply avoiding burnout. Whether better technology leads to more work therefore depends on the strength of the relative-performance comparison and how readily intensive work leads to burnout.

Equipped with Lemma 2, we can now examine how employee welfare and firm profit respond to changes in technology quality.

4.2. Impact of Technology on Employee Welfare

Because better technology makes each unit of work more productive, one might expect employees to benefit, and AI assistance has indeed been shown to improve task satisfaction and lower attrition in some settings (Noy and Zhang, 2023; Brynjolfsson et al., 2025). Yet whether employees are better off also depends on how much more they work to produce the additional output. We find that when relative-performance incentives are strong, better technology can lower employee welfare even though it makes every employee more productive:

Proposition 1 (Technology and employee welfare)**.** *Let* $\bar{\gamma}_W \equiv n(\alpha-1)/(n-1)$*. The following statements hold.*

(i) In the absence of burnout, $\rho = 0$*, employee welfare* W *is strictly increasing, constant, or strictly decreasing in* θ *on* $[1, \theta^m]$ *according as* $\gamma < \bar{\gamma}_W$*,* $\gamma = \bar{\gamma}_W$*, or* $\gamma > \bar{\gamma}_W$*.*

(ii) For any $\gamma > \bar{\gamma}_W$ *and* $\phi^w > 0$*, sufficiently high exposure* ρ *implies that* W *strictly decreases in* θ *on* $[1, \theta_1]$ *for some* $\theta_1 \in (1, \theta^m)$*.*

(iii) For each $\gamma > \bar{\gamma}_W$*, there exists a threshold* $\bar{\phi}^w > 0$ *such that if* $\phi^w \in (0, \bar{\phi}^w)$*, then for sufficiently large* ρ *there exist a finite* $\theta^m > 1$ *and thresholds* $1 < \theta_1 < \theta_2 < \theta^m$ *with the following property:* W *strictly decreases in* θ *on* $[1, \theta_1]$*, while equilibrium work intensity* x^* *and burnout probability* ψ^* *strictly decrease and* W *strictly increases on* $[\theta_2, \theta^m]$*. Consequently,* W *has at least one interior minimum over* $[1, \theta^m]$*.*

Proposition 1(i) shows that strong relative-performance incentives alone can make technological progress harmful to employees. In the absence of burnout, all employees produce the same output, so competition induces additional work without delivering any relative reward. To unpack the intuition with burnout, let $\widehat{W}(x, \theta)$ denote total employee welfare when all employees choose the same work intensity x, holding ρ and γ fixed. Because equilibrium welfare is $W(\theta) = \widehat{W}(x^*(\theta), \theta)$, the total effect of better technology on welfare can be decomposed as

$$\frac{dW}{d\theta} = \underbrace{\frac{\partial \widehat{W}}{\partial \theta}}_{\text{Direct technology effect}} + \underbrace{\frac{\partial \widehat{W}}{\partial x}\frac{dx^*}{d\theta}}_{\text{Strategic work-intensity effect}}. \tag{7}$$

Under the conditions in parts (ii) and (iii), the direct technology effect is positive, so the direction of the total effect depends on the strategic work-intensity effect. When burnout exposure is high and technology quality is low, work intensity is low and coworker burnout is rare. In this regime, the rat race effect described following Lemma 2 dominates, $dx^*/\,d\theta > 0$. This additional work lowers welfare, $\partial \widehat{W}/\partial x < 0$, because employees end up working more intensely than they would collectively prefer. The strong incentive $\gamma > \bar{\gamma}_W$ ensures that this strategic effect outweighs the direct benefit of better technology (Proposition 1(ii)).

In contrast, when the employee burnout cost is also sufficiently small, competition cools at higher technology levels and work intensity falls, $dx^*/\,d\theta < 0$. Both terms in (7) are then positive, and welfare recovers (Proposition 1(iii)). Note that falling intensity is sufficient but not necessary for this recovery: Welfare can increase while intensity is still rising, provided competition has cooled enough for the direct effect to dominate. Figure 2 depicts a numerical example in which welfare begins to recover near

$\theta = 3.3$, even as burnout probability continues to rise.

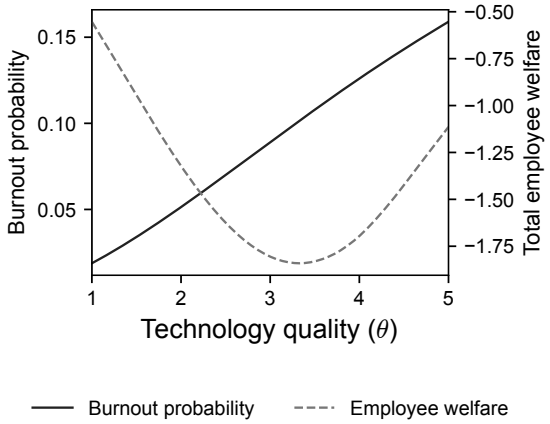


Figure 2: Technology and employee outcomes under a fixed incentive. Employee welfare initially falls as competition intensifies, then recovers as competition cools, even as burnout probability continues to rise. The dashed curve (right axis) shows total employee welfare, which reaches a minimum near $\theta = 3.3$; the solid curve (left axis) shows burnout probability. Parameters: $\alpha = 3$, $n = 4$, $\gamma = 3$, $\rho = 0.01$, $\phi^w = 2$.

What does Proposition 1 imply for firms in which employees compete for rewards (e.g., through forced-ranking systems)? As technology progresses, such firms may see output rise while employee welfare falls, even if they leave their reward structure unchanged. Each employee works harder to keep up with more productive coworkers, even though all employees would benefit from collectively moderating their response. Employees' willingness to take on more work with AI (Ranganathan and Ye, 2026) may therefore reflect competitive pressure rather than productivity gains alone. Nonetheless, if the risk of burnout is strong enough to moderate employee competition, employees may still benefit from the productivity gains as technology improves.

4.3. Impact of Technology on Firm Profit

We now consider how technological progress affects firm profit. Because better technology both raises the value of completed work and induces more of it (Lemma 2), it is natural to expect the firm's marginal return to technology to rise as technology improves. In that case, the firm would enjoy increasing marginal returns to technology. Our next result shows that this intuition indeed holds in the absence of burnout, but that burnout risk can eventually reverse it.

Proposition 2 (Burnout and marginal returns to technology)**.** *The following statements hold.*

(i) In the absence of burnout risk, $\rho = 0$, the return to technology $d\Pi/d\theta$ is positive and strictly increases in θ on $[1, \theta^m]$.

(ii) For any $\gamma > 0$ and $\phi^w > 0$, sufficiently large ρ implies that, for sufficiently large v, the return to technology is positive and strictly increases in θ on $[1, \theta_1]$ for some $\theta_1 \in (1, \theta^m)$.

(iii) For each $\gamma > \bar{\gamma}_R$, there exists a threshold $\bar{\phi}^w > 0$ such that if $\phi^w \in (0, \bar{\phi}^w)$, then for sufficiently large ρ there exist a finite $\theta^m > 1$ and thresholds $1 < \theta_1 < \theta_2 < \theta^m$ with the following property: For sufficiently large v, the return to technology is positive and strictly increases on $[1, \theta_1]$, while it is positive and strictly decreases on $[\theta_2, \theta^m]$. On the latter interval, equilibrium work intensity x^* and burnout probability ψ^* also strictly decrease. Consequently, $d\Pi/d\theta$ has at least one interior maximum over $[1, \theta^m]$.

Proposition 2 shows that burnout risk can turn increasing returns to technology into decreasing returns. To unpack the intuition, consider how the net value of employee output, $(v-1)\theta L(x^*)$, changes as θ increases. As in (7), this change consists of a direct effect, as each unit of expected total work $L(x)$ becomes more productive, and a strategic effect, as employees adjust their work intensity $x^*(\theta)$ and thereby change expected total work. The firm's marginal return to technology therefore depends on both the level of $L(x^*)$ and how x^* adjusts.

In the absence of burnout, the two effects reinforce one another. Better technology always intensifies the rat race, so equilibrium work intensity is proportional to $\theta^{1/(\alpha-1)}$, profit is proportional to $\theta^{\alpha/(\alpha-1)}$, and the marginal return rises with technology quality (Proposition 2(i)). With burnout, marginal returns can also increase initially. As in Proposition 1(ii), high exposure keeps work intensity low at low technology levels, so realized burnout is rare, and better technology encourages additional work. The marginal return then rises when the value of output is sufficiently high (Proposition 2(ii)).

At higher technology levels, however, strong relative-performance incentives allow coworker burnout to cool competition, and a sufficiently small employee burnout cost allows work intensity to reach a level at which this effect becomes important. As work intensity levels off and begins to decline, expected output continues to rise, but at a decreasing rate. The large-v condition ensures that this output effect dominates changes in incentive payments and employer burnout costs. As a consequence, technology continues to raise profit, but by progressively smaller amounts (Proposition 2(iii)). Figure 3 depicts a numerical example. Note that the marginal return peaks before work intensity does: A slowdown in the growth of work intensity is enough to diminish the firm's returns.

Proposition 2 cautions against extrapolating from early gains: In competitive workplaces where

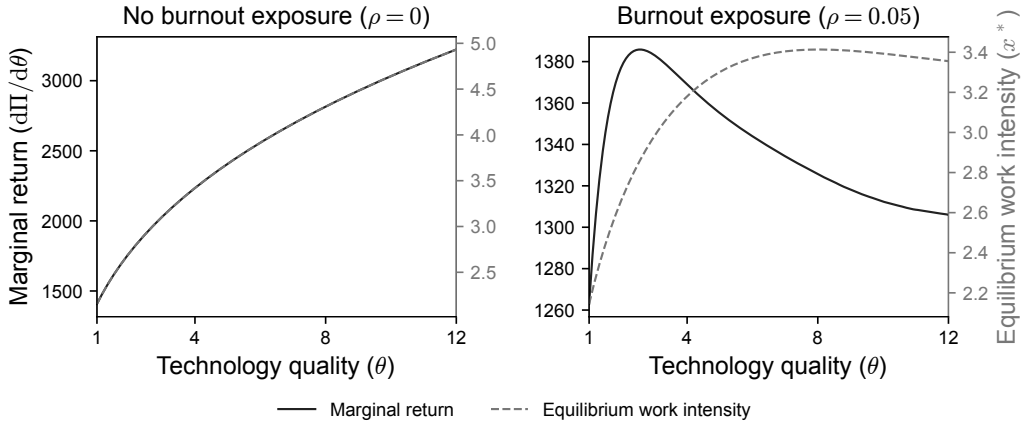


Figure 3: Marginal returns to technology with and without burnout exposure. Left panel: Without burnout, the marginal return $d\Pi/d\theta$ and equilibrium work intensity x^* both increase in technology quality. The two curves overlap because they are proportional and plotted on separate axes. Right panel: With burnout, the marginal return peaks and then declines as competition cools, while work intensity begins to decrease only at higher technology quality. Parameters: $\alpha = 4$, $n = 10$, $\gamma = 10$, $v = 50$, $\phi^w = 0.1$, $\phi^f = 0.1$.

employees face burnout risk, further improvements in technology may yield progressively smaller returns. Importantly, these diminishing returns need not reflect limits of the technology itself. Instead, they may arise because employees moderate their work intensity as technology improves, anticipating that coworker burnout will give them a relative advantage. This behavior is consistent with evidence that contest leaders reduce effort as their lead grows (Casas-Arce and Martínez-Jerez, 2009).

To fully reap the benefits of technological progress, firms should therefore be mindful of how competition among employees adjusts to it. Because the strategic survival behavior requires both strong relative-performance incentives and high burnout exposure, the firm's returns to technology are shaped jointly by the competitiveness of its workplace and its work conditions. More broadly, our result lends support to the view that organizational practices shape the returns to technology (Brynjolfsson and Hitt, 2000).

5. Work Conditions and the Firm's Incentive Response

Section 4 shows that productivity-enhancing technology can intensify competition and reduce employee welfare. These effects may be tempered by improvements in work conditions, such as greater flexibility over work hours (Moen et al., 2016; Kelly and Moen, 2020), which we capture as a reduction in burnout exposure ρ. Such improvements are often determined outside the firm's incentive decision, for example by regulation or broader cultural changes in workplace norms. We therefore treat ρ as exogenous and ask: To what extent do improvements in work conditions benefit employees if the firm can adjust the performance incentive? We first hold technology quality θ fixed, allowing the firm to choose the incentive γ before employees choose their work intensities. We return to the role of technology quality

θ at the end of the section.

The firm chooses its performance incentive to maximize equilibrium profit:

$$\gamma^*(\theta, \rho) \in \arg\max_{\gamma \geq 0} \Pi(\theta, \rho, \gamma).$$

We write $x^*(\theta, \rho)$, $\psi^*(\theta, \rho)$, and $W^*(\theta, \rho)$ for equilibrium work intensity, burnout probability, and total employee welfare under this incentive. Proposition 3 characterizes the effect of an improvement in work conditions when the firm can freely adjust the incentive γ.

Proposition 3 (Burnout exposure and employee outcomes)**.** *Fix θ and $\phi^f > 0$. The following statements hold.*

(i) For any fixed incentive $\gamma > 0$, there exists an exposure threshold $\bar{\rho} > 0$ such that as ρ decreases within $(0, \bar{\rho})$, equilibrium work intensity x^* strictly increases but burnout probability ψ^* strictly decreases.

(ii) When the firm chooses the incentive γ, there exists an exposure threshold $\bar{\rho} > 0$ such that as ρ decreases within $(0, \bar{\rho})$, the optimal incentive γ^*, work intensity x^*, and burnout probability ψ^* strictly increase, while employee welfare W^* strictly decreases.

(iii) If $1 < (v-1)\phi^w/\phi^f < \alpha$, there exists an exposure threshold $\underline{\rho} > 0$ such that as ρ decreases within $(\underline{\rho}, \infty)$, the firm's optimal incentive induces strictly higher work intensity x^*, burnout probability ψ^*, and employee welfare W^*.

Part (i) establishes a benchmark with a fixed incentive: Lower burnout exposure encourages employees to work more, but when exposure is already low, the protection offered by better work conditions is strong enough that realized burnout still falls. Part (ii) shows that this benefit does not occur if the firm can choose its incentive. Instead, the firm increases γ, and the additional work it induces outweighs the improvement in work conditions from the decrease in ρ. As a consequence, equilibrium burnout *rises* instead.

To understand why this occurs, it is helpful to consider the two effects of a reduction in burnout exposure ρ. The first is a direct "protection effect": At a fixed work intensity, lower exposure reduces the burnout hazard and keeps employees productive for longer. The second is an indirect "incentive ratcheting effect": Safer work conditions give the firm room to demand more from its employees, so it raises the incentive γ^* to induce a higher work intensity x^*. Thus, whether burnout rises depends on whether work intensity increases by more than the factor needed to offset lower exposure. Under the

conditions in part (ii), the firm raises intensity by more than this factor, and burnout rises.[4]

Why does the firm "overshoot" on work intensity and induce greater burnout? In short, the firm sets its incentive based on marginal burnout risk, whereas burnout depends on cumulative exposure. In other words, the firm induces work until its marginal burnout cost, which is proportional to $\rho x^{\alpha-1}$, equals the marginal return to work (which changes little with exposure because the value of that additional work does not depend on ρ). Thus, a decrease in ρ leads the firm to raise intensity until $\rho x^{\alpha-1}$ returns to roughly its previous level. Burnout, however, depends on *cumulative* exposure $\rho x^{\alpha}/\alpha = (x/\alpha) \cdot \rho x^{\alpha-1}$, so holding the marginal risk fixed while raising intensity raises total burnout risk.

Part (iii) shows that employee welfare does not always decrease as ρ decreases, despite the firm possibly overshooting on work intensity and increasing the equilibrium burnout probability ψ^*. Employees can still benefit from the firm's incentive ratcheting because the combination of the additional compensation and lower burnout exposure outweighs the additional induced work. An increase in burnout can therefore accompany either a welfare gain or a welfare loss. The left panel of Figure 4 depicts both cases.



Figure 4: Burnout exposure under the firm's optimal incentive. Left panel: Lower exposure raises equilibrium burnout and, in the shaded low-exposure region, lowers employee welfare (Proposition 3(ii)). Right panel: Lower exposure leads the firm to induce more work, as shown by the intersections of its normalized marginal return (solid) and marginal employer burnout cost (dashed). The shaded area under each cost curve up to its intersection is proportional to cumulative burnout exposure $\rho(x^*)^{\alpha}/\alpha$; the larger area at lower ρ therefore corresponds to higher burnout probability. Curves compare $\rho_1 = 0.05$ (circles) and $\rho_2 = 0.8$. Parameters: $\alpha = 5$, $n = 4$, $\theta = 2$, $v = 1.5$, $\phi^w = 13.35$, $\phi^f = 4$.

The firm's incentive response also changes how technology affects employees, as the following result shows.

[4]One may interpret part (ii) as a form of risk compensation (Peltzman, 1975), in which a safety improvement is offset by riskier behavior. Here, the riskier behavior is prompted by the firm: Its change in the incentive induces employees to work more, which more than offsets the safety improvement.

Corollary 1 (Technology under endogenous incentives)**.** *Fix $\phi^f > 0$. When the firm chooses the incentive γ, there exists an exposure threshold $\bar{\rho} > 0$ such that, for any $\rho \in (0, \bar{\rho})$, equilibrium work intensity x^* and burnout probability ψ^* strictly increase in technology quality θ on $[1, \theta^m]$.*

Corollary 1 shows that, when exposure is sufficiently low, work intensity and burnout continue to rise as technology improves under the firm's optimal incentive. As technology improves, each unit of completed work becomes more valuable to the firm, so it adjusts its incentive to induce more intensive work. The decline in intensity and burnout that can arise under fixed incentives in Section 4 is therefore absent in this region.

Proposition 3 adds an important caveat to the notion that improved work conditions can buffer employees against burnout (Bakker et al., 2005): The firm can optimize away these protections by adjusting its performance incentives. For employees, the benefit of greater flexibility or other preventive support therefore depends on whether the firm also raises performance expectations in tandem. Corollary 1 further suggests that an improvement in technology quality can drive the firm to create a more competitive environment, increasing burnout. Comprehensively evaluating policies that improve employees' work conditions therefore requires considering both the direct reduction in burnout exposure and the additional work induced by the firm's response.

6. Mitigation Spending and Employee Welfare

Investments in employee well-being, including wellness programs, provide a natural starting point for assessing how well a workplace protects its employees. However, Section 5 shows that work conditions and performance incentives are closely linked: When the environment improves, a profit-maximizing firm may respond by strengthening its incentive and inducing more work.

This section considers investment in burnout mitigation jointly with the choice of performance incentive. We compare a profit-maximizing firm with one that maximizes social welfare, which also accounts for employees' costs, allowing us to isolate the effect of a firm incorporating employees' costs of work and burnout. This benchmark reflects the choices of a regulator, or of a firm that fully internalizes employee welfare.

Formally, we allow the firm to choose ρ, a stylized representation of policy or investment choices, such as greater scheduling flexibility or employer-funded therapy. Let $C(\rho)$ denote the per-employee cost required to achieve ρ. The firm chooses ρ jointly with the performance incentive γ, after which employees choose their work intensities.

Assumption 1 (Burnout mitigation cost)**.** *Mitigation spending per employee is $C(\rho) > 0$, where C is*

continuously differentiable with $(\partial/\partial\rho)C(\rho) < 0$, $\lim_{\rho\to 0}\rho C(\rho) = \infty$, *and* $\lim_{\rho\to\infty}\rho C(\rho) = 0$.

Assumption 1 imposes regularity conditions on $C(\rho)$ such that it is optimal for the firm to choose a strictly positive and finite value of ρ.

We consider both profit-maximizing and social welfare-maximizing objectives. Using the equilibrium profit $\Pi(\theta, \rho, \gamma)$ defined by (5), the profit-maximizing design $(\rho^F(\theta), \gamma^F(\theta))$ maximizes $\Pi(\theta, \rho, \gamma) - nC(\rho)$ over $\rho > 0$ and $\gamma \geq 0$. For social welfare, combining firm profit in (5) with employee welfare in (4), and subtracting mitigation spending, gives the social welfare objective

$$\Pi(\theta, \rho, \gamma) + W(\theta, \rho, \gamma) - nC(\rho) = v\theta L(\mathbf{x}^*, \rho) - n\left[\left(\phi^f + \frac{1}{\rho} + \phi^w\right)\psi(x^*, \rho) + C(\rho)\right]. \tag{8}$$

Note that the employee payment terms cancel in the sum of firm profit and employee welfare. Each unit of output thus contributes its full gross value v to the social welfare objective in (8).

Let $(\rho^S(\theta), \gamma^S(\theta))$ denote any design that maximizes (8), and let $\psi^S(\theta)$ and $\psi^F(\theta)$ denote the equilibrium burnout probabilities under the social welfare-maximizing and profit-maximizing designs, respectively. We suppress the dependence on θ when it is clear. To compare the designs under common work conditions, we also fix ρ and write $x^F(\rho)$ and $x^S(\rho)$ for the work intensities each design prefers when it chooses only γ, with associated incentives $\gamma^F(\rho)$ and $\gamma^S(\rho)$ and burnout probabilities $\psi^F(\rho)$ and $\psi^S(\rho)$. Lemma 8 in Appendix A characterizes $x^S(\rho)$.

Proposition 4 characterizes the optimal choice of ρ and γ under both the profit- and social welfare-maximizing designs, and the implications for employees' equilibrium burnout probabilities.

Proposition 4 (Social welfare and burnout mitigation)**.** *The following statements hold.*

(i) At any exposure $\rho > 0$*, the profit-maximizing design induces at least as much work, competitive pressure, and burnout as the social design:* $x^F(\rho) \geq x^S(\rho)$, $\gamma^F(\rho) \geq \gamma^S(\rho)$, *and* $\psi^F(\rho) \geq \psi^S(\rho)$. *All three inequalities are strict whenever* $\gamma^S(\rho) > 0$.

(ii) Suppose Assumption 1 holds. There exist thresholds $\underline{\phi}^w > 0$, $\overline{\phi}^f > 0$, *and* $\underline{\theta} > 1$ *such that if* $\phi^w > \underline{\phi}^w$, $\phi^f \in (0, \overline{\phi}^f)$, *and* $\theta \in [1, \underline{\theta}]$, *the social welfare-maximizing design spends less on mitigation* $C(\rho^S) < C(\rho^F)$, *leading to higher burnout exposure,* $\rho^S > \rho^F$. *It also chooses a weaker incentive,* $\gamma^S < \gamma^F$, *and induces lower burnout,* $\psi^S < \psi^F$.

Part (i) gives a comparison under the same work conditions: Stronger competition raises work intensity and reduces equilibrium employee welfare. A profit-maximizing firm therefore has a stronger reason to induce work than a social welfare-maximizing one, which also counts employees' costs. Part (ii) delivers a more striking contrast: The social welfare-maximizing design spends less on burnout mitigation,

leading to higher burnout exposure, $\rho^S > \rho^F$.

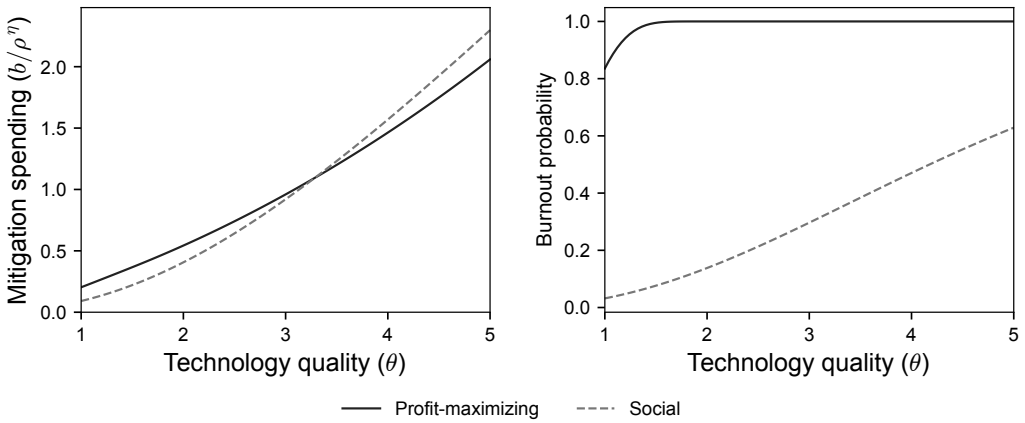


Figure 5: Comparison of profit-maximizing and social welfare-maximizing workplace designs. Numerical example uses mitigation cost function $C(\rho) = b/\rho^\eta$, which satisfies Assumption 1. Left panel: The social welfare design spends less on mitigation at low technology quality because it demands less work from employees. Right panel: Burnout probability approaches one under the profit-maximizing design but remains much lower under the social welfare design, despite its lower mitigation spending. Parameters: $\alpha = 3$, $n = 4$, $v = 3$, $\phi^w = 4$, $\phi^f = 0.25$, $b = 20$, $\eta = 1.5$.

The result in Proposition 4(ii) is driven by the different ways in which the two designs account for burnout. In the profit function Π, burnout affects expected total work, employee payments, and the employer burnout cost $n\phi^f\psi$. In contrast, the social welfare objective in (8) also counts employees' active-work cost, $n\rho^{-1}\psi$, and burnout loss, $n\phi^w\psi$. When ϕ^w is high and ϕ^f is low, the social design therefore has a stronger reason to reduce work, which it does by weakening the incentive ($\gamma^S < \gamma^F$).

Burnout mitigation is valuable only to the extent that there is work to protect. Because the social welfare design induces weaker competition (lower γ), and thus demands less work from employees, it does not need to spend as much on mitigation. When technology quality is low, the output sacrificed by reducing work is small, so the social welfare design prefers to reduce work in the first place rather than protect it ($\rho^S > \rho^F$). Although the higher exposure induced by the social welfare design raises the burnout hazard at a given work intensity, the reduction in work intensity is large enough that the burnout probability remains lower under the social welfare design, $\psi^S < \psi^F$. In summary, the incentive determines how much work is performed, and mitigation protects that work – a firm that internalizes employee welfare simply uses less of both.

In the numerical example in Figure 5, the profit-maximizing design induces near-certain burnout once technology quality is sufficiently high (parameters chosen to satisfy Proposition 4(ii)). In this example, the firm extracts the maximum work each employee can sustain and simply absorbs burnout as the cost of doing so. At higher technology quality, however, reducing work sacrifices more valuable output, and mitigation can become the better way to protect employees, which is why the social welfare design

eventually spends more on mitigation when θ is large.

Proposition 4 implies that mitigation spending can be a misleading measure of employee protection. A profit-maximizing firm ends up spending more on mitigation, because it induces more intensive work through strong incentives, and so must spend more to protect employee productivity from burnout. A firm's spending on well-being may therefore reflect the demands it places on employees through induced competition, in addition to reflecting the firm's valuation of employee well-being.

7. Discussion

Productivity-enhancing technologies such as AI have been observed to intensify work (Ranganathan and Ye, 2026). Our results describe how this pattern may depend on three features of the workplace: the quality of the technology, the strength of relative-performance incentives, and how readily intensive work leads to burnout. Table 1 summarizes the main findings.

Table 1: Summary of main findings.

Dimension	Main Finding	Implication for Managers
Technology quality	With strong relative-performance incentives, better technology can intensify competition and lower employee welfare, though it can recover as technology improves further (Proposition 1).	Under relative evaluation systems, such as forced rankings, better technology may intensify work (e.g., lengthen working hours). Employees' willingness to take on more work may reflect competitive pressure rather than increased productivity alone.
Returns to technology	Without burnout risk, the firm's marginal returns to technology are increasing; burnout risk and relative-performance incentives can instead lead to diminishing returns (Proposition 2).	Successively smaller returns to technology may reflect employees' strategic responses to the work environment, rather than limits of the technology itself.
Work conditions	If performance expectations rise as work conditions improve (e.g., flexible schedules), employees may face higher burnout and lower welfare (Proposition 3).	Improvements in work conditions may be more effective when paired with a commitment not to raise performance expectations.
Wellness spending	When productivity gains from technology are modest, workplaces that push employees harder may spend more on burnout prevention yet have more burnout, compared to those that moderate competition (Proposition 4).	Wellness spending can be a misleading measure of employee protection. For welfare-conscious firms, weakening relative-performance incentives may protect employees more cost-efficiently.

Many organizations are rethinking performance management (Cappelli and Tavis, 2016). Our results suggest that these efforts should also account for how technology changes competition among employees. Under relative-performance incentives, productivity gains from AI may lead to more work and lower employee welfare, even if firms leave their compensation schemes unchanged (Proposition 1). This

mechanism also offers a theoretical basis for why AI might make workers "much busier" (Altman, 2026), and yields a testable prediction: The intensification of work following AI adoption should be stronger when performance evaluation is relative. For firms adopting AI, accounting for these effects may mean loosening forced-ranking quotas or placing more weight on other measures of performance, such as collaboration.

Firms' returns to productivity-enhancing technology may also depend on two features of the workplace: the degree of competition among employees and their risk of burnout (Proposition 2). In high-pressure environments where employee well-being is at risk, further improvements in technology may yield progressively smaller gains if employees moderate their workloads. Crucially, this can occur not only because employees seek to protect themselves, but also because they anticipate burnout-driven declines in their coworkers' productivity. This offers an additional justification for investing in employee well-being: to fully reap the benefits of technological progress.

Policies that improve work conditions, such as greater schedule flexibility, may reduce burnout (Moen et al., 2016). However, if organizations respond by raising performance expectations, the additional work they demand can more than offset this protection, lowering employee welfare (Proposition 3). Kelly and Moen (2020) argue that reducing overload requires work redesign, including giving employees more control over how they work and clear direction on their goals. Our results add that organizations should commit to holding performance targets fixed when work conditions improve, so that the improvement meaningfully translates into lower burnout (Proposition 3(i)).

Investments in employee well-being should also not be judged by spending alone. A workplace that demands intensive work has more productivity to protect, and so may spend more on burnout prevention than a welfare-oriented workplace (Proposition 4). Our results also suggest that wellness spending and burnout may be positively correlated across firms, consistent with evidence that wellness programs have had limited measurable effects on employee outcomes (Jones et al., 2019). Croft et al. (2024) attribute the muted impact of wellness programs to their focus on individual employees rather than broader work conditions. Our results support this view: When the productivity gains from technology are modest, moderating competition may be a more welfare-efficient approach to protecting employees than additional wellness spending.

Lastly, our analysis abstracts from several features of real workplaces. Employees may differ in how effectively they use technology, one employee's burnout may shift work onto coworkers, and work intensity may change over time. Firms may also use other levers, such as team-based rewards, which can dampen competition but invite free-riding. We also take improvements in technology as given; how firms' technology adoption decisions interact with their performance evaluation systems and well-being investments is a natural direction for future work.

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A Proofs

Lemma 3. *For $x > 0$ and $\rho > 0$, the following statements hold.*

(i) Completed work has survival function $\Pr(x\tau_i(x) > k) = e^{-\rho k^\alpha/\alpha}$ for $0 \le k < x$ and zero for $k \ge x$. Thus,

$$\mathbb{E}[x\tau_i(x)] = \int_0^x e^{-\rho k^\alpha/\alpha}\, dk, \qquad \mathbb{E}[(x\tau_i(x))^2] = \int_0^x 2k\, e^{-\rho k^\alpha/\alpha}\, dk. \tag{9}$$

For every x, $\mathbb{E}[x\tau_i(x)] \le c_\alpha \rho^{-1/\alpha}$ and $\mathbb{E}[(x\tau_i(x))^2] \le c_\alpha \rho^{-2/\alpha}$, where c_α depends only on α.

(ii) Completed work $x\tau_i(x)$ is stochastically increasing in x, and work lost to burnout $x[1-\tau_i(x)]$ is stochastically increasing in x and ρ. Their expectations satisfy $(\partial/\partial x)\mathbb{E}[x\tau_i(x)] = 1-\psi$ and $(\partial/\partial x)\mathbb{E}[x(1-\tau_i(x))] = \psi$. Also, $(\partial/\partial x)\mathrm{Var}(x\tau_i(x)) = 2(1-\psi)\mathbb{E}[x(1-\tau_i(x))]$ and $(\partial/\partial x)\psi = \rho x^{\alpha-1}(1-\psi)$.

(iii) With respect to exposure, $\alpha\rho(\partial/\partial\rho)\mathbb{E}[x\tau_i(x)] = x(1-\psi) - \mathbb{E}[x\tau_i(x)]$, $\alpha\rho(\partial/\partial\rho)\mathbb{E}[(x\tau_i(x))^2] = 2\{x^2(1-\psi) - \mathbb{E}[(x\tau_i(x))^2]\}$, and $(\partial/\partial\rho)\psi = x^\alpha(1-\psi)/\alpha$. Consequently,

$$\alpha\rho(\partial/\partial\rho)\mathrm{Var}(x\tau_i(x)) = 2\{x^2(1-\psi) - \mathbb{E}[(x\tau_i(x))^2]\} - 2\mathbb{E}[x\tau_i(x)]\{x(1-\psi) - \mathbb{E}[x\tau_i(x)]\}, \tag{10}$$

and $|\rho(\partial/\partial\rho)\mathrm{Var}(x\tau_i(x))| \le 4x^2/\alpha$. Expected completed work $\mathbb{E}[x\tau_i(x)]$ strictly decreases in ρ, while expected lost work $\mathbb{E}[x(1-\tau_i(x))]$ and burnout probability $\psi(x,\rho)$ strictly increase.

(iv) The distribution of $\tau_i(x)$ depends on x and ρ only through cumulative exposure $u = \rho x^\alpha/\alpha$, with $\Pr(\tau_i(x) \ge t) = e^{-ut^\alpha}$ for $t \in [0,1]$. Its expectation strictly decreases in u. As $u \to 0$, $\mathbb{E}[\tau_i(x)] \to 1$ and $\mathrm{Var}(\tau_i(x)) \to 0$.

As $u \to \infty$, $\mathbb{E}[\tau_i(x)] \to 0$ *and* $\mathrm{Var}(\tau_i(x))/\mathbb{E}[\tau_i(x)] \to 0$.

Proof. (i). For $0 \le k < x$, setting $t = k/x$ in (1) gives $\Pr(x\tau_i(x) > k) = e^{-\rho k^\alpha/\alpha}$. This probability is zero for $k \ge x$ because $\tau_i(x) \le 1$. Since $\mathbb{E}[x\tau_i(x)] = \int_0^\infty \Pr(x\tau_i(x) > k)\,dk$ and $\mathbb{E}[(x\tau_i(x))^2] = \int_0^\infty 2k \Pr(x\tau_i(x) > k)\,dk$, equation (9) follows by substituting $\Pr(x\tau_i(x) > k) = e^{-\rho k^\alpha/\alpha}$ for $0 \le k < x$. Extending the resulting integrals to infinity and substituting $w = \rho^{1/\alpha}k$, we obtain

$$\mathbb{E}[x\tau_i(x)] \le \int_0^\infty e^{-\rho k^\alpha/\alpha}\,dk = \rho^{-1/\alpha}\int_0^\infty e^{-w^\alpha/\alpha}\,dw \le c_\alpha \rho^{-1/\alpha},$$
$$\mathbb{E}[(x\tau_i(x))^2] \le \int_0^\infty 2k\, e^{-\rho k^\alpha/\alpha}\,dk = \rho^{-2/\alpha}\int_0^\infty 2w\, e^{-w^\alpha/\alpha}\,dw \le c_\alpha \rho^{-2/\alpha}.$$

The integrals $\int_0^\infty e^{-w^\alpha/\alpha}\,dw$ and $\int_0^\infty 2w\, e^{-w^\alpha/\alpha}\,dw$ are finite and depend only on α, so choosing c_α at least as large as both proves part (i).

(ii). The survival function $\Pr(x\tau_i(x) > k) = e^{-\rho k^\alpha/\alpha}$ for $0 \le k < x$, and zero for $k \ge x$, weakly increases in x. Similarly, $\Pr(x[1-\tau_i(x)] > l) = 1 - e^{-\rho(x-l)^\alpha/\alpha}$ for $0 \le l < x$, and zero for $l \ge x$, weakly increases in both x and ρ. Thus, $x\tau_i(x)$ is stochastically increasing in x, and $x[1-\tau_i(x)]$ is stochastically increasing in both x and ρ. Differentiating $\mathbb{E}[x\tau_i(x)] = \int_0^x e^{-\rho k^\alpha/\alpha}\,dk$ and $\mathbb{E}[x(1-\tau_i(x))] = x - \int_0^x e^{-\rho k^\alpha/\alpha}\,dk$ with respect to x establishes $(\partial/\partial x)\mathbb{E}[x\tau_i(x)] = 1 - \psi$ and $(\partial/\partial x)\mathbb{E}[x(1-\tau_i(x))] = \psi$. Finally, differentiating $\mathrm{Var}(x\tau_i(x)) = \mathbb{E}[(x\tau_i(x))^2] - \mathbb{E}[x\tau_i(x)]^2$ and $\psi = 1 - e^{-\rho x^\alpha/\alpha}$, using $(\partial/\partial x)\mathbb{E}[(x\tau_i(x))^2] = 2x(1-\psi)$, establishes $(\partial/\partial x)\mathrm{Var}(x\tau_i(x)) = 2(1-\psi)\mathbb{E}[x(1-\tau_i(x))]$ and $(\partial/\partial x)\psi = \rho x^{\alpha-1}(1-\psi)$, proving part (ii).

(iii). Differentiating $\mathbb{E}[x\tau_i(x)] = \int_0^x e^{-\rho k^\alpha/\alpha}\,dk$ and $\mathbb{E}[(x\tau_i(x))^2] = \int_0^x 2k\, e^{-\rho k^\alpha/\alpha}\,dk$ with respect to ρ and integrating by parts establishes $\alpha\rho(\partial/\partial\rho)\mathbb{E}[x\tau_i(x)] = x(1-\psi) - \mathbb{E}[x\tau_i(x)]$ and $\alpha\rho(\partial/\partial\rho)\mathbb{E}[(x\tau_i(x))^2] = 2\{x^2(1-\psi) - \mathbb{E}[(x\tau_i(x))^2]\}$. Equation (10) follows by substituting for $(\partial/\partial\rho)\mathbb{E}[x\tau_i(x)]$ and $(\partial/\partial\rho)\mathbb{E}[(x\tau_i(x))^2]$ in

$$(\partial/\partial\rho)\mathrm{Var}(x\tau_i(x)) = (\partial/\partial\rho)\mathbb{E}[(x\tau_i(x))^2] - 2\mathbb{E}[x\tau_i(x)](\partial/\partial\rho)\mathbb{E}[x\tau_i(x)].$$

Because $x(1-\psi)$, $\mathbb{E}[x\tau_i(x)]$, and $\mathbb{E}[(x\tau_i(x))^2]^{1/2}$ lie in $[0,x]$, (10) implies $|\rho(\partial/\partial\rho)\mathrm{Var}(x\tau_i(x))| \le 4x^2/\alpha$. Differentiating $\psi = 1 - e^{-\rho x^\alpha/\alpha}$ establishes $(\partial/\partial\rho)\psi = x^\alpha(1-\psi)/\alpha > 0$. Finally, $\mathbb{E}[x\tau_i(x)] = \int_0^x e^{-\rho k^\alpha/\alpha}\,dk$ strictly decreases in ρ, so $\mathbb{E}[x(1-\tau_i(x))] = x - \mathbb{E}[x\tau_i(x)]$ strictly increases. This proves part (iii).

(iv). By (1), $\Pr(\tau_i(x) \ge t) = e^{-ut^\alpha}$. Hence $\mathbb{E}[\tau_i(x)] = \int_0^1 e^{-ut^\alpha}\,dt$ strictly decreases in u, and $\mathbb{E}[\tau_i(x)^2] = \int_0^1 2t\, e^{-ut^\alpha}\,dt$. As $u \to 0$, $\mathbb{E}[\tau_i(x)] \to 1$ and $\mathbb{E}[\tau_i(x)^2] \to 1$, so $\mathrm{Var}(\tau_i(x)) = \mathbb{E}[\tau_i(x)^2] - \mathbb{E}[\tau_i(x)]^2 \to 0$. As $u \to \infty$, substituting $w = u^{1/\alpha}t$ shows that $u^{1/\alpha}\mathbb{E}[\tau_i(x)]$ and $u^{2/\alpha}\mathbb{E}[\tau_i(x)^2]$ converge to positive constants. Thus $\mathbb{E}[\tau_i(x)] \to 0$ and $\mathrm{Var}(\tau_i(x))/\mathbb{E}[\tau_i(x)] \le \mathbb{E}[\tau_i(x)^2]/\mathbb{E}[\tau_i(x)] \to 0$, proving part (iv). □

Proof of Lemma 1. (i). Fix $\mathbf{x}_{-i}$ and condition on coworkers' completed work $\{x_j\tau_j(x_j) : j \ne i\}$. By Lemma 3(i), employee i's completed work $x_i\tau_i(x_i)$ has density $\rho k^{\alpha-1}e^{-\rho k^\alpha/\alpha}$ on $(0, x_i)$ and mass $1 - \psi(x_i,\rho)$ at x_i. Differentiating expected compensation $\mathbb{E}[y_i + r_i]$ cancels the boundary terms, leaving $1 - \psi(x_i,\rho)$ times marginal compensation at completed work x_i. Using $(\partial/\partial y_i)r_i = \frac{n-1}{n}[\gamma - (y_i - \bar{y})]_+$ and differentiating the private cost $c(x_i,\rho)$ in (3) gives

$$(\partial/\partial x_i)u_i = [1-\psi(x_i,\rho)]\left\{\theta\left[1 + \tfrac{n-1}{n}\mathbb{E}\left[\left(\gamma - \tfrac{n-1}{n}\theta x_i + \frac{\theta}{n}\sum_{j\ne i} x_j\tau_j(x_j)\right)_+\right]\right] - (1+\rho\phi^w)x_i^{\alpha-1}\right\}. \quad (11)$$

The expression $[1-\psi(x_i,\rho)]^{-1}(\partial/\partial x_i)u_i$ is positive at $x_i=0$ and strictly decreases to $-\infty$, because $\mathbb{E}[(\gamma-\frac{n-1}{n}\theta x_i+\frac{\theta}{n}\sum_{j\neq i}x_j\tau_j(x_j))_+]$ weakly decreases in x_i, while $(1+\rho\phi^w)x_i^{\alpha-1}$ strictly increases to infinity. Since $1-\psi(x_i,\rho)>0$, each employee has a unique positive best response, characterized by $(\partial/\partial x_i)u_i=0$.

(ii). If all employees choose x, then $\frac{n-1}{n}\theta x-\frac{\theta}{n}\sum_{j\neq i}x\tau_j(x)=\frac{\theta}{n}\sum_{j\neq i}x[1-\tau_j(x)]$, so setting $(\partial/\partial x_i)u_i=0$ in (11) gives (6). The left-hand side of (6) strictly increases in x, from 0 at $x=0$ to infinity as $x\to\infty$, whereas the right-hand side is positive, bounded, and weakly decreasing in x because each coworker's lost work $x[1-\tau_j(x)]$ is stochastically increasing in x (Lemma 3). Therefore, (6) has a unique positive solution x^*, which gives the unique symmetric equilibrium.

To rule out asymmetric equilibria, suppose an equilibrium has $x_i>x_j$, and write $S=\sum_{k\notin\{i,j\}}x_k\tau_k(x_k)$ for the completed work of their remaining coworkers. By Lemma 3(ii), $x_j\tau_j(x_j)$ is stochastically no greater than $x_i\tau_i(x_i)$, and both are independent of S. Thus, since $x_i>x_j$ and $(\cdot)_+$ is weakly increasing,

$$\mathbb{E}\Big[\big(\gamma-\tfrac{n-1}{n}\theta x_i+\tfrac{\theta}{n}\{x_j\tau_j(x_j)+S\}\big)_+\Big]\leq\mathbb{E}\Big[\big(\gamma-\tfrac{n-1}{n}\theta x_j+\tfrac{\theta}{n}\{x_i\tau_i(x_i)+S\}\big)_+\Big].$$

The first-order conditions in (11) therefore imply $(1+\rho\phi^w)x_i^{\alpha-1}\leq(1+\rho\phi^w)x_j^{\alpha-1}$, contradicting $x_i>x_j$. Every equilibrium is therefore symmetric and, by the preceding construction, unique. □

If $\gamma\geq\frac{n-1}{n}\theta x$, then $\gamma-\frac{\theta}{n}\sum_{j=1}^{n-1}x[1-\tau_j(x)]\geq\gamma-\frac{n-1}{n}\theta x\geq 0$ for every realization of coworkers' lost work $x[1-\tau_j(x)]$. Therefore, $\mathbb{E}[(\gamma-\frac{\theta}{n}\sum_{j=1}^{n-1}x[1-\tau_j(x)])_+]=\gamma-\frac{n-1}{n}\theta\mathbb{E}[x(1-\tau_i(x))]$, and the equilibrium condition simplifies to

$$(1+\rho\phi^w)x^{\alpha-1}=\theta\left[1+\frac{n-1}{n}\gamma-\left(\frac{n-1}{n}\right)^2\theta\,\mathbb{E}[x(1-\tau_i(x))]\right]. \tag{12}$$

Because lost work $x[1-\tau_j(x)]$ equals 0 with positive probability and has a density on $(0,x)$, the sum $\frac{\theta}{n}\sum_{j=1}^{n-1}x[1-\tau_j(x)]$ equals $\gamma>0$ with probability zero, so $\mathbb{E}[(\gamma-\frac{\theta}{n}\sum_{j=1}^{n-1}x[1-\tau_j(x)])_+]$ is continuously differentiable in x, θ, ρ, and γ. The implicit function theorem then gives continuous differentiability of x^*, W, and Π in θ, ρ, γ, and ϕ^w, since, at $x=x^*>0$,

$$(\partial/\partial x)\left\{(1+\rho\phi^w)x^{\alpha-1}-\theta\left[1+\tfrac{n-1}{n}\mathbb{E}\left[\left(\gamma-\frac{\theta}{n}\sum_{j=1}^{n-1}x[1-\tau_j(x)]\right)_+\right]\right]\right\}>0.$$

When $\gamma>\frac{n-1}{n}\theta x^*$, x^* is infinitely differentiable by (12), because $\mathbb{E}[x(1-\tau_i(x))]=x-\int_0^x e^{-\rho k^\alpha/\alpha}\,dk$.

Lemma 4. *(i) For each realized output profile,*

$$\sum_{i=1}^n r_i(\mathbf{y},\gamma)=-\frac{1}{2}\sum_{i=1}^n(y_i-\bar y)^2+\frac{1}{2}\sum_{i=1}^n(y_i-\bar y-\gamma)_+^2\leq 0. \tag{13}$$

(ii) Let $W(x,\theta,\rho,\gamma)$ and $\pi(x,\theta,\rho,\gamma)$ denote total expected employee welfare and expected firm profit when every employee chooses x, and let $\widetilde{P}(x;\theta,\rho)=(v-1)\theta\mathbb{E}[x\tau_i(x)]-\phi^f\psi(x,\rho)+\frac{n-1}{2n}\theta^2\mathrm{Var}(x\tau_i(x))$. Then

$$\begin{aligned}\pi(x,\theta,\rho,\gamma)/n&=\widetilde{P}(x;\theta,\rho)-\tfrac{1}{2}\mathbb{E}\big[(y_1-\bar y-\gamma)_+^2\big],\\ W(x,\theta,\rho,\gamma)/n&=\theta\mathbb{E}[x\tau_i(x)]-c(x,\rho)-\frac{n-1}{2n}\theta^2\mathrm{Var}(x\tau_i(x))+\tfrac{1}{2}\mathbb{E}\big[(y_1-\bar y-\gamma)_+^2\big],\end{aligned} \tag{14}$$

where $\mathbb{E}[(y_1-\bar y-\gamma)_+^2]=0$ if and only if $\gamma\geq\frac{n-1}{n}\theta x$. If mitigation spending is $C(\rho)$ per employee, total

social welfare, $\pi + W - nC(\rho)$*, is* $n\{v\theta\mathbb{E}[x\tau_i(x)] - (\phi^f + 1/\rho + \phi^w)\psi(x,\rho) - C(\rho)\}$.

Proof. (i). By (2), $r_i = \gamma(y_i - \bar{y}) - (y_i - \bar{y})^2/2 + (y_i - \bar{y} - \gamma)_+^2/2$. Summing over employees and using $\sum_i (y_i - \bar{y}) = 0$ gives (13), where the inequality holds because $0 \le (y_i - \bar{y} - \gamma)_+ \le |y_i - \bar{y}|$ for $\gamma \ge 0$.

(ii). At a symmetric intensity, outputs are i.i.d., so $\mathbb{E}[\sum_i (y_i - \bar{y})^2] = (n-1)\theta^2 \mathrm{Var}(x\tau_i(x))$. Taking expectations in (13) and substituting into the definitions of $\pi(x,\theta,\rho,\gamma)$ and $W(x,\theta,\rho,\gamma)$ gives (14). Because the support of $y_1 - \bar{y} = \frac{\theta x}{n}\sum_{j=2}^{n}[\tau_1(x) - \tau_j(x)]$ has supremum $\frac{n-1}{n}\theta x$, $\mathbb{E}[(y_1 - \bar{y} - \gamma)_+^2] = 0$ if and only if $\gamma \ge \frac{n-1}{n}\theta x$. Adding profit π and employee welfare W cancels employee payments. Subtracting mitigation spending gives $\pi + W - nC(\rho) = n\{v\theta\mathbb{E}[x\tau_i(x)] - (\phi^f + 1/\rho + \phi^w)\psi(x,\rho) - C(\rho)\}$, proving part (ii). □

Proof of Lemma 2. Write $x = x^*(\theta,\rho,\gamma)$. Because the left-hand side of (6) strictly increases in x and the right-hand side weakly decreases in x, the implicit function theorem implies that $(d/d\theta)x$ has the same sign as the following partial derivative, evaluated at fixed x:

$$\begin{aligned}(\partial/\partial\theta)&\left\{\theta\left[1 + \frac{n-1}{n}\mathbb{E}\left[\left(\gamma - \frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)]\right)_+\right]\right]\right\} \\ &= 1 + \frac{n-1}{n}\mathbb{E}\left[\left(\gamma - \frac{2\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)]\right)\mathbf{1}\left\{\frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)] < \gamma\right\}\right].\end{aligned} \tag{15}$$

Since $(d/d\theta)\psi^* = \rho(x^*)^{\alpha-1}(1-\psi^*)(d/d\theta)x^*$ and $\rho(x^*)^{\alpha-1}(1-\psi^*) > 0$, $(d/d\theta)\psi^*$ has the same sign as $(d/d\theta)x^*$.

(i). If $\gamma = 0$, the event $\{\frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)] < \gamma\}$ is empty, and the right-hand side of (15) equals one. If $\gamma > 0$, then $\gamma - \frac{2\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)] > -\gamma$ whenever $\frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)] < \gamma$. Moreover, $\Pr(\frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)] < \gamma) > 0$ because no coworker burns out with positive probability. Therefore, the right-hand side of (15) exceeds $1 - \frac{n-1}{n}\gamma$, which is nonnegative when $\gamma \le \bar{\gamma}_R$. In both cases, $(d/d\theta)x^* > 0$, which establishes part (i).

(ii). Fix $\gamma \in (\bar{\gamma}_R, \theta^m - 1)$. When $\gamma > \frac{n-1}{n}\theta x$, differentiating (12) with respect to θ and using Lemma 3 gives

$$\left[(1+\rho\phi^w)(\alpha-1)x^{\alpha-2} + \left(\frac{n-1}{n}\right)^2\theta^2\psi(x,\rho)\right](d/d\theta)x = 1 + \frac{n-1}{n}\gamma - 2\left(\frac{n-1}{n}\right)^2\theta\,\mathbb{E}[x(1-\tau_i(x))], \tag{16}$$

so equilibrium intensity strictly decreases in θ if and only if

$$\mathbb{E}[x(1-\tau_i(x))] > \frac{n[n + (n-1)\gamma]}{2(n-1)^2\theta}. \tag{17}$$

Because expected lost work $\mathbb{E}[x(1-\tau_i(x))]$ is zero at $x = 0$ and strictly increases to infinity in x (Lemma 3), there is a unique intensity $\bar{x}$ at which (17) holds with equality at $\theta = \theta^m$. It suffices to show that $\bar{x} < x^*(\theta^m) < n\gamma/[(n-1)\theta^m]$ for suitable ρ and ϕ^w, since then (16) applies and (17) holds at θ^m, and $(d/d\theta)x^* < 0$ and $(d/d\theta)\psi^* < 0$ hold on some interval $[\bar{\theta}, \theta^m]$ by continuity and the sign relation established above.

Because $n/(n-1) < \gamma < \theta^m - 1$ and $n \ge 3$, the right-hand side of (17) at θ^m is less than $\min\{1, n\gamma/[(n-1)\theta^m]\}$. Because $\bar{x} = n[n + (n-1)\gamma]/[2(n-1)^2\theta^m] + \mathbb{E}[\bar{x}\tau_i(\bar{x})]$ and $\mathbb{E}[\bar{x}\tau_i(\bar{x})] \le c_\alpha \rho^{-1/\alpha}$, there exists $\bar{\rho}$ such that $\bar{x} < \min\{1, n\gamma/[(n-1)\theta^m]\}$ for all $\rho > \bar{\rho}$.

Lastly, fix $\rho > \bar{\rho}$. By (6), $x^*(\theta^m)$ is continuous and strictly decreasing in ϕ^w, satisfies $x^*(\theta^m) \ge (\theta^m)^{1/(\alpha-1)} >$

$1 > \bar{x}$ at $\phi^w = 0$, and converges to zero as $\phi^w \to \infty$. Therefore, there exist $0 \leq \underline{\phi}^w < \overline{\phi}^w$ such that $\bar{x} < x^*(\theta^m) < n\gamma/[(n-1)\theta^m]$ for all $\phi^w \in (\underline{\phi}^w, \overline{\phi}^w)$, as desired. □

The next lemma, used for Propositions 1(iii) and 2(iii), identifies a technology level at which equilibrium work intensity switches from increasing to decreasing.

Lemma 5. *Suppose $\gamma > \bar{\gamma}_R$. There exists $\bar{\phi}^w > 0$ such that, if $\phi^w \in (0, \bar{\phi}^w)$ and $\rho > 1/\bar{\phi}^w$, there is a technology level $\bar{\theta}$, with $\bar{x} = x^*(\bar{\theta})$, for which the following statements hold: (i) $\gamma > \frac{n-1}{n}\bar{\theta}\bar{x}$, and at $\bar{\theta}$, $(d/d\theta)x^* = 0$ and $(d^2/d\theta^2)x^* < 0$; (ii) $\mathbb{E}[\tau_i(\bar{x})] > \frac{n-1}{n}\bar{\theta}\bar{x}\,\mathrm{Var}(\tau_i(\bar{x}))$; and (iii) for fixed ϕ^w, $\bar{\theta} \to \infty$ as $\rho \to \infty$.*

Proof. (i). When $\gamma > \frac{n-1}{n}\theta x^*$, (16) gives $(d/d\theta)x^* = 0$ if and only if (17) holds with equality, in which case the right-hand side of (12) equals $\theta[n + (n-1)\gamma]/(2n)$. Write $u = \rho x^\alpha/\alpha$. By Lemma 3, $u\,\mathbb{E}[1 - \tau_i(x)]$ depends on x and ρ only through u and strictly increases in u, from 0 at $u = 0$ to infinity as $u \to \infty$. Let $\bar{x}$ be the unique intensity at which

$$u\,\mathbb{E}[1 - \tau_i(x)] = \frac{[n + (n-1)\gamma]^2}{4\alpha(n-1)^2(\phi^w + 1/\rho)}, \tag{18}$$

and set $\bar{\theta} = n[n + (n-1)\gamma]/\{2(n-1)^2\bar{x}\,\mathbb{E}[1 - \tau_i(\bar{x})]\}$, so that (17) holds with equality at $(\bar{x}, \bar{\theta})$. Using $(1 + \rho\phi^w)\bar{x}^\alpha = \alpha(\phi^w + 1/\rho)u$, (18) gives $(1 + \rho\phi^w)\bar{x}^{\alpha-1} = \bar{\theta}[n + (n-1)\gamma]/(2n)$, so $\bar{x}$ solves (12) at $\theta = \bar{\theta}$. Also, $\frac{n-1}{n}\bar{\theta}\bar{x} < \gamma$ if and only if $\mathbb{E}[1 - \tau_i(\bar{x})] > [n + (n-1)\gamma]/[2(n-1)\gamma]$, where the right-hand side is less than one because $\gamma > n/(n-1)$.

By (18), $u \geq [n + (n-1)\gamma]^2/[4\alpha(n-1)^2(\phi^w + 1/\rho)]$ at $\bar{x}$. Because $\mathbb{E}[1 - \tau_i(x)] \to 1$ as $u \to \infty$ (Lemma 3), there exists $\bar{\phi}^w > 0$ such that, whenever $\phi^w + 1/\rho < 2\bar{\phi}^w$, we have $\mathbb{E}[1 - \tau_i(\bar{x})] > [n + (n-1)\gamma]/[2(n-1)\gamma]$. Suppose $\phi^w < \bar{\phi}^w$ and $\rho > 1/\bar{\phi}^w$, so that $\phi^w + 1/\rho < 2\bar{\phi}^w$. Then $\gamma > \frac{n-1}{n}\bar{\theta}\bar{x}$, so $\bar{x} = x^*(\bar{\theta})$ and $(d/d\theta)x^* = 0$ at $\bar{\theta}$. Differentiating (16) with respect to θ at $\bar{\theta}$ then gives

$$\left[(1 + \rho\phi^w)(\alpha - 1)\bar{x}^{\alpha-2} + \left(\frac{n-1}{n}\right)^2 \bar{\theta}^2\psi(\bar{x}, \rho)\right](d^2/d\theta^2)x^* = -2\left(\frac{n-1}{n}\right)^2 \mathbb{E}[\bar{x}(1 - \tau_i(\bar{x}))] < 0.$$

(ii). By part (i), $\mathbb{E}[1 - \tau_i(\bar{x})] > 1/2$, so $\frac{n-1}{n}\bar{\theta}\bar{x} \leq [n + (n-1)\gamma]/(n-1)$. Because $\mathrm{Var}(\tau_i(x))/\mathbb{E}[\tau_i(x)] \to 0$ as $u \to \infty$ (Lemma 3), the lower bound on u in part (i) implies that, after reducing $\bar{\phi}^w$ if necessary, $\mathrm{Var}(\tau_i(\bar{x}))/\mathbb{E}[\tau_i(\bar{x})] < (n-1)/[n + (n-1)\gamma]$ whenever $\phi^w + 1/\rho < 2\bar{\phi}^w$. Hence $\mathbb{E}[\tau_i(\bar{x})] > \frac{n-1}{n}\bar{\theta}\bar{x}\,\mathrm{Var}(\tau_i(\bar{x}))$, as claimed.

(iii). Fix ϕ^w. As $\rho \to \infty$, the value of u solving (18) converges to a finite positive value, so $\bar{x} = (\alpha u/\rho)^{1/\alpha} \to 0$ and $\bar{\theta} \geq n[n + (n-1)\gamma]/[2(n-1)^2\bar{x}] \to \infty$. □

Proof of Proposition 1. (i). At $\rho = 0$, no employee burns out, and the private cost is x^α/α, the limit of $c(x, \rho)$ as $\rho \to 0$. By (6), $x^* = \{[1 + (n-1)\gamma/n]\theta\}^{1/(\alpha-1)}$, so $(d/d\theta)x^* = x^*/[(\alpha - 1)\theta]$. All employees produce $y_i = \theta x^* = \bar{y}$, so $r_i = 0$ and $W = n[\theta x^* - (x^*)^\alpha/\alpha]$, and using $(x^*)^{\alpha-1} = [1 + (n-1)\gamma/n]\theta$, we obtain $(d/d\theta)W = nx^*\{1 - (n-1)\gamma/[n(\alpha - 1)]\}$, which has the sign of $\bar{\gamma}_W - \gamma$, as claimed.

(ii). Fix $\gamma > 0$ and $\phi^w > 0$. When $\gamma > \frac{n-1}{n}\theta x$, Lemma 4 gives $W/n = \theta\mathbb{E}[x\tau_i(x)] - c(x, \rho) - \frac{n-1}{2n}\theta^2\mathrm{Var}(x\tau_i(x))$. Differentiating W along $x = x^*(\theta)$, using $(\partial/\partial x)c = (1 + \rho\phi^w)x^{\alpha-1}(1 - \psi)$, (12), and Lemma 3, gives

$$\frac{1}{n}(d/d\theta)W = \mathbb{E}[x\tau_i(x)] - \frac{n-1}{n}\theta\,\mathrm{Var}(x\tau_i(x)) - \frac{n-1}{n}\theta(1 - \psi)\left[\gamma + \frac{\theta}{n}\mathbb{E}[x(1 - \tau_i(x))]\right](d/d\theta)x, \tag{19}$$

where the first two terms are the direct technology effect and the last term is the strategic work-intensity effect.

Set $\theta = 1$. By (6), $(x^*)^{\alpha-1} \leq [1 + (n-1)\gamma/n]/(1 + \rho\phi^w)$, so $x^* \to 0$ and $\rho(x^*)^\alpha \to 0$ as $\rho \to \infty$. By Lemma 3, it follows that $\mathbb{E}[x^*\tau_i(x^*)]/x^* \to 1$, $\mathrm{Var}(x^*\tau_i(x^*))/x^* = x^*\mathrm{Var}(\tau_i(x^*)) \to 0$, and $\psi \to 0$. In particular, $\gamma > \frac{n-1}{n}x^*$ for large ρ, and because $\mathbb{E}[x^*(1-\tau_i(x^*))] \leq x^*$, both $(1 + \rho\phi^w)(x^*)^{\alpha-1}$ and the right-hand side of (16) converge to $1 + (n-1)\gamma/n$. Dividing (16) by $(1 + \rho\phi^w)(x^*)^{\alpha-1}$ and letting $\rho \to \infty$ gives $(1/x^*)(d/d\theta)x^* \to 1/(\alpha-1)$, as in part (i).

Now suppose $\gamma > \bar{\gamma}_W$. At $\theta = 1$, substituting $\mathbb{E}[x^*\tau_i(x^*)]/x^* \to 1$, $\mathrm{Var}(x^*\tau_i(x^*))/x^* \to 0$, $\psi \to 0$, and $(1/x^*)(d/d\theta)x^* \to 1/(\alpha-1)$ into (19) and dividing by x^* gives $(1/(nx^*))(d/d\theta)W \to 1 - (n-1)\gamma/[n(\alpha-1)] < 0$, as in part (i). Also, $\{\mathbb{E}[x^*\tau_i(x^*)] - \frac{n-1}{n}\theta\,\mathrm{Var}(x^*\tau_i(x^*))\}/x^* \to 1$ and $(1/x^*)(d/d\theta)x^* \to 1/(\alpha-1) > 0$. Thus, for sufficiently large ρ, continuity gives $\theta_1 \in (1, \theta^m)$ such that $(d/d\theta)W < 0$, $(d/d\theta)x^* > 0$, and $\mathbb{E}[x^*\tau_i(x^*)] - \frac{n-1}{n}\theta\,\mathrm{Var}(x^*\tau_i(x^*)) > 0$ on $[1, \theta_1]$, proving part (ii).

(iii). Fix $\gamma > \bar{\gamma}_W$, which exceeds $\bar{\gamma}_R$ because $\alpha > 2$, let $\bar{\phi}^w$ be the threshold in Lemma 5, and fix $\phi^w \in (0, \bar{\phi}^w)$. For $\rho > 1/\bar{\phi}^w$, let $\bar{\theta}$ and $\bar{x} = x^*(\bar{\theta})$ be as in that lemma. At $\bar{\theta}$, $(d/d\theta)x^* = 0$, so (19) gives $(1/n)(d/d\theta)W = \bar{x}\{\mathbb{E}[\tau_i(\bar{x})] - \frac{n-1}{n}\bar{\theta}\bar{x}\,\mathrm{Var}(\tau_i(\bar{x}))\} > 0$. Because $(d^2/d\theta^2)x^* < 0$ at $\bar{\theta}$, by continuity there exist θ_2 and θ^m with $\bar{\theta} < \theta_2 < \theta^m$ such that, on $[\theta_2, \theta^m]$, $\gamma > \frac{n-1}{n}\theta x^*$, $(d/d\theta)x^* < 0$, and $\mathbb{E}[x^*\tau_i(x^*)] - \frac{n-1}{n}\theta\,\mathrm{Var}(x^*\tau_i(x^*)) > 0$. Equation (19) therefore implies $(d/d\theta)W > 0$ on this interval, while $(d/d\theta)x^* < 0$ implies $(d/d\theta)\psi^* < 0$.

Lastly, for sufficiently large ρ, Lemma 5 gives $\bar{\theta} > 1$, and part (ii) gives $(d/d\theta)W < 0$ on $[1, \theta_1]$ for some $\theta_1 \in (1, \bar{\theta})$. Continuity gives a minimum of W on $[1, \theta^m]$. Since $(d/d\theta)W < 0$ at $\theta = 1$ and $(d/d\theta)W > 0$ at $\theta = \theta^m$, every minimum is interior. □

Proof of Proposition 2. (i). In the absence of burnout, all employees produce $y_i = \theta x^* = \bar{y}$, so $r_i = 0$. Equation (6) gives $x^* = \{[1 + (n-1)\gamma/n]\theta\}^{1/(\alpha-1)}$, and profit is $\Pi = n(v-1)\theta x^*$. Therefore, $(d/d\theta)\Pi = n\alpha(v-1)x^*/(\alpha-1) > 0$, which strictly increases in θ because x^* does.

(ii). Fix $\gamma > 0$ and $\phi^w > 0$, write $x = x^*(\theta)$, and consider $\theta = 1$ as $\rho \to \infty$. The proof of Proposition 1(ii) gives $x \to 0$, $\rho x^\alpha \to 0$, $(1 + \rho\phi^w)x^{\alpha-1} \to 1 + (n-1)\gamma/n$, and $(1/x)(d/d\theta)x \to 1/(\alpha-1)$. Differentiating (16) with respect to θ then yields $(1/x)(d^2/d\theta^2)x \to (2-\alpha)/(\alpha-1)^2$ at $\theta = 1$, as in the absence of burnout.

Next, expected output per employee is $\mathbb{E}[y_i] = \theta\mathbb{E}[x\tau_i(x)]$. By Lemma 3, $(d/d\theta)\mathbb{E}[y_i] = \mathbb{E}[x\tau_i(x)] + \theta(1-\psi)(d/d\theta)x$ and $(d^2/d\theta^2)\mathbb{E}[y_i] = (1-\psi)[2(d/d\theta)x + \theta(d^2/d\theta^2)x - \rho\theta x^{\alpha-1}\big((d/d\theta)x\big)^2]$, so at $\theta = 1$, $(1/x)(d/d\theta)\mathbb{E}[y_i] \to \alpha/(\alpha-1) > 0$ and $(1/x)(d^2/d\theta^2)\mathbb{E}[y_i] \to \alpha/(\alpha-1)^2 > 0$. Fix sufficiently large ρ. By continuity, $(d/d\theta)\mathbb{E}[y_i] > 0$, $(d^2/d\theta^2)\mathbb{E}[y_i] > 0$, and $\gamma > \frac{n-1}{n}\theta x$ on $[1, \theta_1]$ for some $\theta_1 \in (1, \theta^m)$. On this interval, Lemma 4 gives $\Pi/n = (v-1)\mathbb{E}[y_i] - \phi^f\psi(x,\rho) + \frac{n-1}{2n}\theta^2\mathrm{Var}(x\tau_i(x))$. Because $x = x^*(\theta)$ does not depend on v, the burnout-cost term $\phi^f\psi(x,\rho)$ and variance term $\frac{n-1}{2n}\theta^2\mathrm{Var}(x\tau_i(x))$ have bounded first and second derivatives with respect to θ, independent of v. Both $(d/d\theta)\mathbb{E}[y_i]$ and $(d^2/d\theta^2)\mathbb{E}[y_i]$ have positive minima on $[1, \theta_1]$. Therefore, $(d/d\theta)\Pi > 0$ and $(d^2/d\theta^2)\Pi > 0$ on $[1, \theta_1]$ for sufficiently large v, proving part (ii).

(iii). Fix $\gamma > \bar{\gamma}_R$, let $\bar{\phi}^w$ be the threshold in Lemma 5, and fix $\phi^w \in (0, \bar{\phi}^w)$. For $\rho > 1/\bar{\phi}^w$, let $\bar{\theta}$ be as in that lemma. Because $(d/d\theta)x^* = 0$ and $(d^2/d\theta^2)x^* < 0$ at $\bar{\theta}$, the formulas in part (ii) reduce to $(d/d\theta)\mathbb{E}[y_i] = \mathbb{E}[x^*\tau_i(x^*)] > 0$ and $(d^2/d\theta^2)\mathbb{E}[y_i] = \bar{\theta}(1-\psi^*)(d^2/d\theta^2)x^* < 0$ at $\bar{\theta}$. Choose ρ large enough that $\bar{\theta} > 1$ and the argument in part

(ii) applies on $[1, \theta_1]$ for some $\theta_1 \in (1, \bar{\theta})$. By continuity, there exist θ_2 and θ^m with $\bar{\theta} < \theta_2 < \theta^m$ such that, on $[\theta_2, \theta^m]$, $\gamma > \frac{n-1}{n}\theta x^*$, $(d/d\theta)\mathbb{E}[y_i] > 0$, $(d^2/d\theta^2)\mathbb{E}[y_i] < 0$, and $(d/d\theta)x^* < 0$, so that ψ^* also strictly decreases. As in part (ii), choosing v sufficiently large gives $(d/d\theta)\Pi > 0$ on both intervals, $(d^2/d\theta^2)\Pi > 0$ on $[1, \theta_1]$, and $(d^2/d\theta^2)\Pi < 0$ on $[\theta_2, \theta^m]$. Lastly, continuity gives a maximum of $(d/d\theta)\Pi$ on $[1, \theta^m]$. Every maximum is interior because $(d/d\theta)\Pi$ increases near 1 and decreases near θ^m. □

The next two lemmas characterize implementable intensities and the firm's optimal intensity.

Lemma 6. *(i) Equation (20) defines a unique $\gamma(x, \theta, \rho) \geq 0$ if and only if $x \geq [\theta/(1+\rho\phi^w)]^{1/(\alpha-1)}$:*

$$\mathbb{E}\left[\left(\gamma - \frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)]\right)_+\right] = \frac{n[(1+\rho\phi^w)x^{\alpha-1} - \theta]}{(n-1)\theta}. \tag{20}$$

If $x = [\theta/(1+\rho\phi^w)]^{1/(\alpha-1)}$, then $\gamma(x, \theta, \rho) = 0$. If $x > [\theta/(1+\rho\phi^w)]^{1/(\alpha-1)}$, then $\gamma(x, \theta, \rho) > 0$ and $(\partial/\partial x)\gamma(x, \theta, \rho) > 0$.

(ii) If

$$(1+\rho\phi^w)x^{\alpha-1} > \theta + \left(\frac{n-1}{n}\right)^2 \theta^2 \mathbb{E}[x\tau_i(x)], \tag{21}$$

then $\gamma(x, \theta, \rho) > \frac{n-1}{n}\theta x$.

Proof. (i). Rearranging (6) gives (20). The left-hand side of (20) equals zero at $\gamma = 0$ and converges to infinity as $\gamma \to \infty$. For $\gamma > 0$,

$$(\partial/\partial\gamma)\mathbb{E}\left[\left(\gamma - \frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)]\right)_+\right] = \Pr\left(\frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)] < \gamma\right) > 0,$$

because no coworker burns out with positive probability. Therefore, (20) has a unique solution $\gamma \geq 0$ if and only if its right-hand side is nonnegative, and this solution is zero if and only if the right-hand side is zero. For $x > [\theta/(1+\rho\phi^w)]^{1/(\alpha-1)}$, the right-hand side strictly increases in x, whereas the left-hand side weakly decreases in x (Lemma 3), so implicitly differentiating (20) gives $(\partial/\partial x)\gamma(x, \theta, \rho) > 0$.

(ii). Let $\hat{\gamma}$ solve (12) for γ. Using $\mathbb{E}[x(1-\tau_i(x))] = x - \mathbb{E}[x\tau_i(x)]$, we have $\hat{\gamma} - \frac{n-1}{n}\theta x = \frac{n}{(n-1)\theta}[(1+\rho\phi^w)x^{\alpha-1} - \theta - (\frac{n-1}{n})^2\theta^2\mathbb{E}[x\tau_i(x)]]$. If (21) holds, then $\hat{\gamma} > \frac{n-1}{n}\theta x$, so $\hat{\gamma}$ solves (20). By uniqueness, $\gamma(x, \theta, \rho) = \hat{\gamma}$. □

We say that an intensity x is *implementable* if $x \geq [\theta/(1+\rho\phi^w)]^{1/(\alpha-1)}$, in which case the incentive $\gamma(x, \theta, \rho)$ induces x as the equilibrium intensity (Lemma 6). By Lemma 3, $(\partial/\partial x)\widetilde{P}(x; \theta, \rho) = [1 - \psi(x, \rho)]G(x; \theta, \rho)$, where

$$G(x; \theta, \rho) = (v-1)\theta + \frac{n-1}{n}\theta^2\mathbb{E}[x(1-\tau_i(x))] - \phi^f\rho x^{\alpha-1}. \tag{22}$$

By Lemma 4, profit per employee at an implementable intensity x is at most $\widetilde{P}(x; \theta, \rho)$, with equality when $\gamma(x, \theta, \rho) \geq \frac{n-1}{n}\theta x$. Consequently, if $\widetilde{P}(\cdot\,; \theta, \rho)$ has a unique maximizer $\hat{x}$ that satisfies (21), then $\hat{x}$ is implementable, $\gamma(\hat{x}, \theta, \rho) > \frac{n-1}{n}\theta\hat{x}$ (Lemma 6), and $\hat{x}$ uniquely maximizes profit over implementable intensities.

Lemma 7. *(i) There exists $\kappa > 0$, depending only on α, v, and θ^m, such that if $\phi^f \max\{\rho, \rho^{1/\alpha}\} < \kappa$, then for every $\theta \in [1, \theta^m]$, $G(\cdot\,; \theta, \rho)$ has a unique root x^*, at which $(\partial/\partial x)G < 0$. This root uniquely maximizes profit over implementable intensities, and the corresponding incentive satisfies $\gamma^* > \frac{n-1}{n}\theta x^*$.*

(ii) For fixed θ and ϕ^f, as $\rho \to 0$, $\rho^{1/(\alpha-2)}x^* \to [(n-1)\theta^2/(n\phi^f)]^{1/(\alpha-2)}$ and $(\rho/x^*)(d/d\rho)x^* \to -1/(\alpha-2)$.

Proof. (i). Fix $\theta \in [1, \theta^m]$. Since $G(0;\theta,\rho) = (v-1)\theta > 0$ and $G(x;\theta,\rho) \to -\infty$ as $x \to \infty$, G has a root. At any root, $\phi^f \rho x^{\alpha-1} \geq (v-1)\theta \geq v-1$, so by Lemma 3,

$$x \geq \left[\frac{v-1}{\phi^f \rho}\right]^{1/(\alpha-1)}, \qquad \frac{\mathbb{E}[x\tau_i(x)]}{x} \leq c_\alpha \left[\frac{\phi^f \rho^{1/\alpha}}{v-1}\right]^{1/(\alpha-1)}. \tag{23}$$

The bounds on x and $\mathbb{E}[x\tau_i(x)]/x$ do not depend on θ. As $\phi^f \max\{\rho, \rho^{1/\alpha}\} \to 0$, $x \to \infty$ and $\mathbb{E}[x\tau_i(x)]/x \to 0$ at every root, uniformly over $\theta \in [1, \theta^m]$. At any root, $G = 0$ also gives $\phi^f \rho x^{\alpha-2} \geq \frac{n-1}{n}\theta^2\{1 - \mathbb{E}[x\tau_i(x)]/x\}$, so, because $\psi \leq 1$,

$$(\partial/\partial x)G = \frac{n-1}{n}\theta^2\psi - (\alpha-1)\phi^f \rho x^{\alpha-2} \leq \frac{n-1}{n}\theta^2\left[1 - (\alpha-1)\left(1 - \frac{\mathbb{E}[x\tau_i(x)]}{x}\right)\right],$$

which is negative whenever $\mathbb{E}[x\tau_i(x)]/x < (\alpha-2)/(\alpha-1)$. By (23), this holds at every root when $\phi^f \max\{\rho, \rho^{1/\alpha}\}$ is small, so G changes sign only from positive to negative and has a unique root x^*, which uniquely maximizes $\widetilde{P}$ because $(\partial/\partial x)\widetilde{P} = (1-\psi)G$.

At $x = x^*$, divide both sides of (21) by x. The left-hand side is at least $x^{\alpha-2}$, and the right-hand side is at most $\theta^m/x + (\theta^m)^2\mathbb{E}[x\tau_i(x)]/x$. By (23), as $\phi^f \max\{\rho, \rho^{1/\alpha}\} \to 0$, $x^{\alpha-2} \to \infty$ and $\theta^m/x + (\theta^m)^2\mathbb{E}[x\tau_i(x)]/x \to 0$, with bounds that do not depend on θ. Thus, for sufficiently small $\phi^f \max\{\rho, \rho^{1/\alpha}\}$, Lemma 6 gives implementability and $\gamma^* > \frac{n-1}{n}\theta x^*$. Profit per employee is bounded above by $\widetilde{P}$ and attains this bound at x^*, so x^* uniquely maximizes profit.

(ii). Fix θ and ϕ^f, and let $\rho \to 0$. By (23), $x^* \to \infty$ and $\mathbb{E}[x^*\tau_i(x^*)]/x^* \to 0$, and $\rho(x^*)^\alpha \geq [(v-1)/\phi^f]^{\alpha/(\alpha-1)}\rho^{-1/(\alpha-1)} \to \infty$, so $\psi \to 1$ at $x = x^*$. Dividing $G(x^*;\theta,\rho) = 0$ by x^* then gives $\phi^f \rho(x^*)^{\alpha-2} \to \frac{n-1}{n}\theta^2$, so $\rho^{1/(\alpha-2)}x^* \to [(n-1)\theta^2/(n\phi^f)]^{1/(\alpha-2)}$, and $(\partial/\partial x)G \to -(\alpha-2)\frac{n-1}{n}\theta^2$ at $x = x^*$. Implicitly differentiating $G(x^*;\theta,\rho) = 0$ with respect to ρ, and using $\phi^f\rho(x^*)^{\alpha-2} \to \frac{n-1}{n}\theta^2$, $(\partial/\partial x)G \to -(\alpha-2)\frac{n-1}{n}\theta^2$, and $\rho(\partial/\partial\rho)\mathbb{E}[x\tau_i(x)]/x = \{1 - \psi - \mathbb{E}[x\tau_i(x)]/x\}/\alpha \to 0$ at $x = x^*$ (Lemma 3), establishes $(\rho/x^*)(d/d\rho)x^* \to -1/(\alpha-2)$, proving part (ii). □

Proof of Proposition 3. (i). Fix $\gamma > 0$ and write $x = x^*(\theta,\rho,\gamma)$. At a fixed $x > 0$, increasing ρ strictly raises the left-hand side of (6) and weakly lowers the right-hand side, because each coworker's lost work $x[1-\tau_j(x)]$ is stochastically increasing in ρ (Lemma 3). Therefore, equilibrium intensity strictly decreases in ρ. As $\rho \to 0$, (6) gives $x \to \{[1+(n-1)\gamma/n]\theta\}^{1/(\alpha-1)}$, and conditioning on which coworkers burn out shows that $\mathbb{E}[(\gamma - \frac{\theta}{n}\sum_{j=1}^{n-1} x[1-\tau_j(x)])_+]$ is continuously differentiable in (x,ρ) at $\rho = 0$, so by the implicit function theorem, $(d/d\rho)x$ remains bounded near $\rho = 0$. Therefore, $(d/d\rho)\psi(x,\rho) = (1-\psi)[x^\alpha/\alpha + \rho x^{\alpha-1}(d/d\rho)x] \to \alpha^{-1}\{[1+(n-1)\gamma/n]\theta\}^{\alpha/(\alpha-1)} > 0$, so burnout strictly increases in ρ near $\rho = 0$, proving part (i).

(ii). *Step 1.* For small ρ, Lemma 7 gives a unique optimal intensity $x^* = x^*(\theta,\rho)$ with $\gamma^* > \frac{n-1}{n}\theta x^*$, so Lemma 4 gives $W^*/n = \theta\mathbb{E}[x^*\tau_i(x^*)] - (1/\rho + \phi^w)\psi^* - \frac{n-1}{2n}\theta^2\mathrm{Var}(x^*\tau_i(x^*))$. Let $u^* = \rho(x^*)^\alpha/\alpha$ denote cumulative exposure, so that $\psi^* = 1 - e^{-u^*}$. By Lemma 7, $\rho^{1/(\alpha-2)}x^* \to [(n-1)\theta^2/(n\phi^f)]^{1/(\alpha-2)}$ and $(\rho/x^*)(d/d\rho)x^* \to -1/(\alpha-2)$. Since $u^* = \rho(x^*)^\alpha/\alpha$, we have $\rho^{2/(\alpha-2)}u^* \to \alpha^{-1}[(n-1)\theta^2/(n\phi^f)]^{\alpha/(\alpha-2)} > 0$ as $\rho \to 0$ and

$$\frac{\rho}{u^*}(d/d\rho)u^* = 1 + \alpha\frac{\rho}{x^*}(d/d\rho)x^* \longrightarrow -\frac{2}{\alpha-2}. \tag{24}$$

Because $\rho^{1/(\alpha-2)}x^*$ and $\rho^{2/(\alpha-2)}u^*$ both converge to positive constants, the product of $1-\psi^* = e^{-u^*}$ with any fixed powers of x^* and ρ, or with the bounded elasticity $(\rho/x^*)(d/d\rho)x^*$, converges to zero as $\rho \to 0$.

Step 2. Differentiating W^* with respect to ρ along $x^*(\theta,\rho)$ and multiplying by ρ^2/n, we have $(\rho^2/n)(d/d\rho)W^* = \psi^* + R(\rho)$, where

$$R(\rho) = \theta\rho^2(d/d\rho)\mathbb{E}[x^*\tau_i(x^*)] - (1+\rho\phi^w)\rho(d/d\rho)\psi^* - \frac{n-1}{2n}\theta^2\rho^2(d/d\rho)\mathrm{Var}(x^*\tau_i(x^*)).$$

Expand the derivatives in $R(\rho)$ using Lemma 3. Terms containing $1-\psi^*$ converge to zero by Step 1. Using $\mathrm{Var}(x^*\tau_i(x^*)) \le \mathbb{E}[(x^*\tau_i(x^*))^2]$, the contribution without $1-\psi^*$, $(\rho/\alpha)\{-\theta\mathbb{E}[x^*\tau_i(x^*)] + \frac{n-1}{n}\theta^2\mathrm{Var}(x^*\tau_i(x^*))\}$, is bounded in absolute value by a constant multiple of $\rho\mathbb{E}[x^*\tau_i(x^*)] + \rho\mathbb{E}[(x^*\tau_i(x^*))^2] \le 2c_\alpha\rho^{1-2/\alpha}$ for $\rho \le 1$, which converges to zero because $\alpha > 2$. Therefore, $(\rho^2/n)(d/d\rho)W^* \to 1$, so W^* strictly increases in ρ near $\rho = 0$.

Step 3. Lemma 7 and (24) give $(d/d\rho)x^* < 0$ and $(d/d\rho)u^* < 0$ near $\rho = 0$, so x^* and $\psi^* = 1 - e^{-u^*}$ strictly increase as ρ decreases.

Step 4. Solving (12) for γ gives $\gamma^* = \frac{n-1}{n}\theta\,\mathbb{E}[x^*(1-\tau_i(x^*))] + \frac{n(1+\rho\phi^w)(x^*)^{\alpha-1}}{(n-1)\theta} - \frac{n}{n-1}$. Because $x^* \to \infty$ and $\alpha - 1 > 1$, dividing each term by $(x^*)^{\alpha-1}$ shows that $x^*/\gamma^* \to 0$ and $n(x^*)^{\alpha-1}/[(n-1)\theta\gamma^*] \to 1$. Differentiating γ^* with respect to ρ, and using $x^*/\gamma^* \to 0$, $n(x^*)^{\alpha-1}/[(n-1)\theta\gamma^*] \to 1$, $|\rho(\partial/\partial\rho)\mathbb{E}[x\tau_i(x)]| \le x/\alpha$ (Lemma 3), and $(\rho/x^*)(d/d\rho)x^* \to -1/(\alpha-2)$ (Lemma 7), gives $(\rho/\gamma^*)(d/d\rho)\gamma^* \to -(\alpha-1)/(\alpha-2)$. Therefore, γ^* strictly increases as ρ decreases near $\rho = 0$. Choosing $\bar\rho$ small enough that $(d/d\rho)W^* > 0$, $(d/d\rho)x^* < 0$, $(d/d\rho)\psi^* < 0$, and $(d/d\rho)\gamma^* < 0$ on $(0,\bar\rho)$ proves part (ii).

(iii). Suppose $1 < (v-1)\phi^w/\phi^f < \alpha$. Because $\psi \le \min\{\rho x^\alpha/\alpha, 1\} \le (\rho x^\alpha/\alpha)^{(\alpha-2)/\alpha}$, (22) gives $(\partial/\partial x)G \le x^{\alpha-2}[\frac{n-1}{n}\theta^2(\rho/\alpha)^{(\alpha-2)/\alpha} - (\alpha-1)\phi^f\rho] < 0$ for sufficiently large ρ. Because $G(0;\theta,\rho) > 0$ and $G(x;\theta,\rho) \to -\infty$ as $x \to \infty$, G has a unique root x, which uniquely maximizes $\widetilde{P}$. At this root, $(v-1)\theta \le \phi^f\rho x^{\alpha-1} \le (v-1)\theta + \frac{n-1}{n}\theta^2 x$, so $x \to 0$ and $\phi^f\rho x^{\alpha-1} \to (v-1)\theta$ as $\rho \to \infty$. Consequently, $(1+\rho\phi^w)x^{\alpha-1} - \theta - (\frac{n-1}{n})^2\theta^2\mathbb{E}[x\tau_i(x)]$ converges to $\theta[(v-1)\phi^w/\phi^f - 1] > 0$, so by the paragraph preceding Lemma 7, for sufficiently large ρ, $x = x^*(\theta,\rho)$ is the firm's unique optimum and $\gamma^* > \frac{n-1}{n}\theta x$.

Next, $u = \rho x^\alpha/\alpha = x\cdot\rho x^{\alpha-1}/\alpha \to 0$. Because $0 \le \rho(\partial/\partial\rho)\mathbb{E}[x(1-\tau_i(x))] \le x/\alpha$ (Lemma 3), at the optimum we have $\rho(\partial/\partial\rho)G \to -(v-1)\theta$ and $x(\partial/\partial x)G \to -(\alpha-1)(v-1)\theta$. Implicit differentiation of $G(x;\theta,\rho) = 0$ therefore gives $(\rho/x)(d/d\rho)x \to -1/(\alpha-1)$ and $(\rho/u)(d/d\rho)u = 1 + \alpha(\rho/x)(d/d\rho)x \to -1/(\alpha-1)$, so work intensity and burnout strictly decrease in ρ for sufficiently large ρ. Lastly, by Lemma 4, $W^*/n = \theta\mathbb{E}[x\tau_i(x)] - \phi^w\psi - R$ with $R = \psi/\rho + \frac{n-1}{2n}\theta^2\mathrm{Var}(x\tau_i(x))$. Because $u \to 0$, Lemma 3, $(\rho/x)(d/d\rho)x \to -1/(\alpha-1)$, and $\phi^f\rho x^{\alpha-1} \to (v-1)\theta$ imply that $(\rho/\mathbb{E}[x\tau_i(x)])(d/d\rho)\mathbb{E}[x\tau_i(x)] \to -1/(\alpha-1)$ and $(\rho/\psi)(d/d\rho)\psi \to -1/(\alpha-1)$, and that $\phi^w\psi/(\theta x) \to (v-1)\phi^w/(\alpha\phi^f)$, while $\psi/(\rho x) \le x^{\alpha-1}/\alpha \to 0$ and $0 \le (\partial/\partial x)\mathrm{Var}(x\tau_i(x)) \le 2x$ and $|\rho(\partial/\partial\rho)\mathrm{Var}(x\tau_i(x))| \le 4x^2/\alpha$ by Lemma 3. Together with $(\rho/x)(d/d\rho)x \to -1/(\alpha-1)$, the bounds on $\psi/(\rho x)$, $(\partial/\partial x)\mathrm{Var}(x\tau_i(x))$, and $\rho(\partial/\partial\rho)\mathrm{Var}(x\tau_i(x))$ imply $(\rho/x)(d/d\rho)R \to 0$. Therefore,

$$\frac{\rho}{n\theta x}(d/d\rho)W^* \longrightarrow -\frac{1}{\alpha-1}\left(1 - \frac{(v-1)\phi^w}{\alpha\phi^f}\right) < 0.$$

Choosing $\underline{\rho}$ sufficiently large that $(d/d\rho)x^* < 0$, $(d/d\rho)\psi^* < 0$, and $(d/d\rho)W^* < 0$ on $(\underline{\rho},\infty)$ proves part (iii).

□

Proof of Corollary 1. By Lemma 7, there exists $\bar{\rho} > 0$ such that, for every $\rho \in (0, \bar{\rho})$ and $\theta \in [1, \theta^m]$, the firm's optimal intensity x^* is the unique root of $G(\cdot\,; \theta, \rho)$ and $(\partial/\partial x)G < 0$ at x^*. Because $(\partial/\partial\theta)G = (v-1) + 2\frac{n-1}{n}\theta\mathbb{E}[x^*(1-\tau_i(x^*))] > 0$, the implicit function theorem gives $(d/d\theta)x^* > 0$. Because $(\partial/\partial x)\psi = \rho x^{\alpha-1}(1-\psi) > 0$ (Lemma 3), ψ^* also strictly increases in θ, as desired. □

Lemma 8. *(i) At any fixed exposure $\rho > 0$, the social design chooses*

$$x^S(\rho) = \max\left\{\left[\frac{\theta}{1+\rho\phi^w}\right]^{1/(\alpha-1)}, \left[\frac{v\theta}{1+\rho(\phi^w+\phi^f)}\right]^{1/(\alpha-1)}\right\}. \tag{25}$$

(ii) Its incentive is zero if $\rho[\phi^f - (v-1)\phi^w] \geq v-1$, and strictly positive otherwise.

Proof. (i). By Lemma 6, the implementable intensities are exactly those at least $[\theta/(1+\rho\phi^w)]^{1/(\alpha-1)}$, and this lower bound is implemented by $\gamma = 0$. By Lemma 3, the social objective per employee before mitigation spending satisfies

$$\begin{aligned}&(\partial/\partial x)\left\{v\theta\mathbb{E}[x\tau_i(x)] - (\phi^f + \rho^{-1} + \phi^w)\psi(x,\rho)\right\}\\ &\quad = [1-\psi(x,\rho)]\left[v\theta - \{1+\rho(\phi^w+\phi^f)\}x^{\alpha-1}\right].\end{aligned}$$

Since $1-\psi(x,\rho) > 0$ and $v\theta - \{1+\rho(\phi^w+\phi^f)\}x^{\alpha-1}$ changes sign once, from positive to negative, at $[v\theta/\{1+\rho(\phi^w+\phi^f)\}]^{1/(\alpha-1)}$, maximizing over implementable intensities gives (25).

(ii). The maximizer equals $[\theta/(1+\rho\phi^w)]^{1/(\alpha-1)}$ if and only if $\rho[\phi^f-(v-1)\phi^w] \geq v-1$. By Lemma 6, $\gamma(x,\theta,\rho) = 0$ at this bound and strictly increases in x above it. □

Proof of Proposition 4. (i). Fix θ and $\rho > 0$. We first show that $W(x,\theta,\rho,\gamma(x,\theta,\rho))$ strictly decreases in the implemented intensity x. Fix an implementable intensity $x > [\theta/(1+\rho\phi^w)]^{1/(\alpha-1)}$ and let $\gamma = \gamma(x,\theta,\rho)$. At the symmetric equilibrium, $(\partial/\partial x_i)u_i = 0$ for each employee i. For each coworker $j \neq i$, differentiating expected relative pay conditional on the other employees' outputs, as in the proof of Lemma 1, gives $\partial u_i/\partial x_j = -\frac{\theta}{n}(1-\psi)\mathbb{E}[(\gamma - y_i + \bar{y})_+ \mid \tau_j(x) = 1] < 0$, where the inequality is strict because, with positive probability, employee i burns out while all coworkers remain productive, in which case $y_i - \bar{y} < 0$. Also, symmetry gives $\mathbb{E}[y_i - \bar{y}] = 0$, so differentiating (2) with respect to γ yields $\partial u_i/\partial\gamma = \mathbb{E}[(y_i-\bar{y}) - (y_i-\bar{y}-\gamma)_+] = -\mathbb{E}[(y_i-\bar{y}-\gamma)_+] \leq 0$. Because $(\partial/\partial x)\gamma(x,\theta,\rho) > 0$ by Lemma 6, we have $\frac{1}{n}(d/dx)W = \sum_{j\neq i}\partial u_i/\partial x_j + (\partial u_i/\partial\gamma)(d/dx)\gamma < 0$.

Next, along $\gamma = \gamma(x,\theta,\rho)$, $\pi = (\pi + W) - W$. If $\gamma^S(\rho) > 0$, then by the proof of Lemma 8, $(d/dx)(\pi+W) > 0$ for $x < x^S(\rho)$ and $(d/dx)(\pi+W) = 0$ at $x = x^S(\rho)$. Since $(d/dx)W < 0$, it follows that $(d/dx)\pi > 0$ for $[\theta/(1+\rho\phi^w)]^{1/(\alpha-1)} < x \leq x^S(\rho)$. Every profit-maximizing intensity therefore exceeds $x^S(\rho)$. If $\gamma^S(\rho) = 0$, every implementable intensity is at least $x^S(\rho)$. The firm's profit objective has a maximum over implementable intensities because, for sufficiently large x, (21) holds, so $\pi/n = \widetilde{P}$, and $(\partial/\partial x)\widetilde{P} = (1-\psi)G < 0$ for large x. Lastly, $\gamma^F(\rho) \geq \gamma^S(\rho)$ and $\psi^F(\rho) \geq \psi^S(\rho)$ follow, with strict inequalities when $\gamma^S(\rho) > 0$, because both $\gamma(x,\theta,\rho)$ and $\psi(x,\rho)$ strictly increase in x, proving part (i).

(ii). Set $\underline{\theta} = \min\{2, \theta^m\}$ and fix $\theta \in [1, \underline{\theta}]$.

Step 1. Choose the cost thresholds so that $(v-1)\phi^w \geq \phi^f$ throughout the stated parameter region. By Lemma 8, the intensity that maximizes social welfare at each exposure is then $x^S(\rho) = [v\theta/\{1+\rho(\phi^w+\phi^f)\}]^{1/(\alpha-1)}$. Because

$1+\rho(\phi^w+\phi^f)\geq\max\{1,\rho\phi^w\}$, burnout under the social design satisfies $\psi^S\leq\rho x^S(\rho)^\alpha/\alpha\leq(v\theta)^{\alpha/(\alpha-1)}/(\alpha\phi^w)$. Because $x[1-\tau_j(x)]\leq x$ for each coworker j, the left-hand side of (20) is at least $\gamma-\frac{n-1}{n}\theta x$, so (20) and (25) give $\gamma^S\leq\frac{n-1}{n}\theta x^S+n[(1+\rho\phi^w)(x^S)^{\alpha-1}-\theta]/[(n-1)\theta]\leq\frac{n-1}{n}\theta(v\theta)^{1/(\alpha-1)}+n(v-1)/(n-1)$. Lastly, at $\gamma=\gamma^S(\rho)$, the social value per employee before mitigation spending, $[\Pi(\theta,\rho,\gamma)+W(\theta,\rho,\gamma)]/n$, is at most $v\theta\mathbb{E}[x^S\tau_i(x^S)]\leq v\theta x^S(\rho)$.

Step 2. For every incentive γ and induced intensity x, Lemmas 3 and 4 give

$$\Pi(\theta,\rho,\gamma)/n\leq\widetilde{P}(x;\theta,\rho)\leq(v-1)\theta\mathbb{E}[x\tau_i(x)]+\frac{n-1}{2n}\theta^2\mathbb{E}[(x\tau_i(x))^2]\leq c_\alpha\left[(v-1)\theta\rho^{-1/\alpha}+\theta^2\rho^{-2/\alpha}\right],\tag{26}$$

which does not depend on ϕ^w or ϕ^f and vanishes as $\rho\to\infty$. By Lemma 3 and Assumption 1, $\rho^{1/\alpha}\mathbb{E}[\tau_i(1)]$ converges to a positive constant and $\rho C(\rho)\to0$ as $\rho\to\infty$, so there exists ρ_0 such that $C(\rho_0)<(v-1)\mathbb{E}[\tau_i(1)]/2$, where the expectation here and below is evaluated at exposure ρ_0. If $1+\rho_0\phi^w\geq\underline{\theta}+\underline{\theta}^2$, then (21) holds at $(x,\rho)=(1,\rho_0)$, so by Lemmas 6 and 4, and because $\theta\geq1$, $\psi\leq1$, and $\mathrm{Var}(x\tau_i(x))\geq0$, implementing $x=1$ at exposure ρ_0 yields $\Pi/n-C(\rho_0)\geq(v-1)\mathbb{E}[\tau_i(1)]-\phi^f-C(\rho_0)>(v-1)\mathbb{E}[\tau_i(1)]/4>0$ for sufficiently small ϕ^f. Lastly, choose $\rho_1\geq\rho_0$ such that the right-hand side of (26) at $\theta=\underline{\theta}$ is below this positive lower bound for all $\rho>\rho_1$. Note that ρ_1 depends only on $\underline{\theta}$, v, α, and C.

Step 3. For $\rho\in(0,\rho_1]$, we have $\phi^f\max\{\rho,\rho^{1/\alpha}\}\leq\phi^f\max\{\rho_1,\rho_1^{1/\alpha}\}$, so for sufficiently small ϕ^f, Lemma 7 implies that the firm's optimal intensity at exposure ρ is the unique root $x^F(\rho)$ of $G(\cdot\,;\theta,\rho)$, implemented by an incentive greater than $\frac{n-1}{n}\theta x^F(\rho)$, and that the maximized profit per employee, $\widetilde{P}(x^F(\rho);\theta,\rho)$, is continuous in ρ because $(\partial/\partial x)G<0$ at $x^F(\rho)$. By (26), $2/\alpha<1$, and $\rho C(\rho)\to\infty$ as $\rho\to0$, the maximized profit per employee net of mitigation spending, $\widetilde{P}(x^F(\rho);\theta,\rho)-C(\rho)$, converges to $-\infty$ as $\rho\to0$. By Step 2, implementing $x=1$ at ρ_0 yields greater profit per employee net of mitigation spending than every design with $\rho>\rho_1$. Therefore, profit per employee net of mitigation spending has a maximum, and every maximizing design satisfies $\rho^F\leq\rho_1$ and $\gamma^F>\frac{n-1}{n}\theta x^F$. Lastly, $G(x^F;\theta,\rho^F)=0$ gives $x^F\geq[(v-1)/(\phi^f\rho_1)]^{1/(\alpha-1)}$ and $\rho^F(x^F)^\alpha/\alpha\geq(v-1)x^F/(\alpha\phi^f)$, so $x^F\to\infty$ and $\rho^F(x^F)^\alpha/\alpha\to\infty$ as $\phi^f\to0$.

Step 4. For $\rho\leq\rho_1$ and $\gamma=\gamma^S(\rho)$, Step 1 and $x^S(\rho)\leq[v\theta/(\rho\phi^w)]^{1/(\alpha-1)}$ give $\rho[(\Pi+W)/n-C(\rho)]\leq K-\rho C(\rho)$, where $K=(v\underline{\theta})^{\alpha/(\alpha-1)}(\phi^w)^{-1/(\alpha-1)}\rho_1^{(\alpha-2)/(\alpha-1)}$. Because $\rho C(\rho)$ is positive, continuous, and diverges as $\rho\to0$, it is bounded below by a positive constant on $(0,\rho_1]$, and because ρ_1 does not depend on ϕ^w, $K-\rho C(\rho)<0$ for all $\rho\leq\rho_1$ when ϕ^w is sufficiently large. As $\rho\to\infty$, $x^S(\rho)\to0$ and $\rho x^S(\rho)^\alpha\to0$, so Lemmas 3 and 4 and (25) give $[(\Pi+W)/n]/[v\theta x^S(\rho)]\to1-1/\alpha$ at $\gamma=\gamma^S(\rho)$, whereas $\rho x^S(\rho)\to\infty$ because $\alpha>2$, and $\rho C(\rho)\to0$. Therefore, $(\Pi+W)/n-C(\rho)$ at $\gamma=\gamma^S(\rho)$ is positive for large ρ and converges to zero as $\rho\to\infty$. The social welfare objective therefore has a maximum. Every maximizing design satisfies $\rho^S>\rho_1\geq\rho^F$ and has lower mitigation spending, $C(\rho^S)<C(\rho^F)$, because C strictly decreases.

Step 5. By Step 3, $\gamma^F>\frac{n-1}{n}\theta x^F\geq\frac{n-1}{n}x^F$, which diverges as $\phi^f\to0$, whereas Step 1 gives $\gamma^S\leq\frac{n-1}{n}\underline{\theta}(v\underline{\theta})^{1/(\alpha-1)}+n(v-1)/(n-1)$, independently of ϕ^f. Similarly, $\psi^S\leq(v\underline{\theta})^{\alpha/(\alpha-1)}/(\alpha\phi^w)$ by Step 1, which is small for large ϕ^w, whereas $\psi^F=1-\exp\{-\rho^F(x^F)^\alpha/\alpha\}\to1$ as $\phi^f\to0$ by Step 3. The lower bounds on γ^F and ψ^F and the upper bounds on γ^S and ψ^S hold uniformly over $\theta\in[1,\underline{\theta}]$ and all optimal designs. Lastly, choose $\underline{\phi}^w$ sufficiently large and $\overline{\phi}^f$ sufficiently small, with $(v-1)\underline{\phi}^w\geq\overline{\phi}^f$, so that $\rho^S>\rho^F$, $\gamma^S<\gamma^F$, and $\psi^S<\psi^F$ throughout the stated parameter region, as desired. □