Signaling Skill with Unreported Overtime Work

Juho Alasalmi* University of Konstanz
Susanne Goldlücke† University of Konstanz
Michelle Jordan‡ University of Konstanz

June 2022
Preliminary

Abstract

Requiring extra hours to get a job done signals low skills. With unobservable effort (hours of work), image concerned agents may prefer to underreport effort to hide low skills from the principal or themselves. We show how such "hidden overtime" can arise as a consequence of the optimal contract if the principal asks for reports but has no way to ensure that these reports are also correct. The effects of different monitoring systems and regulatory regimes are evaluated.

JEL classification: D91, D82, D86, K31
Keywords: self-signaling, self-deception, hidden effort, remote work

1 Introduction

Advances in information and communication technologies and the effects of the global COVID-19 pandemic have led to a change in the nature of work. Working outside the premises of the employer such as working from home or from rented office spaces has become more and more common. Telework exacerbates monitoring problems, which makes employers fear a decrease in workers' effort. However, at the same time, there is a growing concern that as working time gets more difficult to measure workers may put in longer hours. While this phenomenon of "hidden overtime" is not new,[1]it has received increased attention with the spread of teleworking. For example, ILO (2017) reports that teleworkers tend to work longer hours and more unpaid hours than workers working in the premises of their employers, where supplemental work from home is often

*juho.alasalmi@uni-konstanz.de
†susanne.goldluecke@uni-konstanz.de
‡michelle.jordan@uni-konstanz.de

[1]In the surveys of Rhode (1977) 55% of auditors, Alderman and Deitrick (1982) 67% of auditors, Kelley and Seller (1982) 33% of audit seniors, Lightner et al. (1983) 67% of accountants, Smith et al. (1995) 89% of tax professionals, Otley and Pierce (1996) 54% of audit seniors, Akers et al. (1999): 71% of accountants, Pierce and Sweeney (2003) 40% of auditors, Liyanarachchi and McNamara (2007): 49% of audit partners and managers, Barrainkua and Espinosa-Pike (2015) 55% of audit partners admitted having underreported their working hours.

motivated by "catching up on work" (ILO, 2017, p. 22). Some authors even speak of an "epidemic of hidden overtime" and call for legal regulation of working hours (Jones et al., 2021).

Employers already have an obligation to care for the well-being of their employees, which has recently led the European Court of Justice to determine that employers also have an obligation to record the actual working time of their employees (Judgment of 14 May 2019, case ECJ C-55/18). However, given the delegated nature of work and the difficulty of installing any kind of monitoring system, it is not clear whether such an obligation will succeed in overcoming the hidden overtime problem, and whether there might be unwanted side-effects.

To study these questions, it is important to understand the determinants of hidden overtime. Under-reporting of working hours has been documented to correlate with perceptions that under-reporting improves performance evaluations and career prospects, increases job satisfaction and leads to feeling better about oneself (Rhode, 1977; Kelley and Seller, 1982; Lightner et al., 1983; Akers and Eaton, 2003). The amount of under-reporting has also been found to correlate with feelings of incompetence (Barrainkua and Espinosa-Pike, 2015) and time pressure (Barrainkua and Espinosa-Pike, 2015; Otley and Pierce, 1996). We complement this empirical research with a theoretical model of hidden overtime. Motivated by the findings of this literature, completion time, image and career concerns, and monitoring play a prominent role in our model.

We study a simple labor relationship, in which a principal contracts with an agent who wants to be perceived as high-skilled by the principal or himself. The contract can specify a bonus based on the realization of task output and the agent's reported working time. The agent only successfully completes the task if he either has high skills or does costly overtime work. The principal does not observe the agent's skill and may not observe the actual working hours. By working unreported overtime hours the agent can thus hide low skills from the principal or even from himself, if he does not perfectly recall how long it took him to complete the task. Concealing overtime work may reduce the agent's payment, but results in a more competent (self-)image.[2]

We explore the consequences for the principal's optimal contract and examine potential channels through which the obligation to install a reporting system can have an effect. If there are no image concerns, the agency problems in this model lead to an under-provision of effort. The principal therefore potentially benefits from image concerns, which mitigate this under-provision. This is indeed the case if the benefit of a completed task exceeds the cost of working overtime. If image concerns are large but

[2]Our modeling of the agent's behavior can be interpreted in terms of a model of self-deception with explicit effort denial. This extends the formal literature in economic theory on self-signaling (Bénabou and Tirole, 2004; Bernheim and Thomadsen, 2005; Mijović-Prelec and Prelec, 2010; Bénabou and Tirole, 2006, 2011) with a mechanism that closely corresponds with the findings in the studies of self-deception in experimental and theoretical cognitive psychology (Quattrone and Tversky, 1986; Sloman et al., 2010; Fernbach et al., 2014). We show how such effort denial may manifest as hidden overtime.

working overtime is not efficient, then the image concerns may backfire and the agent works inefficiently long hours. In both these cases, there is hidden overtime, but only in the second case there would be an efficiency gain if overtime was revealed instead.

Regarding the obligation to record working time, we distinguish two cases, depending on how easy it is to manipulate the recording system. If the only possibility is to collect subjective reports of employees, who for example work from home or are impossible to monitor for other reasons, then an obligation to record hours worked has no effect since the agent may (self-)deceive with his reports. In contrast, if the agent has to be present at the facility or to log on to some technical system, then it should be feasible to prevent the agent from understating hours worked. We show that such a system always at least weakly increases welfare. However, we also argue that the principal already has sufficient incentives to install such systems.

In the next section, we further motivate our modeling assumptions and relate the model to two branches of theoretical literature, career concerns and self-deception. In Section 3, the basic model is presented. In Section 4, we first consider the different (self-)signaling equilibria that can arise for fixed contracts. Then we derive the contracts that are optimal for the principal under different regimes.

2 Literature

Hiding overtime seems on one hand to be motivated by performance evaluations and career prospects but on the other hand by feeling good about oneself and protecting one's self-esteem (Akers and Eaton, 2003; Sweeney and Pierce, 2006). We thus motivate agent's image concerns in our model as either stemming from the perceptions of the principal or the agent himself and relate our model to two branches of literature, career concerns and self-deception, respectively.

2.1 Career Concerns

When employers are not perfectly informed about their employees' characteristics, career paths may depend on various signals generated by the employees. This insight goes back at least to Spence (1973), who models education as a signal of skills to the labour market. Effort on the job, if observed, can work as a signal as well: In Akerlof (1976), workers in assembly lines of different speeds are compensated by the average output in their assembly line. This creates an incentive to pool with harder-working colleagues in faster assembly lines. Landers et al. (1996) model high effort as a signal of low disutility of effort: Working long hours improves labour market prospects since hard-working colleagues are desirable joint project partners. Sousa-Poza and Ziegler (2003) and Anger (2008) model high effort as a signal of high productivity by supposing that productivity and disutility from work correlate negatively.

Often output is more readily observable than effort. Our model, in which effort is unobservable and output is observable, also relates to the career concerns literature where an agent chooses unobservable effort to produce observable output interpreted as a signal about skills (e.g. Holmström (1982, 1999); Gibbons and Murphy (1992)). In these models, output, for a given skill, is a stochastic function of effort. As the employee and market symmetrically learn about the employee's unobservable skills, upward distortion in effort biases the output-generating-process, leading to more favorable inferences about the employee's skills and thus to higher wage offers.

Although in our model effort is unobservable and output takes the role of a signal our model is formally closer to the models of asymmetric information with deterministic signals.[3] However, while in e.g. Landers et al. (1996) workers wish to signal their employer that they are willing to put in long hours, we suggest that the workers may wish to signal high productivity by hiding the long hours that it took to produce a given output.[4]

2.2 Self-deception

People's willingness to take actions to retain positive self-image in the sense of a belief in high ability may arise from multiple sources: High self-image may have instrumental value for example as a commitment device in future wage bargaining (Hvide, 2002; Bénabou and Tirole, 2009) or as a boost to motivation to counteract present bias (Bénabou and Tirole, 2002, 2004). Self-image may have signaling value as high self-image reduces signaling costs when the agent tries to convince others about her high ability (Schwardmann and Van der Weele, 2019; Trivers, 2011). Finally, self-image may simply have consumption value (Schelling, 1987), for example as a direct value of self-esteem (Köszegi, 2006) or, insofar as high ability is rewarded with high income, as anticipatory utility of higher future consumption (Löwenstein, 1987).

People's ability to take actions to retain positive self-image requires imperfect recall. Such self-deception has been studied in the literatures of experimental and theoretical cognitive psychology. In the experiment of Quattrone and Tversky (1986), subjects who were told that a high tolerance of cold water is indicative of good future health tolerated cold water longer than subjects who were told the opposite. The majority of subjects denied that the cover story influenced their tolerance and increased their optimism about their future health. Those who admitted having tried to manipulate their tolerance to cold water were not as optimistic about their future health as others.

[3]Also Aron (1987) and Kőszegi and Li (2008) combine unobservable effort and asymmetry of information in a career concerns model. In Aron (1987) agent has private information about his disutility of effort whereas in Kőszegi and Li (2008) agent has private information about his marginal utility of income ("drive").

[4]Previously Sampson (2002) and Kőszegi and Li (2008) have studied how high observable effort may signal low productivity.

This sort of effort denial has later been replicated in the experiments of Sloman et al. (2010) and Fernbach et al. (2014). Fernbach et al. (2014) summarize "As people change their behavior to provide positive evidence for a desirable trait, they simultaneously deny doing so in order to enhance the diagnosticity of the evidence for the positive trait." (Fernbach et al., 2014, page 6).

Self-deception thus seems to require the simultaneous forgetting of the task difficulty and the effort exerted. Later ambiguity with respect to the task difficulty facilitates the malleability of beliefs about productivity and underestimation of exerted effort supports beliefs of high productivity. Self-deception is successful due to the uncertainty of whether the observable output is the result of task difficulty or effort provision. Reffett et al. (2014) experimentally study underreporting of time and indeed find that it is the time between exerting effort and reporting effort that facilitates underreporting pointing to the important role of memory.

That the agent can deny effort distinguishes our model from the formal models of self-signaling in economic theory (Bénabou and Tirole, 2004; Bernheim and Thomadsen, 2005; Mijović-Prelec and Prelec, 2010; Bénabou and Tirole, 2006, 2011). These models have not studied the denial of the action that produces the signals but the action itself has been taken to be the signal.[5] There, denial is with respect to an underlying trait. In contrast, in our model the signal is an outcome jointly caused by action and an underlying trait and denial is with respect to an action and an underlying trait.

3 The Model

We study a principal-agent relationship with hidden action and hidden information. The agent (he) can be interpreted as an employee or a self-employed or freelance worker and the principal (she) as an employer or a customer, respectively. Both agent and principal are risk-neutral. The agent has image concerns and is wealth-constrained such that payments to the agent must be non-negative.

The timeline is illustrated in Figure 1. At the start of the relationship, the principal offers a contract which the agent either accepts or declines. If the agent declines, both receive zero as their (material) outside option payoffs. If the agent accepts, he proceeds to production.

[5]Bénabou and Tirole (2004) and Bénabou and Tirole (2011) allow the signaling actions to be forgotten with exogenous probability. In their models, forgetting an action thus prevents self-signaling whereas in our model forgetting an action facilitates self-signaling.

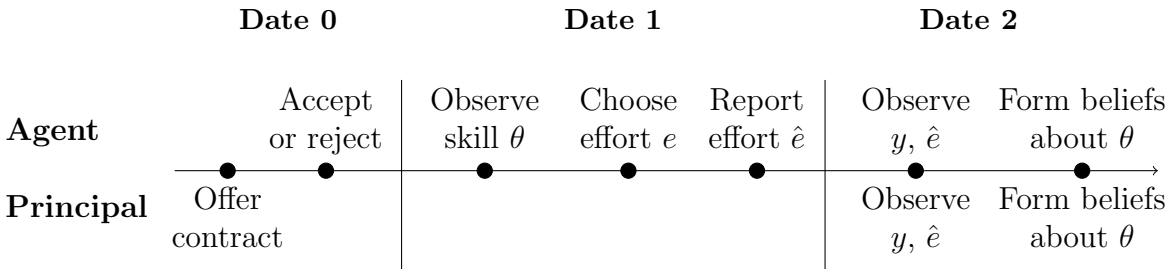

Figure 1: Timeline.

3.1 Production

The agent chooses effort $e \in \{e_L, e_H\}$ at cost $c(e)$. The cost of low effort is normalized to zero, while high effort has a cost of $c > 0$:

$$c(e) = \begin{cases} c & \text{if } e = e_H \\ 0 & \text{otherwise} \end{cases}. \tag{1}$$

We interpret effort as working hours and $e = e_L$ as 'working the contractual working hours' and $e = e_H$ as 'working overtime'.

Both the agent's skill and the exerted effort contribute to output $y \in \{y_L, y_H\}$, where $y = y_H$ means that the task is successfully completed, while $y = y_L$ means that the task was not successfully completed. Binary output is simple, but applicable to a large range of situations. Many tasks, like repairing a product or writing code for a certain purpose, indeed have a pass-fail-structure. Moreover, while output could be much more nuanced, the important assumption here is that performance is only measured in a binary way by comparing it to a fixed standard.

Effort and skill map in a deterministic way into output according to the following production function:

$$y(\theta, e) = \begin{cases} y_L & \text{if } \theta = \theta_L \wedge e = e_L \\ y_H & \text{otherwise} \end{cases}. \tag{2}$$

High-skilled agent can thus complete the task in normal time (e_L), whereas low-skilled agent succeeds if and only if he works overtime (e_H). This production function implies that the high-skilled agent always completes the task. With $p > 0$ it also captures the idea that the principal is hiring for a job that is feasible to complete without working overtime. Only some agents, i.e. those with skill θ_L, are not suited for the job, but even those can succeed by working overtime. The fact that these agents cannot do the principal's task without working overtime allows us to think of the prevalence of low-skilled agent $1 - p$ as the ex ante difficulty of the task.[6]

[6]If $1 - p$ is high, only few agents can finish the task in normal time. In this case, the task difficulty

3.2 Information

After having signed a contract the agent is confronted with a task and only then privately learns his skill or productivity in the task $\theta > 0$. Interpreting θ as task-specific productivity or difficulty of the task to the agent it is natural to assume that it is impossible to know in advance how much difficulties a task will cause, but that this becomes evident once the agent works on the task. The agent is high-skilled, $\theta = \theta_H$, with probability p and low-skilled, $\theta = \theta_L < \theta_H$, with probability $1-p$. Expected productivity is denoted by $\bar{\theta} = p\theta_H + (1-p)\theta_L$ and the range of productivity by $\Delta = \theta_H - \theta_L$. While the principal never observes θ, the type distribution is common knowledge.

While effort is hidden in the sense that the principal cannot condition contracts on effort we allow the principal to observe agent's effort with probability $1-\nu$. We thus imagine a situation where even though the principal can occasionally observe the effort agent exerts, agent's effort remains unobservable to the court and is thus nonverifiable. While contracts cannot be conditioned on principal's observed effort principal's inference about the agent's skill can.

To allow the interpretation of agent's behavior in terms of self-esteem management the agent needs to imperfectly recall the task difficulty θ and his exerted effort e. Otherwise agent's report and output cannot influence his later self-inference. We thus assume that the agent knows his skill θ at Date 2 but not anymore at Date 3. The task difficulty is thus revealed to the agent momentarily when working on the task and not accessible later.[7] Moreover, to model effort denial we let the agent in Date 3 recall the time or effort he spent on working on the task only with probability $1-\nu$.[8] For example, he might not perfectly recall the time he started working, how long the lunch break was, or how many times he interrupted work for private matters.[9] Our model is independent of whether we interpret the agent signaling to the principal or to himself or to both.

3.3 Contracts

Contracts cannot condition on agent's effort or task difficulty. Output, however, is observable and verifiable and can be contracted upon. Also, the contract can condition on agent's report on his working hours. Time cards, time sheets, time books and time-tracking software are all ways for the employer to ask the employee how long he

might be too high or the time forecasts too optimistic. With this interpretation it may be possible that the principal can influence $1-p$ by re-designing the task, so that p is endogeneous.

[7] For similar interpretations of imperfect recall in self-signaling models, see e.g. Bénabou and Tirole (2004, 2006, 2011) and Battaglini et al. (2005).

[8] Letting agent remember and principal observe both skill and effort with probability ν yields identical results since in all the equilibria we study, observation of effort also reveals skill.

[9] McNair (1991) and Sweeney and Pierce (2006) discuss on the perceptions on how only "good hours" and not "bad hours" should be reported and how there often is ambiguity to which hours are good and which are bad.

worked. Self-employed and freelance workers may bill their customers by the time it took to complete the work.

The output y and the agent's self-reported effort $\hat{e} \in \{e_L, e_H\}$ jointly determine the transfer $W(y, \hat{e})$ that the agent receives. The agent faces a limited liability constraint, which means that for all $y, \hat{e}$

$$W(y, \hat{e}) \geq 0. \tag{3}$$

Another interpretation of this constraint is that there is a minimum wage of zero. The set of contracts may be further constrained by regulation, which for example could require that overtime work should be adequately remunerated. However, such a constraint only applies to overtime that the employer agreed to. Hence, it also seems reasonable to assume that the principal does not have to allow all reports. This possibility is incorporated by allowing payments to be zero following an overtime report even if output is high. If output is low, the principal may deny overtime pay also for the reason that low output reveals that overtime work was actually not delivered.

We will focus on a class of contracts which stipulate a bonus b for a successfully completed task and in addition to this performance-dependent component an overtime payment w which depends on the agent's report. The overtime payment is paid if the agent completes the task ($y = y_H$) and reports overtime work ($\hat{e} = e_H$). Hence, we make the following additional restrictions on contracts: $W(y_L, \hat{e}) = 0$, $w = W(y_H, e_H) - W(y_H, e_L) \geq 0$ and

$$b = W(y_H, \hat{e}) - W(y_L, \hat{e}) \geq 0.^{10} \tag{4}$$

When the agent himself is the audience of his signal, we can interpret the effort report in the model in two ways. First, we can think of the effort report as soft information or soft reminders as in Bernheim and Thomadsen (2005), that is, as information that can be falsified or manipulated. Then the report is a concrete record that the agent later has access to while the memories about exerted effort have faded. Second, as a more cognitive interpretation, the effort reports can be interpreted not as written records, but as memories of exerted effort (Bénabou, 2015; Bénabou and Tirole, 2016). In this case, the agent can self-servingly encode the exerted effort into his memory and later selectively recall it when assessing her skills or potentially reporting her effort.[11]

[10] Among these restrictions, (3) and (4) are the only ones that are not without loss of generality. The assumption $w \geq 0$ pins down the meaning of messages if overtime is revealed.

[11] Later when reporting the agent would form a belief and might not take the recalled signal as face value. But if the agents pooled, all of them would report the same effort. If they did not pool they would report their true efforts. Thus all that changes is that in the equilibria where effort reports pool the reported effort is not only low or high effort, respectively, but the mean effort.

3.4 Payoffs

In addition to the transfers stipulated by the contract and effort disutility, the agent is motivated by (self-)image or career concerns. These image concerns may stem from various sources as discussed in Section 2. The exact origin of the value of image does not matter for our purposes and we summarize image concerns as a linear function that is increasing in inferred skill.

Overall, an agent of type $\theta \in \{\theta_L, \theta_H\}$ has utility:

$$u(\theta, e, \hat{e}) = W(y(\theta, e), \hat{e}) - c(e) + s(\nu E[\theta | y(\theta, e), \hat{e}] + (1 - \nu) E[\theta | y(\theta, e), e]), \quad (5)$$

where $s \geq 0$ is the weight on image concerns.[12] An agent with $s = 0$ would only care for material payoff and not for his reputation. The weight s is observed by the principal. With probability ν beliefs about skill are based on the report $\hat{e}$; with probability $1 - \nu$ beliefs are based on the effort actually exerted e.

The principal's profit is:

$$\pi(y, \hat{e}) = y - W(y, \hat{e}). \quad (6)$$

We let the material payoffs of both the agent and the principal from taking the outside option to be zero. The agent thus values his outside option at $s\bar{\theta}$, which is consistent with either remaining ignorant about skill or learning it in some other relationship.

Since the agent receives the same expected image gain when taking the outside option, the surplus that is generated in the work relationship is solely determined by the expected output and the expected effort costs. We denote the maximum expected surplus by

$$S^* = py_H + (1 - p) \max\{y_H - c, y_L\}. \quad (7)$$

To focus on the interesting cases in this model, we assume that image concerns are not too large. The maximum return from the project should still be larger than the maximal image gain.

Assumption 1. *Assume throughout that* $\nu s \Delta \leq y_H$.

This assumption ensures that the principal always offers a contract to the agent.

[12] The parameter s can thus be interpreted as a sum of two parameters, one measuring the importance of self-image, say s_1 and another measuring the importance of career concerns, s_2. if signaling to a competitive external job market, s_2 measures the value of production there. The parameter s_2 may also be determined by the performance evaluation scheme used by the principal and, thus, could be endogenized as a part of the contract. Similarly ν could vary across the potential receivers.

3.5 Solution Concept

The solution concept for the (self-)signaling game that arises for a given contract is Perfect Bayesian Equilibrium (PBE). This concept requires that the equilibrium strategies are sequentially rational given the player's beliefs and that the beliefs are consistent with the equilibrium strategies and Bayes' rule whenever possible.

A pure strategy for the agent assigns to each skill type an effort and a report. We denote such a strategy by $e(\theta) \in \{e_L, e_H\}$, $\hat{e}(\theta) \in \{e_L, e_H\}$. By $\mu(y, \hat{e})$ we denote the principal's (or agent's) posterior belief that the agent's skill is high.

There are many equilibria since PBE does not impose any restrictions on beliefs following signals that are not sent in equilibrium. Without any refinement, the principal is not restricted in his choice of equilibrium outcomes following a given contract. We assume, however, that the principal can only pick equilibria with reasonable belief systems.

Specifically, we assume that off-the-equilibrium-path beliefs have to fit the production technology and have to satisfy a "strong monotonicity" condition. By the former we mean that task failures generally have to be associated with low skills, i.e., $\mu(y_L, e_H) = \mu(y_L, e_L) = 0$ always holds. This directly follows from the commonly known production technology according to which any project failures must originate from low-skilled agents, no matter what the agent reports.[13]

By the latter we mean that in case of doubt normal time reports are attributed to high skills and overtime reports to low skills, i.e. off-the-equilibrium path $\mu(y_H, e_L) = 1$ and $\mu(y_H, e_H) = 0$. The reports in our model have a natural and exogenously given meaning as messages about hours worked. Since output is observable, such a report translates directly into a message about the skill type. When the task is completed and an agent deviates to $\hat{e} = e_L$, the report $\hat{e} = e_L$ has the obvious meaning "I am high-skilled". Since choosing high effort is strictly dominated for the high type, the report $\hat{e} = e_H$ similarly has the meaning "I am low-skilled". Our assumption on out-of-equilibrium beliefs is hence that unexpected reports are taken at face value when the task is completed. This choice of out-of-equilibrium beliefs is intuitive, and while it narrows down the set of equilibria, the equilibrium payoffs are not affected. Moreover, it would correspond to the D1 refinement if there were arbitrarily small lying costs.[14]

[13] Beliefs $\mu(y_L, e_H), \mu(y_L, e_L) > 0$ are not structurally consistent (Kreps and Wilson, 1982) as there does not exist a behavior strategy that would lead to $y = y_L$ with positive probability and yield $\mu(y_L, e_H) > 0$ or $\mu(y_L, e_L) > 0$, respectively, as a consistent belief.

[14] In Section 6, we study an extension with lying cost and use the D1 refinement to pin down equilibria. The equilibria that satisfy these restrictions here are then justified as the limits of equilibria in the game with lying costs as lying costs go to zero.

4 Analysis

We start with a characterization of the possible pure strategy equilibria of the (self-)signaling game that unfolds once the agent has accepted a given contract (w, b). Note first that there are no equilibria in which the high type works overtime e_H. For the high type, working overtime is costly, but generates no benefit. Payment and reputation depend only on output, which is the same for both effort levels, and his report, which he can choose independently of his effort. Thus, it is always strictly better to work normal time.

The cases that we consider are *hidden, false, revealed*, and *no overtime*. In the first three cases, the low-skilled agent works overtime. When overtime is hidden, the low type deflates his working time in his report, whereas with false overtime the high type inflates his working time. Under revealed overtime the agent reports truthfully. No overtime describes a situation in which the low type does not work overtime and the types are separated by output.[15]

For these four cases, we specify the conditions on contracts for which a specific equilibrium can arise. We verify when the agent is willing to participate in a contract that leads to the specific equilibrium and characterize the least cost contract with which the principal can implement this equilibrium. In Section 4.2, we then turn to finding the principal's optimal contracts.

4.1 Agent's Behavior

4.1.1 Hidden Overtime

By hidden overtime we refer to agent's equilibrium behavior where high type works normal time, low type works overtime and neither of the types report overtime. That is, $\hat{e}(\theta_L) = \hat{e}(\theta_H) = e_L$, $e(\theta_H) = e_L$ and $e(\theta_L) = e_H$. Both types complete the task and receive the performance-based transfer b. Moreover, the types pool such that following a task success and a normal-time-report both types obtain image $E[\theta|y_H, e_L] = \bar{\theta}$ if effort remains unobservable. If effort is observed, also skills are inferred. Consequently, on the equilibrium path an agent of type θ receives utility $b - c(e(\theta)) + \nu s\bar{\theta} + (1-\nu)s\theta$. Given our refinement, beliefs following a deviation to an overtime report or low output put probability one on the low type, $\mu(y_L, e_H) = \mu(y_L, e_L) = \mu(y_H, e_H) = 0$. With these beliefs, an agent of type θ who reported overtime would receive $b + w - c(e(\theta)) + \nu s\theta_L + (1-\nu)s\theta$, and a low type agent who deviated to low effort (irrespective of report) would

[15] There is a last equilibrium candidate in pure strategies in which the low-skilled agent completes the task but reports are reversed: a low-skilled agent reports normal time, whereas a high-skilled agent reports overtime. Consistently, overtime-reports are associated with high skills and normal-time-reports with low skills. But then it would be better for the low types to truthfully reveal their overtime work. Hence, this equilibrium does not exist. See also footnote 16. Equilibria that involve mixed strategies are considered in Section 4.2.

receive $s\theta_L$. Hidden overtime is an equilibrium whenever

$$\nu sp\Delta \geq w \tag{8}$$

$$\text{and } \nu sp\Delta \geq c - b. \tag{9}$$

Condition (8) ensures that deviating to reporting overtime is not worthwhile because the image loss of a higher self-report would outweigh the overtime pay. Note that overtime can be hidden even for positive overtime pay as long as image concerns are sufficiently important. Condition (9) ensures that the low type works overtime. Working overtime together with hiding it helps the agent to hide his lower competence and may generate a reputation benefit of $sp\Delta$. This expected image gain needs to offset the net costs $c-b$ of working longer hours.

The degree of unobservability and imperfect recall of effort ν and uncertainty about skill Δ mediate the effects of image concerns. The more likely principal observes effort, the less room agent has to influence principal's inference about skills by not reporting overtime. Also, the more difficult it is to the agent himself to keep track of his working hours, the more room there is to deny effort, and thus the more overtime remains hidden. The incentives for image management also depend on the degree of uncertainty there is about skill. When uncertainty about skills is small, there is not much room to influence perceptions by hiding overtime.

Image concerns do not matter for the participation constraint. The agent only accepts the contract if the transfer, given equilibrium behavior, at least covers his expected effort costs:

$$b \geq (1-p)c. \tag{10}$$

Let now (b^{HO}, w^{HO}) denote the contract that minimizes the cost of inducing hidden overtime. The overtime payment w^{HO} can be any $w \geq 0$ for which (8) holds. The performance bonus b^{HO} is the lowest transfer that satisfies both the incentive and participation constraints (9) and (10),

$$b^{HO} = \max\{(1-p)c, c - \nu sp\Delta\}. \tag{11}$$

Thus, the optimal performance-based compensation depends on the importance of image measured by the parameter s. Consider first the case that the maximal image gain is lower than the effort costs of overtime work, $c > \nu s\Delta$. In this case, the agent is not willing to work overtime without extrinsic incentives. Thus, the main challenge in this case is to make the low-skilled agent exert effort and this issue is more severe than making the agent sign the contract. If instead $c \leq \nu s\Delta$, the bonus b^{HO} is designed to cover the expected effort costs. The participation constraint is binding and the principal receives the whole expected surplus.

4.1.2 False Overtime

False overtime captures the possibility that the high-skilled agent exaggerates working time. In this equilibrium, the low type works overtime and the high type normal time, but both report overtime. That is, $e(\theta_L) = \hat{e}(\theta_L) = e_H$, $e(\theta_H) = e_L$ and $\hat{e}(\theta_H) = e_H$. Again neither the output nor the self-report gives away the type of the agent. Hence, the type-θ-agent's utility is $b + w - c(\theta) + \nu s\bar{\theta} + (1-\nu)s\theta$. Given off-the-equilibrium-path beliefs that satisfy our refinement $\mu(y_H, e_L) = 1$ and $\mu(y_L, e_H) = \mu(y_L, e_L) = 0$, the conditions for the false overtime equilibrium are:

$$w \geq \nu s(1-p)\Delta \tag{12}$$

$$\text{and } \nu sp\Delta \geq c - b - w. \tag{13}$$

Condition (12) tells us that the overtime compensation must outweigh the image gain that the agent may get by switching to a normal time report. Reporting normal time would create a more competent appearance, but also lower the transfer. Agents only report overtime if the appearance gain is small enough. Condition (13) is the incentive constraint for the low-skilled agent, who only works long hours if the benefit of preserving his (self-)image exceeds the costs of doing so, which are given by the effort costs net of the transfer.

Since again the participation constraint requires that expected effort costs are covered, the least costly way to implement false overtime satisfies the condition

$$w^{FO} + b^{FO} = \max\{(1-p)c, c - \nu sp\Delta, \nu s(1-p)\Delta\}. \tag{14}$$

If $\nu s\Delta \leq c$, the overtime payment and bonus are substitutes. The total transfer is the same as in the hidden overtime case,

$$b^{FO} + w^{FO} = b^{HO}.$$

The principal is then indifferent between the contracts (w^{FO}, b^{FO}) and (w^{HO}, b^{HO}), and the agent's payoff is also the same. In contrast, for $\nu s\Delta > c$, the contract that induces false overtime is more expensive, with

$$b^{FO} = 0 \text{ and } w^{F0} = \nu s(1-p)\Delta.$$

The difference to hidden overtime is due to the beliefs following an unexpected report. With hidden overtime, an unexpected overtime report triggers the belief that the agent is low-skilled, which is the optimal belief to sustain an equilibrium. With false overtime, an unexpected normal time report instead triggers the belief that the agent is high-skilled.

4.1.3 Revealed Overtime

Next consider under which conditions the high and low types complete the task in normal time and overtime, respectively, and also truthfully report this. That is, $e(\theta_L) = \hat{e}(\theta_L) = e_H$ and $e(\theta_H) = \hat{e}(\theta_H) = e_L$. In this case, the principal (or agent) learns the underlying effort and thus also the type. The low type's payoff is $b + w - c + s\theta_L$ and the high type's payoff is $b + s\theta_H$. Beliefs following low output must put all probability on the low type, $\mu(y_L, e_H) = \mu(y_L, e_L) = 0$. The revealed overtime equilibrium prevails whenever the overtime payment is equal to the image loss that an overtime report entails,

$$w = \nu s \Delta, \tag{15}$$

and the overtime payment and bonus together are high enough to cover the effort costs of the low-skilled worker,

$$b + w \geq c. \tag{16}$$

Participation requires

$$b + (1 - p)w \geq (1 - p)c, \tag{17}$$

which is implied by (16). Optimal overtime payment is pinned down by (15) for any contract that induces revealed overtime, including the least costly one:

$$w^{RO} = \nu s \Delta. \tag{18}$$

Given w^{RO}, the performance-based transfer

$$b^{RO} = \max\{0, c - \nu s \Delta\} \tag{19}$$

is optimal for the principal. If the limited liability constraint is not binding, which occurs if $\nu s \Delta \leq c$, the total expected transfer is again the same as in the previous two cases. It is thus the limited liability constraint that destroys the equivalence between the equilibria, making revealed overtime worse for the principal than hidden overtime in the case $\nu s \Delta > c$.

4.1.4 No Overtime

No overtime describes a situation in which both types work normal time, $e(\theta_L) = e(\theta_H) = e_L$. This working behavior implies a task success for the high type, but not for the low type. The agent's type can thus be inferred from the output. The easiest way for the principal to implement no overtime is to simply forbid it, i.e., to only allow the report $\hat{e} = e_L$. Alternatively, the principal can set $w^{NO} = 0$. In this case,

both normal and overtime reports are possible for the high type. Off-equilibrium-path beliefs are determined by our refinements: $\mu(y_L, e_L) = \mu(y_L, e_H) = \mu(y_H, e_H) = 0$ and $\mu(y_H, e_L) = 1$. There is then only one incentive constraint for this equilibrium, namely that the low type has to prefer working normal time to working overtime and pooling with the high type:

$$b + \nu s\Delta \leq c \tag{20}$$

If $s\Delta \leq c$, the principal can prevent overtime work and capture the complete surplus by setting

$$(b^{NO}, w^{NO}) = (0, 0). \tag{21}$$

The principal's profit then is $py_H + (1-p)y_L$. If $\nu s\Delta > c$, there is no contract for which the no overtime equilibrium exists.

4.2 Optimal Contracts

At date 0, the principal anticipates the agent's behavior and chooses a contract that maximizes her payoff among all contracts that satisfy the limited liability and monotonicity constraint. In standard problems of hidden information and hidden effort, additionally asking the agent for reports is not necessary. While this result does not, due to image concerns attached to reporting, immediately carry over to our setting with image concerns, we will show that it also holds here. Moreover, in our setting it is often possible to pin down the reporting strategy of the agent.

Proposition 1 (Optimal contracts)**.** *Suppose first that $\nu s\Delta > c$. The principal's optimal contract is the hidden overtime contract (w^{HO}, b^{HO}). Now suppose that $\nu s\Delta \leq c$. If $\nu sp\Delta < c - (y_H - y_L)(1-p)$, the no overtime contract (w^{NO}, b^{NO}) obtains. Otherwise, contracts (w^{HO}, b^{HO}), (w^{FO}, b^{FO}) and (w^{RO}, b^{RO}) are optimal.*

Proof. We first consider the benchmark that the principal does not ask for reports, which then also allows us to quickly compare the two cases. Let $W(y_H)$ and $W(y_L)$ be the payments in the cases of high and low output, respectively. The constraints on payments are $W(y_H) \geq W(y_L) \geq 0$. The cheapest contract that induces both types to pool on high output and accept the contract is $W(y_H) = \max\{c - s\nu p\Delta, (1-p)c\}$ and $W(y_L) = 0$. This is the hidden overtime contract, with payoffs $y_H - \max\{c - s\nu p\Delta, (1-p)c\}$ for the principal and $s\bar{\theta} + \max\{0, p(c - s\nu\Delta)\}$ for the agent. If $s\nu\Delta \geq c$ and $y_H - y_L \geq c$, there is clearly no better contract, since the principal receives the full surplus S^* in this case.

The least cost contract that induces $e(\theta_L) = e_L$ is the no-overtime contract $W(y_H) = W(y_L) = 0$. However, the principal can make the low type work normal time only if $s\nu\Delta \leq c$. If $s\nu\Delta \leq c$ and $y_H - y_L \leq c$, there is clearly no better contract as the principal again receives S^*.

Consider now the case $s\Delta \leq c$ and $y_H - y_L \geq c$. Inducing a mixed strategy is dominated by either full separation (no-overtime) or pooling (hidden overtime), so that we have to compare the principal's payoff in these cases. The pooling contract is optimal if $y_H - (c - s\nu p\Delta) \geq py_H + (1-p)y_L$. Rearranging yields $s\nu p\Delta \geq c - (y_H - y_L)(1-p)$. In this case the agent receives a positive rent of $p(c - s\nu\Delta)$.

Finally, consider the case $s\nu\Delta > c$ and $y_H - y_L < c$. While inducing a behavior strategy is typically dominated by one of the corner cases of no or full overtime, if no overtime is impossible, mixing between the two effort levels might be an outcome that the principal wants to implement. Let $\epsilon \in [0,1]$ be the probability with which the low type chooses high effort, and let $\tilde{p} = p + (1-p)\epsilon$. The low type is indeed indifferent between high and low effort if $W(y_L) = W(y_H) - c + s\nu\frac{p}{\tilde{p}}\Delta$. Because of the constraint $W(y_H) \geq W(y_L)$, $\tilde{p}$ takes its lowest value for $W(y_L) = W(y_H)$. In this case $\tilde{p} = \min\{1, \frac{s\nu p\Delta}{c}\}$. The agent has to be compensated for the increase in working time so that the principal receives $y_L + \tilde{p}(y_H - y_L) - (\tilde{p} - p)c$. If $sp\Delta < c$ this is equal to $y_L + \frac{sp\Delta}{c}(y_H - y_L - c) + cp$ else it is again the payoff from the hidden overtime contract $y_H - (1-p)c$. If $y_H \geq (1-p)c$, which follows from Assumption 1, these contracts are better than no contract. In the mixing contract, inefficient overtime work occurs with some probability, and if it occurs, it is hidden.

As a second step, we study contracts $W(y, \hat{e})$ that condition on reports. Suppose $\nu s\Delta > c$. With revealed and false overtime the principal can maximally get $y_H - (1-p)\nu s\Delta$ which is strictly smaller than what she can get with hidden overtime, i.e. $y_H - (1-p)c$. Thus, out of the contracts that make the low type work overtime, the principal prefers the hidden overtime contract (w^{HO}, b^{HO}). With $\nu s\Delta > c$ the no overtime equilibrium cannot occur. Suppose $\nu s\Delta \leq c$. In this case, the principal is indifferent between the contracts that induce overtime work (w^{HO}, b^{HO}), (w^{FO}, b^{FO}) or (w^{RO}, b^{RO}), which all yield profit $y_H - c + \nu sp\Delta$.[16]

We consider here also the possibility of mixing between reports. Since reports are cheap talk, there can for example be a "babbling" equilibrium, in which the types mix with equal probability among the two reports and reputation is always equal to the expected skill. However, arbitrarily small lying costs would destroy these equilibria. In addition, it is straightforward to show that among all contracts that make the agent indifferent between the two reports, the revealed overtime is optimal for the principal. If the agent produces low output, reports are not pinned down because the type is already revealed by output. Moreover, following high output, our refinement ensures

[16]There is a last equilibrium candidate in pure strategies in which the low-skilled agent completes the task but reports are reversed. Consistently, overtime-reports are associated with high skills and normal-time-reports with low skills. This inverse revealed overtime would result as an equilibrium following a contract with $w = -\nu s\Delta$. Hence, this equilibrium is not consistent with our assumption $w \geq 0$ at least if $s > 0$ (and for $s = 0$ working overtime is not part of the optimal contract). Note also that this strategy is never an equilibrium strategy for arbitrarily small lying costs, no matter how the contract is adjusted.

$\mu(y_H, e_L) = 1$. Hence, in any mixed effort equilibrium, overtime must remain hidden, and in the no-overtime equilibrium arbitrarily small lying costs would similarly result in the normal time report. □

Asking for reports does not increase principal's profit. However, revealing overtime by asking for reports can be part of an optimal contract even if $w > 0$ if image concerns are not too high. In the absence of image concerns, all strictly positive overtime premiums simply lead everyone to report overtime. An image concerned agent, in contrast, is discouraged by the negative signal an overtime report emits and is thus not as eager to falsely report overtime. In Section 6, we further show that with arbitrarily small lying costs revealing overtime can be strictly preferred by the principal.

When image concerns are not important and principal is indifferent between the agent revealing or hiding overtime. Inducing hidden overtime may thus not benefit the principal. Indeed, revealing overtime does not reduce principal surplus. While when revealing overtime the principal has to pay overtime premiums w, the wages b are lower. Revealing overtime thus leads to more effective allocation of transfers across types. On the other hand, inducing hidden overtime while reducing the overtime payments w requires higher wages b to attract workers. Image-concerned agents expect they might end up working hidden overtime and thus require higher wages.

When image concerns are important, it is in the principal's interest to keep overtime hidden and the optimal contract induces hidden overtime. On one hand, revelation of overtime requires large overtime premium and is thus very expensive. On the other hand, image concerns constitute a cheap way of providing incentives for effort provision and the principal can take advantage of this by inducing hidden overtime. This is particularly true in the hidden overtime equilibrium, in which any deviation would result in a reputation as being low-skilled. Moreover, pooling the two types allows the principal to reduce the expected agent's rent to zero despite the limited liability constraint.

We are also interested in the welfare consequences of the principal's optimal contract as characterized by Proposition 1.

Corollary 1 (Welfare)**.** *If working overtime is efficient ($y_H - y_L \geq c$), then the surplus and principal's payoff are weakly increasing in the strength of the image concerns $s\nu\Delta$. The agent receives strictly positive rent $p(c - \nu s\Delta)$ over his outside option payoff if and only if $c - (y_H - y_L)(1 - p) \leq \nu sp\Delta < c$. If working overtime is inefficient ($y_H - y_L < c$), then the surplus and principal's payoff are weakly decreasing with $s\nu\Delta$. The agent's payoff equals his outside option payoff.*

Proof. Suppose $y_H - y_L \geq c$. By Proposition 1 the agent provides sub-optimal effort in the no-overtime equilibrium for any $s\nu\Delta < \frac{c-(y_H-y_L)(1-p)}{p}$. In this parameter range, which may also be empty, the principal receives the surplus $py_H + (1 - p)y_L < S^*$

and the agent receives his outside option. For $c > s\nu\Delta \geq \frac{c-(y_H-y_L)(1-p)}{p}$, the efficient outcome obtains. The principal receives $y_H - c + \nu sp\Delta > py_H + (1-p)y_L$ and the agent in expectation $p(c - \nu s\Delta)$ in addition to his image utility $s\bar{\theta}$. For $s\nu\Delta \geq c$, the principal receives S^*. Hence, the principal's payoff is at a maximum while the agent only receives his outside option payoff in expectation.

Suppose $y_H - y_L < c$. If $\nu s\Delta \leq c$, the principal implements the no-overtime contract, which does not make any positive transfer to the agent, leaving the principal with the full surplus S^*. If $\nu s\Delta > c$, the agent works too much. The principal has to compensate the agent for the cost of working overtime in expectation, so that the agent always receives his outside option payoff. The principal's payoff is the remaining surplus which is however less than the optimal surplus:

$$y_L + \min\{1, \frac{s\nu\Delta p}{c}\}(y_H - y_L - c) + cp < S^*.$$

This payoff is weakly decreasing in $s\nu\Delta$. □

Image concerns may either decrease or increase the inefficiency that arises in delegation. If low type's overtime is efficient, image concerns alleviate inefficiency. If low type's overtime is inefficient, image concerns aggravate inefficiency.

When low type's overtime work is efficient and image concerns are not too important, there is the usual result of hidden action that the agent provides sub-optimal effort. Image concerns, however, alleviate this inefficiency. In the hidden overtime equilibrium image concerns motivate hidden effort provision and thus alleviate moral hazard. In the revealed overtime equilibrium image concerns discourage false overtime reporting and thus allows the principal to increase overtime pay to motivate overtime work.

When low type's overwork is inefficient and image concerns are not too important low type's low effort provision is efficient and, under the optimal contract, only high type produces. However, when image concerns are important, the principal is not able to elicit the information about task difficulty and cannot thus produce without possibility of overtime work. Thus, principal's choice is between both type producing high output or not offering a contract at all. Since efficiency requires only the high type to produce, there is either too little or too much effort. If costs relative to the high output are high, that is if $y_H < (1-p)c$, the principal does not offer a contract and there is no production. However, if $(1-p)c < y_H < c + y_L$, the agent always produces high output and there is thus overwork.[17] The principal is not able to separate high and low skill agents and thus cannot produce high output only when high type producing

[17]While the standard agency problem is one of underprovision of effort, there are a few contributions have also identified cases in which the optimal contract leads to overwork. Reasons are countervailing incentives (Lewis and Sappington, 1989), hidden information with limited liability and contractible effort (Goldlücke and Schmitz, 2018), a salience bias which makes an agent focus too much on a potential bonus (Römeis et al., 2022).

high output is efficient. Low-skilled agent either does not work or works too much, but it is the principal who is hurt by this inefficiency. The agent rationally anticipates the increased effort and therefore will only accept the contract if he is compensated for it.

Agent's individual rationality bounds principal's profit above by S^*. By inducing hidden overtime, the principal cannot thus capture excessive surplus in the sense of exceeding S^* and, in this sense, cannot exploit the agent. As the agent expects to potentially work hidden overtime, this is compensated in the performance wage to satisfy participation constraint.

However, image concerns increase the share of the surplus that the principal captures. The agent receives more than his outside option only for intermediate image concerns and if working overtime is efficient. In this case, encouraging effort in the presence of limited liability requires a relatively large bonus, but since the agent is partly motivated by image concerns, this payment is not so large that inducing overtime is no longer optimal. When image concerns are very large, the agent is again only paid according to his outside option. This means that a low-skilled agent does not receive a full (monetary) compensation for his overtime work. There might hence be room for regulation here that aims at deterring this kind of ex-post unpaid overwork. However, the agent's cost is covered in expectation and he is partly compensated by the image gain.

5 Regulation

While simply requiring reports is not likely to automatically have an effect, the European Court of Justice has specified some minimal requirements on the recording system in its 2019 ruling. Working time is supposed to be recorded with an "objective, reliable and accessible system" (ECJ, C-55/18, par. 60). Moreover, the European Court probably expects national authorities to monitor and enforce compliance. Our basic model corresponds to a situation in which a recording system is easily manipulated. This will be the case for example if employees work from home. As was shown in Proposition 1, in this teleworking case an obligation to report hours worked has no effect since the agent may (self-)deceive with his reports.

In the following, we will explore potential channels for a recording system to have some effect. We will first consider the most optimistic assumptions on data availability, namely that a perfect recording system is available which cannot be manipulated or that truthful reports can be enforced by regular investigations by some higher authority. We then turn to the more realistic case that some manipulation is always possible. Deterring downward reports is arguably easier than detecting upward distortions. For this reason, we will ask whether a recording systems that can prevent hidden overtime would be beneficial to the agent/for welfare.

5.1 External Enforcement of Reports

Making the agent reveal the truth about effort acts only as an additional constraint and is never uniquely optimal for the principal. If asking for the reports had even a tiny cost for the principal, she would strictly prefer not to install such a cheap talk recording system. An obligation to install such a recording system leaves principal's and agent's payoff the same, except for any costs associated with the system. While reports on working time alone do not guarantee the revelation of overtime work, the policy-maker can make additional requirements. On might think that an obligation to install a recording system might have an effect if the court imposes also a constraint on contracts that the principal has to adequately remunerate overtime work. However, hidden overtime is consistent with some compensation for overtime work as long as (8) is satisfied.

5.2 Perfect Monitoring

We first consider the benchmark of a perfect monitoring system. If the agent never lied (to himself or the principal), a simple reporting system would have this property.

Proposition 2 (Perfect monitoring)**.** *Assume a monitoring system, which makes effort choice observable and verifiable, was available at cost $k > 0$. Such a system would allow the principal to implement the efficient outcome and receive the full surplus. If the increase in efficiency is larger than the cost, the principal installs the system.*

Proof. If effort is observable and verifiable, then the contract $W(y, \hat{e})$ can be written directly for effort $\hat{e} = e$. Consider the contract $W(y_H, e_H) = c$ and $W(y, e) = 0$ for all other cases. If the high-skilled agent produces y_H in normal time, it is now impossible for the low type to pool with the high type. With a compensation of c, the low skilled type is indifferent between working overtime and working normal time. The same holds for the high type, who always receives $s\theta_H$. Hence, the principal will implement overtime work if and only if $y_H \geq c$. Her payoff is S^*, the agent receives his outside option.

Now consider the principal's incentives to install such a perfect monitoring system. Let S^{NR} denote the surplus that is created without such a system by the contract characterized in Proposition 1, and let π^{NR} be the principal's payoff in this situation. It is efficient to install the system if $S^* - k > S^{NR}$. However, this inequality implies $\pi^{NR} \leq S^{NR} < S^* - k$, which is the principal's payoff if she installs the system. This means that the principal would voluntarily install the monitoring system if it is socially beneficial to do so. A legal obligation to install it would hence either have no effect, or lower welfare. □

Thus, if installing a perfect monitoring system was cheap enough to be socially beneficial, no external obligation would be needed. Since the principal is able to capture

the total surplus with such a system, her incentive to install it are already excessive.[18] If the principal does not voluntarily install the monitoring system, it must be the case that the costs of installing it outweigh the efficiency gain. The only reason for a policymaker to wish for such a regulation would be to always ensure adequate monetary compensation for overtime work.

5.3 External Enforcement of Truthful Reports

A policymaker might want to incentivize the principal to establish a work environment that reveals overtime work. One obvious possibility is to randomly investigate whether self-reports are truthful and impose a fine on principals whenever they tolerated deceptive self-reports.

Suppose that with probability κ there is an investigation which verifies the truthfulness of self-reports. Whenever self-reports are untruthful, the principal must pay a fine F. We assume that the fine is sufficiently large to make the principal comply, e.g. $(1-p)\kappa F \geq S^*$. In this case, the fine is never paid and the principal implements revealed overtime or no overtime.

Proposition 3. *Assume that the revealed overtime equilibrium is enforced. This policy only has an effect if $s\Delta > c$. If $(1-p)c < y_H < (1-p)s\Delta$, welfare decreases as no contract is written anymore. Else, the agent receives more of the surplus than with hidden overtime, but welfare also decreases if $y_H - y_L < c$.*

Proof. Suppose first that $s\Delta \leq c$. If $y_H - y_L \geq c$ and $c - (y_H - y_L)(1-p) \leq sp\Delta$, the hidden, false, and revealed overtime contracts are all equivalent and nothing changes. If $y_H - y_L \leq c$ and also if $y_H > c$ and $sp\Delta < c - (y_H - y_L)(1-p)$, the no overtime contract (w^{NO}, b^{NO}) still obtains and nothing changes.

Now suppose that $s\Delta > c$. Revealed overtime requires $w^{RO} = s\Delta$ such that the principal's payoff is $\pi^{RO} = y_H - (1-p)s\Delta$. If $(1-p)c < y_H < (1-p)s\Delta$, the rule forces the firm to shut down. Assume now $y_H > (1-p)s\Delta$. The agent receives $s\bar{\theta} + (1-p)(s\Delta - c)$, which is more than without regulation. If $y_H - y_L < c$, the outcome is inefficient, the agent works too much.

□

A policy-maker who is interested in improving the agent's well-being may thus want to make the principal create a work environment that discourages deceptive reports. However, such an intervention never increases and sometimes reduces welfare.

[18] In fact, there are even cases in which she installs it although the outcome is already efficient. This is the case when the agent receives a rent, in the parameter range $y_H - y_L > c > s\Delta > \frac{c-(y_H-y_L)(1-p)}{p}$ and $0 < k < pc - s\Delta$.

In practice, it is not likely that a labor inspectorate will monitor firms on a regular basis, if at all. The monitoring problems should indeed be larger for an external authority or a worker's council than for the employer itself. In particular, the false overtime equilibrium is very unlikely to be detected. In the following, we make the more realistic assumption that every monitoring system is imperfect and can be manipulated by reporting more hours than actually worked.

5.4 Imperfect Monitoring that Prevents Underreporting

Given the delegated nature of work, it seems that every recording system must remain imperfect. In this subsection, we consider the case that in order to do his work, the agent has to be present at the facility or to log on to some technical system. In this case, the agent can easily report higher but not lower working time than the actual number of hours.

Proposition 4. *Assume that understating hours worked is not possible. If* $s\Delta \leq c$ *nothing changes, only that the hidden overtime contract is never offered. If* $s\Delta > c$ *a revealed overtime equilibrium with contract* $(0, c)$ *obtains if* $y_H - y_L \geq c$*, otherwise the no overtime contract* (b^{NO}, w^{NO}) *results. Thus, efficiency increases and the low-skilled agent is protected from overwork.*

Proof. For the high type it is still strictly dominant to work normal time. Since it is impossible to lie downwards, the hidden overtime equilibrium cannot exist anymore. First consider $y_H - y_L \leq c$. A zero payment contract would now lead to the agent working normal time, since mimicking the high type is no longer possible for the low type. Note that we assumed in the no-overtime equilibrium that the high-skilled agent, who is indifferent between high and low report, tells the truth. Alternatively, the principal simply forbids overtime. With this monitoring system, he can make sure that the agent works only normal time. Hence, if $s\Delta > c$, efficiency goes up and there is no overwork anymore. Now consider the case $y_H - y_L \geq c$. The false overtime (b^{FO}, w^{FO}) of section 4.1 requires the same conditions as before. The revealed overtime equilibrium now requires $w \leq s\Delta$ and $b + w \geq c$. Consider first the case that $\Delta s \geq c$. The revealed overtime contract $(0, c)$ gives the principal the full surplus S^* which is strictly larger than her profit with false overtime, $y_H - (1-p)s\Delta$. If $s\Delta < c$, the revealed overtime contract (w^{RO}, b^{RO}) and false overtime contract (w^{FO}, b^{FO}) are the same as before and equivalent. Hence, nothing changes in this parameter region. □

A recording system that deters underreporting thus increases efficiency. When image concerns are high, $s\Delta > c$, it would thus be better if the agent worked at the facility or had to log on some technical system, because this makes underreporting impossible. If overtime work is efficient, the principal gets the whole surplus like in the "no regulation"

case, but the low-skilled agent is adequately paid for his overtime work. He receives c instead of only $(1-p)c$.

6 Lying Costs

In Section 4.2, we concluded that if the reports are costless, the principal prefers not to install a system to record cheap talk. However, if effort reports correlated with the hidden effort, they would potentially be valuable to the principal. Incentivizing effort with the performance pay b is expensive to the principal due to the rent that the high type collects. Information on the hours actually worked allows the principal to target the payments toward incentivizing the overtime work of the low type thus decreasing the total payment.

Here we study how the principal may be able to incentivize and reveal overtime with the overtime pay w. While the revelation of overtime may increase the efficiency of payments, it clearly comes with increased overtime payments. The principal's choice of whether to reveal or hide overtime is thus that of between information and better allocation of payments or ignorance and savings in overtime compensations.

In setting the overtime pay that reveals the hours worked, the principal has to balance between incentivizing low type's truthful reporting and disincentivizing high type's overreporting. Indeed, in our benchmark model the revelation of overtime is restricted by the high type's incentives of overreporting and so much so that the overtime pay cannot be set high enough for the better allocation of payments to dominate hiding overtime. Stricter constraints on overreporting hours might increase the principal's leeway in targeting the compensation toward incentivizing overtime work of the low type and away from the rents of the high type.

Thus, we now consider the possibility that given an effort choice, reports are not cheap, but, as a reduced form approach, subject to direct lying costs. Let the agent's payoff be

$$u(\theta, e, \hat{e}) = W(y(\theta, e), \hat{e}) - c(e) + sE[\theta|y(\theta, e), \hat{e}] - \underline{l}\mathbb{1}(e > \hat{e}) - \bar{l}\mathbb{1}(e < \hat{e}) \tag{22}$$

with $0 \leq \underline{l} \leq \bar{l} < c$. We allow asymmetric lying costs: Social conventions may, for instance, judge underreporting as less reprehensible as overreporting.[19] For convenience, we set $\nu = 1$.

[19]While Ponemon (1992) find that that higher level of moral reasoning inhibits underreporting pointing to the existence of lying costs in underreporting Barrainkua and Espinosa-Pike (2015) find that underreporting of working hours is often considered neither unethical or ethical. Overreporting or "time theft", on the other hand, is usually considered a crime (Snider, 2001; Henle et al., 2010; Harold et al., 2021).

6.1 Off-the-equilibrium Path Beliefs

Lemma 1. *Suppose* $0 = \underline{l} < \bar{l}$ *or* $0 < \underline{l} \leq \bar{l}$. *D1 (Cho and Kreps, 1987) restricts* $\mu(\theta_H|\bar{y}, e_H) = 0$ *in Hidden Overtime and* $\mu(\theta_L|\bar{y}, e_L) = 0$ *in False Overtime.*

Proof. Let $u^*(\theta)$ denote the expected payoff of a type θ sender and let

$$D(\hat{e}, \theta) = \{\mu : u(\theta, e, \hat{e}, \mu) > u^*(\theta)\}$$

be the set of pure-strategy inferences that lead to payoffs at least as great the equilibrium payoff for player θ. Behavior strategies $(e^*, \hat{e}^*)$ together with beliefs μ^* satisfy D1 if for any unsent message $\hat{e}$, if $D(\hat{e}, \theta) \subset D(\hat{e}, \theta')$ (proper subset), then $\mu^*(\theta) = 0$.

Suppose $0 = \underline{l} < \bar{l}$ or $0 < \underline{l} \leq \bar{l}$. Consider hidden overtime. We have to show that $D(e_H, \theta_H) \subset D(e_H, \theta_L)$. Suppose $\mu \in D(e_H, \theta_H)$, then

$$\begin{aligned}
&\mu \in \{\mu : u(\theta_H, e_L, e_H, \mu) > u^*(\theta_H)\} \\
\iff &u(\theta_H, e_L, e_H, \mu) > u^*(\theta_H) \\
\iff &s\hat{\theta}(\mu) + w > s\bar{\theta} + \bar{l} \\
\implies &s\hat{\theta}(\mu) + w > s\bar{\theta} - \underline{l} \\
\iff &u(\theta_L, e_H, e_H, \mu) > u^*(\theta_L) \\
\iff &\mu \in \{\mu : u(\theta_L, e_H, e_H, \mu) > u^*(\theta_L)\} \\
\iff &\mu \in D(e_H, \theta_L).
\end{aligned}$$

We thus have $D(e_H, \theta_H) \subseteq D(e_H, \theta_L)$. To show that $D(e_H, \theta_H) \subset D(e_H, \theta_L)$, let μ satisfy $s\hat{\theta}(\mu) + w = s\bar{\theta} + \bar{l}$. Then $s\hat{\theta}(\mu) + w > s\bar{\theta}$ and thus $\mu \in D(e_H, \theta_L)$ but it is not true that $s\hat{\theta}(\mu) + w > s\bar{\theta} + \bar{l}$ and thus $\mu \notin D(e_H, \theta_H)$. Hence, $D(e_H, \theta_H) \subset D(e_H, \theta_L)$. Then, by D1, $D(e_H, \theta_H) \subset D(e_H, \theta_L)$ gives us $\mu^*(\theta_H) = 0$. For False overtime, show that $D(e_L, \theta_L) \subset D(e_L, \theta_H)$. The argument is similar as above and gives, $\mu^*(\theta_L) = 0$. □

This refinement is quite strong: whenever some type would always benefit a little more from a deviation to an out-of-equilibrium signal, then the receiver, were he to observe this out-of-equilibrium-signal, must believe that it is infinitely more likely that it must have been sent by this type. In this model, it should mean that no matter how small the lying costs, the belief must put probability 1 on the type that doesn't have to lie.

In the hidden overtime, the gain from a deviation for a low type for an off-equilibrium path belief z is $w - s(\bar{\theta} - z) + \underline{l}$ and for a high type $w - s(\bar{\theta} - z) - \bar{l}$. The gain is thus larger for the low type and D1 assigns belief $z = \theta_L$. In the False overtime, the gain from a deviation for a low type for an off-equilibrium path belief z is $s(z - \bar{\theta}) - w - \underline{l}$ and for a high type $s(z - \bar{\theta}) - w + \bar{l}$. The gain is thus larger for the high type and D1 assigns belief $z = \theta_H$.

Intuitively, in Hidden overtime, if the low type deviates to revealing his overtime, he stops lying whereas if the high type deviates to overreporting he starts lying. Thus, the deviation is more costly to the high type. In False overtime, if the high type deviates to low report, he stops lying whereas if the low type hides his overtime he starts lying. Thus, the deviation is more costly to the low type. All deviations are thus interpreted as deviations toward truthful reporting.

6.2 Agent's Problem

The incentive compatibility constraints for report and effort, respectively, to induce hidden overtime are

$$sp\Delta \geq w + \underline{l}, \tag{23}$$

$$sp\Delta \geq c - b + \underline{l}, \tag{24}$$

and the participation constraint $b \geq (1-p)(c+\underline{l})$. Low type's equilibrium path payoff is $-c + s\bar{\theta} + b - \underline{l}$ and high type's $s\bar{\theta} + b$.

The incentive compatibility constraints for report and effort, respectively, to induce false overtime are

$$s(1-p)\Delta \leq w - \bar{l}, \tag{25}$$

$$sp\Delta \geq c - b - w, \tag{26}$$

and the participation constraint $b + w \geq p\bar{l} + (1-p)c$. Low type's equilibrium path payoff is $-c + s\bar{\theta} + b + w$ and high type's $s\bar{\theta} + b + w - \bar{l}$.

The incentive compatibility constraints for report and effort, respectively, to induce revealed overtime are

$$s\Delta - \underline{l} \leq w \leq s\Delta + \bar{l}, \tag{27}$$

$$b + w \leq c, \tag{28}$$

and the participation constraint as without lying costs as there is no lying on the equilibrium path. Low type's equilibrium path payoff is $-c + s\theta_L + b - w$ and high type's $s\theta_H + b$. Lying costs loosen the condition for revealed overtime. Downward lying costs $\underline{l}$ incentivize the low type's reveal of overtime and the upward lying costs $\underline{l}$ disincentivize the high type's overreporting.[20]

With lying costs there is a unique no overtime equilibrium where both types exert and report low effort. Since lying costs are not incurred in such an equilibrium the incentive compatibility conditions remain as without lying costs.

[20]Since $\bar{l} < c$ the high type never wants to work overtime to report overtime without lying.

6.3 Principal's Problem

Lemma 2. *The least cost contract that induces*

(i) Hidden Overtime satisfies $0 \leq w^* \leq sp\Delta - \underline{l}$ *and* $b^* = (1-p)(c+\underline{l})$ *when* $c < s\Delta - \underline{l}$ *and* $b^* = c + \underline{l} - sp\Delta$ *when* $c \geq s\Delta - \underline{l}$ *and yields profit*

$$\pi^{HO} = \begin{cases} \bar{y} - (1-p)(c+\underline{l}) & \text{if} \quad c < s\Delta - \underline{l} \\ \bar{y} - c - \underline{l} + sp\Delta & \text{if} \quad c \geq s\Delta - \underline{l} \end{cases} \tag{29}$$

(ii) False Overtime satisfies $w^* = s(1-p)\Delta + \bar{l}$ *and* $b^* = c - s\Delta - \bar{l}$ *when* $c > s\Delta + \bar{l}$ *and* $(1-p)(c-\bar{l}) - s\Delta$ *when* $c \leq s\Delta + \bar{l}$ *and yields profit*

$$\pi^{FO} = \begin{cases} \bar{y} - c + sp\Delta & \text{if} \quad c > s\Delta + \bar{l} \\ \bar{y} - (1-p)c - p\bar{l} & \text{if} \quad c \leq s\Delta + \bar{l} \end{cases} \tag{30}$$

(iii) Revealed Overtime satisfies $w^* = s\Delta + \bar{l}$ *and* $b^* = c - w^* = c - s\Delta - \bar{l}$ *when* $s\Delta < c - \bar{l}$, $w^* = c$ *and* $b^* = 0$, *when* $c - \bar{l} < s\Delta < c + \underline{l}$ *and* $w^* = s\Delta - \underline{l}$ *and* $b^* = 0$ *when* $s\Delta > s + \underline{l}$. *This yields profit*

$$\pi^{RO} = \begin{cases} \bar{y} - (1-p)[s\Delta - \underline{l}] & \text{if} \quad c < s\Delta - \underline{l} \\ \bar{y} - (1-p)c & \text{if} \quad c - \bar{l} < s\Delta < c + \underline{l} \\ \bar{y} - c + p[s\Delta + \bar{l}] & \text{if} \quad c > s\Delta + \bar{l} \end{cases} \tag{31}$$

False Overtime is always dominated if $\frac{1-p}{p}\underline{l} < \bar{l}$.

Proof. (i) To induce hidden overtime, the principal has to satisfy the incentive compatibility constraints (23), (24), and the participation constraint $b \geq (1-p)(c+\underline{l})$. The optimal overtime pay satisfies $0 \leq w^* \leq sp\Delta - \underline{l}$ and the optimal performance based payment is

$$b^* = max\{(1-p)(c+\underline{l}), c + \underline{l} - sp\Delta\}. \tag{32}$$

i.e.

$$b^* = \begin{cases} (1-p)(c+\underline{l}) & \text{if} \quad c < s\Delta - \underline{l} \\ c + \underline{l} - sp\Delta & \text{if} \quad c \geq s\Delta - \underline{l} \end{cases} \tag{33}$$

Limited liability constraint does not bind as $c + \underline{l} - sp\Delta > 0 \iff c \geq sp\Delta - \underline{l}$

which holds whenever $c \geq s\Delta - \underline{l}$. Principal's profit thus is

$$\pi^{HO} = \begin{cases} \bar{y} - (1-p)(c + \underline{l}) & \text{if} \quad c < s\Delta - \underline{l} \\ \bar{y} - c - \underline{l} + sp\Delta & \text{if} \quad c \geq s\Delta - \underline{l} \end{cases} \tag{34}$$

(ii) To induce false overtime, the principal has to satisfy the incentive compatibility constraints (25), (26), and the participation constraint $b + w \geq p\bar{l} + (1-p)c$. The optimal overtime pay is $w^* = s(1-p)\Delta + \bar{l}$ and the optimal performance pay is

$$b^* = \begin{cases} c - s\Delta - \bar{l} & \text{if} \quad c > s\Delta + \bar{l} \\ (1-p)(c - \bar{l}) - s\Delta & \text{if} \quad c \leq s\Delta + \bar{l} \end{cases} \tag{35}$$

we thus have

$$b^* + w^* = \begin{cases} c - sp\Delta & \text{if} \quad c > s\Delta + \bar{l} \\ (1-p)c + p\bar{l} & \text{if} \quad c \leq s\Delta + \bar{l} \end{cases} \tag{36}$$

Principal's profit reads

$$\pi^{FO} = \begin{cases} \bar{y} - c + sp\Delta & \text{if} \quad c > s\Delta + \bar{l} \\ \bar{y} - (1-p)c - p\bar{l} & \text{if} \quad c \leq s\Delta + \bar{l} \end{cases} \tag{37}$$

(iii) To induce revealed overtime, the principal has to satisfy the incentive compatibility constraints (27), (28). Participation constraint is implied by the incentive compatibility constraints.

Suppose $s\Delta < c - \bar{l}$. Then since $w^* \leq s\Delta + \bar{l}$, we have $b \geq c - w > 0$, i.e. limited liability does not bind. Thus, to minimize $b + (1-p)w$ such that $b + w \geq c$ set w as high as possible, i.e. $w^* = s\Delta + \bar{l}$. Then $b^* = c - w^* = c - s\Delta + \bar{l}$. Principal's payoff is $\bar{y} - c + p[s\Delta + \bar{l}]$.

Suppose $c - \bar{l} < s\Delta < c + \underline{l}$. Now, to minimize $b + (1-p)w$ set $b^* = 0$. Then we need $w^* \geq c$. Set $w^* = c$. Clearly, $s\Delta - \underline{l} < w^* < s\Delta + \bar{l}$ is satisfied. Principal's payoff is $\bar{y} - (1-p)c$.

Suppose $s\Delta > c + \underline{l}$. To minimize $b + (1-p)w$ set $b^* = 0$. Now $w \geq s\Delta - \underline{l}$ becomes binding. Set $w^* = s\Delta - \underline{l}$. Clearly, $b^* + w^* = s\Delta - \underline{l} > c$. Principal's payoff is $\bar{y} - (1-p)[s\Delta - \underline{l}]$.

Principal's payoff is

$$\pi^{RO} = \begin{cases} \bar{y} - (1-p)[s\Delta - \underline{l}] & \text{if} \quad c < s\Delta - \underline{l} \\ \bar{y} - (1-p)c & \text{if} \quad c - \bar{l} < s\Delta < c + \underline{l} \\ \bar{y} - c + p[s\Delta + \bar{l}] & \text{if} \quad c > s\Delta + \bar{l} \end{cases} \tag{38}$$

Show now when false overtime is dominated. For $c > s\Delta + \bar{l}$, False Overtime yields $\bar{y} - c + sp\Delta$ and revealed overtime yields $\bar{y} - c + sp\Delta + p\bar{l}$. For $c - \bar{l} < s\Delta < c + \underline{l}$, False Overtime yields $\bar{y} - (1-p)c - p\bar{l}$ and revealed overtime yields $\bar{y} - (1-p)c$. For $c < s\Delta - \underline{l}$ False Overtime yields $\bar{y} - (1-p)c - p\bar{l}$ and Hidden Overtime yields $\bar{y} - (1-p)(c - \underline{l})$. Hidden overtime thus yields larger profit iff $\frac{1-p}{p}\underline{l} < \bar{l}$. □

Thus if $\underline{l} = 0$ or if p is large, then false overtime is a dominated action for the principal.

The principal's choice over contracts is effectively a choice between ignorance and information. By inducing hidden overtime work, the principal can avoid paying extra for the overtime but still reap the returns as the low types get the task done. This, however, comes with the cost of losing information and not being able to condition the contract on effort and thus not being able to differentiate between the types in compensation. Without such differentiation motivating the low type to work means increasing transfers for the high type as well.

By inducing revelation of overtime work on the other hand, the principal can condition contracts on overtime and so compensate for the overtime only when overtime is needed. Clearly, the principal has to now pay for the overtime whenever the agent works overtime. Whether the principal prefers to induce revealed or hidden overtime work depends on the cost of overtime and agent's image concerns.

Proposition 5. *Suppose $0 = \underline{l} < \bar{l} < c$. For $s\Delta < c - \bar{l}$ principal reveals overtime with a contract $(b, w) = (c - s\Delta - \bar{l}, s\Delta + \bar{l})$ if $sp\Delta > c - (1-p)\bar{y} - p\bar{l}$ and otherwise the no overtime contract obtains. For $c - \bar{l} < s\Delta < c$ principal reveals overtime with a contract $(b, w) = (0, c)$ if $\bar{y} > c$ and otherwise the no overtime contract obtains. For $s\Delta > c$ the principal hides overtime with a contract $(b, w) = ((1-p)c, 0)$ if $\bar{y} \geq (1-p)c$ and otherwise there is no contract.*

Proof. Suppose $0 = \underline{l} < \bar{l} < c$. By Lemma 2 false overtime is always dominated. When $s\Delta < c - \bar{l}$ the optimal contract that hides overtime yields a profit $\bar{y} - c + ps\Delta$, optimal contract that reveals overtime yields $\bar{y} - c + ps\Delta + p\bar{l}$ where the latter is clearly larger. The no overtime contract yields $p\bar{y}$ and is thus preferred to revealed overtime whenever $sp\Delta < c - (1-p)\bar{y} - p\bar{l}$. When $c - \bar{l} < s\Delta < c$, the optimal contract that hides overtime yields a profit $\bar{y} - c + ps\Delta$ and the optimal contract that reveals overtime yields a profit $\bar{y} - (1-p)c$, where the latter is larger as $s\Delta < c$. The latter profit is larger than $p\bar{y}$

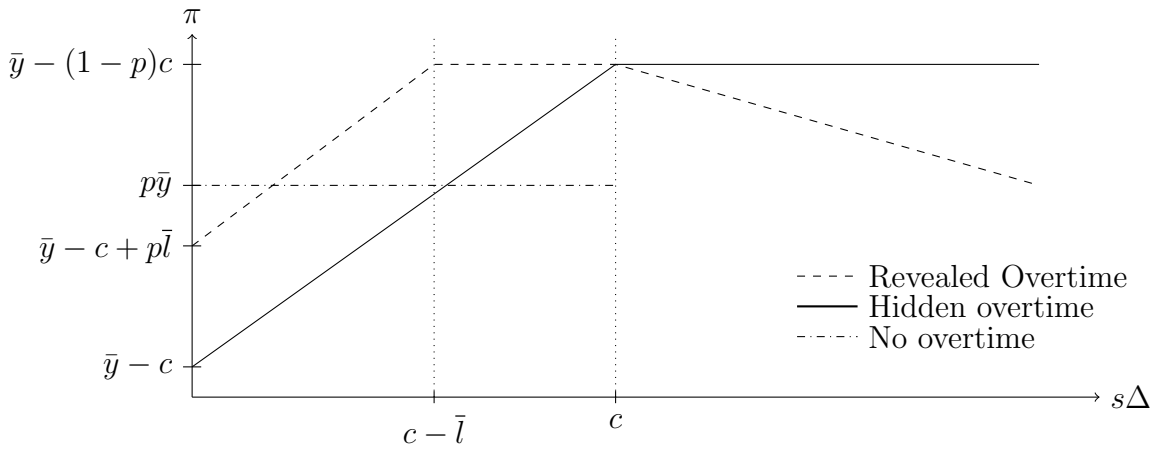

Figure 2: Principal's profit function $0 = \underline{l} < \bar{l}$.

if $c < bary$. When $s\Delta > c$, the optimal contract that hides overtime yields a profit $\bar{y} - (1-p)c$ and the optimal contract that reveals overtime yields $\bar{y} - (1-p)s\Delta$. For $s\Delta > c$ no overtime contract is not feasible. □

When $c - \bar{l} < s\Delta < c$, overtime pay can be set such that the low type reveals his overtime but the high type does not overreport. Here, the principal can set the performance based component of the transfer to zero and compensate the cost of overtime work for the low type by setting $w = c$. Overtime pay thus reveals the hidden action and the contract can be conditioned on effort.

When $s\Delta < c - \bar{l}$, lying costs do not alone disincentivize high type's deviation to overreporting. To reveal hours the principal has to decrease the overtime pay. This, however, requires an increase in performance pay. The high type thus gets a rent and the principal's payoff decreases in $s\Delta$.

If when $s\Delta < c - \bar{l}$, the principal induced hidden overtime, the total payment would be $b = c - sp\Delta$ whereas with the revealed overtime the total payment is

$$b + (1-p)w = \underbrace{c - s\Delta - \bar{l}}_{b} + (1-p)\underbrace{(s\Delta + \bar{l})}_{\text{w}} = c - sp\Delta - p\bar{l}. \tag{39}$$

By revealing overtime, the principal can thus pay $\bar{l}$ less in performace pay that all workers receive and reallocate this to overtime pay that only the workers working overtime receive. This saves $p\bar{l}$ in total payments. Lying costs increase the informativeness of reports and, thus, the larger the lying costs are the more beneficial it is for the principal to reveal overtime and conditition contracts on reports. Clearly, as the upward lying cost $\bar{l}$ goes to zero, the region $(c - \bar{l}, c)$ vanishes and revealing overtime has no advantage.

When $s\Delta > c - \bar{l}$ revealing overtime from the low type becomes exceedingly expensive. On the other hand, as the low type's image concerns are strong enough alone

to incentivize effort, the moral hazard problem disappears and, thus, there is also no benefit in conditioning contracts on effort.

7 Conclusion

We explain hidden overtime in terms of signaling ability, career concerns, self-deception, and effort denial. Given output, requiring more hours to complete a task signals low ability. An overtime report thus signals inability to complete the task during the normal working hours. This, on one hand, disciplines agent's reports such that honest reporting may arise in equilibrium but, on the other hand, motivates the agent to hide or deny having worked overtime. We thus show how overtime pay contingent on self-reported hours can be part of an optimal contract when the agent has image concerns but how overtime remains hidden when image concerns are high.

Given the signal overtime reports emit, an agent confronted with a difficult task may want to complete the task working overtime while hiding or denying this overtime to salvage his image. The model thus generates a positive correlation between feelings of incompetence and underreporting hours (Barrainkua and Espinosa-Pike, 2015). Hiding overtime also allows the low skill agent to pool with the high skilled agents leading to a positive correlation between underreporting hours and self-esteem and performance evaluations (Rhode, 1977; Kelley and Seller, 1982; Lightner et al., 1983; Akers and Eaton, 2003).

The effects of underreporting hours are mediated by the observability or ambiguity of the amount of effort and uncertainty about agent's skills. We predict unobservability of effort to increase the propensity of hidden overtime and thus explain the joint increase in teleworking and hidden overtime (ILO, 2017). We predict imperfect recall of effort to increase the propensity of hidden overtime and thus how the time lag between effort and its report may increase the propensity of hidden overtime (Reffett et al., 2014) and also how the lack of boundaries between leisure and work time leading to ambiguity about exact hours worked may increase the propensity of hidden overtime. We predict uncertainty about skills to increase the propensity of hidden overtime and thus explain why younger employees more often hide overtime than older employees (Shapeero et al., 2003).

Depending on whether the costs of overtime work exceed the value of overtime work, image concerns and hidden overtime may either increase or decrease efficiency. If overtime work is efficient, then image concerns, on one hand, motivate hidden effort provision and so alleviate moral hazard and, on the other hand, discourage false overtime reports allowing motivation of hidden effort in the form of higher overtime payments. If overtime work is not efficient, efficiency would require task completion only when feasible without overtime. However, an image-concerned agent when hiding

overtime does not provide the required information to the principal. This reduces principal's ability to separate between high and low skilled agents and produce only when production is efficient. Principal's options are thus between not offering a contract at all or inducing task completion in all states of the world. There is thus either too much or too little production.

Individual rationality of the agent does not allow exploitation in the sense of principal gaining profits in excess of the total surplus available in the employment relationship. An agent hiding overtime and thus losing overtime pay receives higher performance pay than an agent truthfully reporting his overtime and receiving overtime pay. The agent's expected rent is, however, decreasing in image concerns and for large image concerns the low-skilled agent does not receive a full monetary compensation for his effort costs, which ex post can be seen as a "problem of hidden overtime".

The resulting inefficiencies, overwork and insufficient monetary compensation for overtime work may call for policy interventions. First, merely requiring employers to ask their employees' reports of overtime may not have an effect as overtime may remain hidden. Second, if the objective of the policymaker is to increase the agent's compensation, in particular for costly overtime work, one solution is to have an external authority that performs random checks to verify the truthfulness of reports. However, this may prove prohibitively difficult or costly, and also reduces welfare in some cases.

Another question is what characteristics a recording system has to have. First, if a monitoring system that makes effort verifiable was available the principal would voluntarily install it whenever efficient. Such a system would, on one hand, remove the need of image concerns to motivate hidden effort provision, and on the other hand, provide the principal with the required information to employ overtime only when necessary.

A recording system that protects the agent from overwork without any negative effects on the created surplus prevents reports that are lower than actual working time. For example, the employer could make the agent log on to a time recording device as soon as he arrives in the employee's office and enforce lunch breaks. Then overstating working hours, e.g. by doing unreported breaks, is possible, but understating working hours is infeasible. We find that such a recording system can not only protect the agent from doing hidden overtime work, but when image concerns are high it can also increase the principal's profit and welfare. Thus, it should be especially valuable for occupations in which (self-) image concerns are pronounced.

There are, however, two caveats. The first is that the agent, in expected terms, does not benefit from such a reporting system. The second, related, issue is that the principal would install such a system voluntarily if it was socially efficient. A legal obligation to install it seems not necessary. The reason behind this result is that the agent is rational and cannot be exploited by the principal. A policymaker who calls for

a legal regulation to record working time might have a more naïve employee in mind, who does not foresee that image concerns will make him work hard if the task turns out to be difficult.

Another interesting question is the role of bargaining power. In our model, the principal makes a take-it-or-leave-it offer to the agent at the start of the relationship (which is consistent with the view of the European Court of Justice that the employee is the weaker part of the labor relation). However, if the agent had some bargaining power, the incentives of the principal to install a reporting system that increases the surplus are reduced since the agent now captures part of this surplus. In this case, the legal obligation to install a system that prevents hidden overtime can increase welfare and the agent's payoff.

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