The Behavioral Economics of Incentives
Theory and Evidence

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Contents

Preface

What motivates people, intrinsically and extrinsically?
—The Question That Never Gets Old—

Human behavior is captivating, and what is even more fascinating are the forces that drive human behavior. These forces can be intrinsic (e.g., innate preferences: loss aversion, reciprocity) or extrinsic (e.g., monetary or non-monetary rewards, peer groups, leaders, work environment). The insight opens up many interesting questions, especially with respect to the relationship between employers and employees in organizations: Should employers turn a blind eye on under-performing outcomes of employees, as an act of leniency? If employees are averse to losses, what is the implication for their wage contract? Why do employers negotiate wages with prospective employees? Does employees' reciprocity play a role in such wage negotiations? How does the current pandemic affect employees' performance and mental health? Which leadership skills of employers help to mitigate the impact of the pandemic? How do good leaders affect employees' productivity and well-being, especially in times of crisis?

In this dissertation, I attempt to understand better these motivating forces and delve deeper into their effects and implications on various work-related aspects. Chapter 1 looks at the implication of loss aversion on the optimal wage contract. Chapter 2 examines how reciprocity plays a role in wage negotiations. Chapter 3 studies the effects of the current pandemic on employees' performance and mental health, and how good leaders might take a mitigating role. The overview of these three chapters are as follows:

Chapter 1. In Chapter 1 titled "Loss Aversion, Moral Hazard, and Stochastic Contracts", I examine whether stochastic contracts benefit the principal in the setting of moral hazard and loss aversion. Incorporating that the agent is expectation-based loss averse and allowing the principal to add noise to performance signals, I find that stochastic contracts reduce the principal's implementation cost in comparison with deterministic contracts. Surprisingly, if performance signals are highly informative about the agent's action, stochastic contracts strictly dominate the optimal deterministic contract for almost any degree of loss aversion. The finding has an important implication for designing contracts for loss-averse agents: the principal should insure the agent against wage uncertainty by employing stochastic contracts that increase the probability of a high wage.

Chapter 2. Chapter 2 titled "Wage-Setting Mechanisms with Reciprocal Workers" examines a firm's endogenous selection into posting a public wage or bargaining wages in private negotiations with workers. In a static wage-bargaining model, I incorporate a behavioral insight that workers are reciprocal in that the more rent they receive at the wage bargaining stage, the higher quality they deliver at the production stage. The main result is that there exists a unique separating equilibrium in which a low-surplus firm self-selects into a public wage offer and a high-surplus firm self-selects into private negotiations. Negotiating wages with reciprocal workers, firms face a tradeoff between quality and net surplus: a high bargained wage induces workers' reciprocity, yielding firms high quality; but workers may be able to extract a considerable share of the surplus through negotiations, yielding firms a low net surplus. To the best of my knowledge, this chapter is the first to provide a behavioral explanation for why firms may choose to bargain wages with workers.

Chapter 3. Chapter 3 titled "Work Environment, Mental Health, and The Pandemic: How COVID-19 affected loan officers' work in India" is joint work with Kristina Czura, Florian Englmaier, and Lisa Spantig. This chapter focuses on issues related to working during the pandemic, in an industry that has been severely affected by the crisis and where work from home is hard to implement due to the nature of the tasks and technological restrictions: microfinance. We document how the work of loan officers changes during the pandemic as compared to before, how employees are impacted in terms of work organization and mental well-being, and whether leadership can play a mitigating role. To do so, we collect panel survey data from over 500 employees of a large Indian microfinance organization from December 2019 to December 2020 and use administrative records of performance indicators to characterize the work environment. We document that: first, even though the working environment has become more challenging, the tasks required from loan officers have not changed; second, perceived stress worsened at the early stages of the pandemic, but showed signs of improvement at the later stages; and third, leadership seems to be positively related to loan officers' performance pre-pandemic and subjective well-being during the pandemic.

Chapter 1

Loss Aversion, Moral Hazard, and Stochastic Contracts

1.1 Introduction

The interplay between risk aversion and incentives is central to the moral hazard literature, especially in designing an optimal contract. In this literature, one of the very few general results, as Bolton and Dewatripont (2005) argue, is the informativeness principle. This theory, going back to Holmstrom et al. (1979), Holmstrom (1982), and Grossman and Hart (1983), states that a wage contract should contain only informative signals about the agent's effort. Despite the well-established paradigm, many labor contracts are stochastic in that they include noise that does not provide any statistical information about the agent's effort.[1] This gap between theory and observed contracts suggests that a traditional approach focusing solely on risk aversion might give a partial and incomplete picture of the moral hazard problem.

Although loss aversion is a fundamental concept in behavior economics and is well-established with ample experimental and field evidence, the interplay between loss aversion and incentives remains understudied in the moral hazard literature. More recently, Camerer, Loewenstein and Rabin (2004) argue that loss aversion drives much of human behavior. "In a wide variety of domains", as Rabin (2004) puts forward, "people are significantly more averse to losses than they are attracted to same-sized gains". One prominent realm in which loss aversion plays an significant role is the domain of money and wealth (Tversky and Kahneman, 1991). It is thus important to incorporate loss aversion in the analysis of the optimal wage contract, and to better understand how loss aversion affects the tradeoff between insurance and incentives in the moral hazard model.

[1] In workplaces, firms successfully adopt teams and team incentives (Che and Yoo, 2001; Lazear and Shaw, 2007; Bandiera, Barankay and Rasul, 2013) in which a team's performance depends not only on an employee's effort but also the effort exerted by other team members. In addition, non-executive employees increasingly receive payments in stock options (Core and Guay, 2001; Bergman and Jenter, 2007; Hochberg and Lindsey, 2010; Kim and Ouimet, 2014) whose valuation is influenced by external shocks in the financial sector.

This chapter analyzes the optimal wage contract in the setting of moral hazard and loss aversion, in which the agent is expectation-based loss averse and the principal can use stochastic contracts. The main result is that stochastic contracts reduce the principal's implementation cost in comparison with deterministic contracts that implement the same action. When performance signals are highly informative about the agent's effort, the dominance of stochastic contracts over deterministic contracts holds for almost any degree of loss aversion. Furthermore, I find that limited liability ensures the existence of the optimal contract, and that the optimal stochastic contract pays a high wage with certainty when a good signal is realized and with a positive probability when a bad signal is realized.

More specifically, I extend the simple principal-agent model under moral hazard, in which both the agent's actions and observable signals are binary, by making two assumptions. The first assumption is that the agent is expectation-based loss averse as defined in Kőszegi and Rabin (2006, 2007). In particular, the agent forms a reference point *after* taking an action, and thus his chosen action affects his reference point. The agent compares his realized wage to the stochastic reference point, and he feels a loss if the actual wage is smaller than the reference wage. The second assumption is that the principal can add noise to performance signals by employing stochastic contracts. In particular, the principal can add a lottery after observing the realized signal. Stochastic contracts thus serve as a tool for the principal to manipulate the signal distribution. A crucial feature of my model is that the principal can fully control the structure of the stochastic contract, i.e., the odds of the lottery.

I find that there exists a stochastic contract that strictly dominates deterministic contracts. Under the stochastic contract, the principal pays out a high wage whenever she observes a good signal, while upon observing a bad signal she adds a lottery that gives either the high wage or a low wage that serves as a harsh penalty to the agent for the bad signal. The advantages of this stochastic contract under loss aversion are twofold. First, the stochastic contract with this turning-a-blind-eye structure remedies an implementation problem associated with loss aversion. In deterministic contracts, this implementation problem is well-established, i.e., the agent may choose the stochastically dominated action when he is sufficiently loss averse (Herweg, Müller and Weinschenk, 2010). As a result, the principal may be unable to induce the agent to exert effort. In sharp contrast, by employing the stochastic contract, the principal can always implement the desired action for any degree of loss aversion.

Second, even if deterministic contracts do not face the implementation problem, the stochastic contract helps the principal lower the cost of implementing the desired action beyond what is achieved under the optimal deterministic contract. Note that the stochastic contract, as compared to deterministic contracts, has two countering effects on the principal's cost. On the one hand, the stochastic contract might increase the principal's cost, because the high wage is now paid out more often and a larger wage spread is required to incentivize the agent to work. On the other hand, the stochastic contract reduces the probability that the agent feels a loss, thus the principal might capitalize on this reduction in the agent's loss premium to achieve a lower cost. When the positive effect of reducing the loss premium outweighs the negative effect of increasing the expected bonus, the stochastic contract dominates deterministic contracts. Whether the stochastic contract is dominant depends on the agent's degree of loss aversion and the informativeness of performance signals.

Interestingly, as performance signals get more informative about the agent's action, the principal favors the stochastic contract under a wider range of the degree of loss aversion. When performance signals are highly uninformative, the principal is better off with the stochastic contract under a most restrictive condition, i.e., only when the agent feels losses at least twice as strongly as same-sized gains. This condition gets weaker if performance signals provide some information about the agent's action. When performance signals convey almost perfect information, the stochastic contract dominates deterministic contracts for almost any degree of loss aversion. Intuitively, when performance signals are highly informative, the principal can provide further wage certainty at a negligible cost. Thus, this finding has an important implication for designing contracts for loss-averse agents: the principal has an incentive to add noise after the bad signal to insure the agent against wage uncertainty.

Yet I show that the second-best optimal stochastic contract might not exist. In particular, the principal's cost strictly decreases as the probability of getting the high wage increases. This implies that the principal prefers to push the probability of the high wage close to one. However, the principal cannot provide wage certainty because of the incentive constraint, and hence the solution to the principal's problem is not well-defined. This existence problem differs from the above implementation problem under loss aversion in that the stochastic contract can always implement the desired action, but if used, the optimal stochastic contract does not exist. Given the wide range under which stochastic contracts dominate deterministic contracts, the existence problem appears more severe than previously thought.

In mitigating the non-existence problem, I find that limited liability helps restore the existence of the optimal stochastic contract. The optimal stochastic contract pays a bonus with certainty when the good signal is realized and with a positive probability when the bad signal is realized; otherwise, the agent receives a lowest possible wage, at which the limited liability constraint is binding. This finding highlights the importance of imposing limited liability in stochastic contracts to restrict the extent the principal can punish the agent in the event of the bad signal and to ensure that the second-best optimal contract exists.

While for the most part of the chapter, I assume that a reference point is formed after the decision is taken, and allow for a stochastic reference point. In the Discussion section, I relax these assumptions and discuss alternative notions of loss aversion. In particular, the result holds under the forward-looking disappointment aversion according to Bell (1985), Loomes and Sugden (1986), or Gul (1991), in which the reference point is the recent expectation but does not allow for stochastic reference points. It also remains valid to the concept of *preferred personal equilibrium* by Kőszegi and Rabin (2007), which assumes that the reference point is formed before taking the decision and hence is taken as given. The robustness of the result suggests that noise should be generally added to performance signals in the optimal contract for loss-averse agents. When loss aversion plays a significant role in the agent's preferences, the principal can insure the agent against wage uncertainty by employing stochastic contracts.

The rest of the article is organized as follows. Section 1.2 summarizes the related literature. Section 1.3 outlines the model, and Section 1.4 specifies the principal's problem and derives the set of feasible contracts. Section 1.5 presents the main results and discusses alternative notions of loss aversion. Section 1.6 concludes. All proofs of lemmas and propositions are relegated to the Appendix.

1.2 Related Literature

In this section, I provide an overview of the literature on behavioral contract theory, which is most related to this chapter. I also refer to the literature that highlights the optimality of stochastic contracts and that provides explanations for the unresponsiveness of wages to performance.

This chapter is most closely related and complementary to Herweg, Müller and Weinschenk (2010) who show that, in the setting of moral hazard and loss aversion, the optimal deterministic contract is a bonus contract. Complementary to their finding, this chapter provides further insight into the characteristics of the optimal contract under loss aversion: the probability of getting a bonus is set as high as possible. Furthermore, while their paper proposes stochastic contracts as a remedy to the implementation problem of deterministic contracts, this chapter highlights the optimality of stochastic contracts for almost any degree of loss aversion, and even when deterministic contracts are implementable.

In the literature on behavioral contract theory, this chapter also relates to Daido and Murooka (2016) who show that the principal may employ team incentives when the agents are loss averse. Similar to their paper, this chapter stresses the role of limited liability in ensuring the existence of the optimal contract. However, their paper focuses on team incentives and takes a team structure as given, whereas I examine individual stochastic contracts and consider noise as one of the principal's variables.

This chapter also relates to the extensive literature on reference-dependent preferences, starting out with the seminal work of Kahneman and Tversky (1979) where the agent's utility depends on a reference point and the agents feel losses more strongly than gains. Subsequently, as reviewed by Barberis (2013), several papers have contributed to theoretical extensions—covering reference-dependent models of both static (Bell, 1985; Loomes and Sugden, 1986; Munro and Sugden, 2003; Sugden, 2003; Kőszegi and Rabin, 2006; De Giorgi and Post, 2011) and dynamic nature (Kőszegi and Rabin, 2009; Barberis and Huang, 2001; Barberis, Huang and Santos, 2001)—and applications of reference-dependent preferences into real-life problems, such as in tournaments (Gill and Stone, 2010), saving decisions (Jofre, Moroni and Repetto, 2015), asset pricing (Pagel, 2016), life-cycle consumption (Pagel, 2017), intertemporal incentives (Macera, 2018), and portfolio choices (Pagel, 2018). This chapter contributes to the literature strand that incorporates expectation-based reference-dependent preferences into moral hazard models, as summarized by Koszegi

(2014), by providing the characteristics of the optimal stochastic contracts for loss-averse agents.

My results speak to a growing literature that highlights the optimality of noise in the contract. Haller (1985) finds that randomization benefits the principal when the agent faces an aspiration constraint of achieving certain income levels with certain probabilities. Strausz (2006) shows that stochastic mechanisms may be optimal in a screening context. Lang (2020) examines the optimal contract with subjective evaluations, and shows that stochastic contracts may increase the principal's profits and eliminate the requirement of a third-party payment. Ostrizek (2020) finds that the principal prefers to set wages contingent on a noisy information structure, because the agent remains uninformed about their match-specific ability and is cheaper to motivate. Contributing to this literature, I show that noise can serve as a tool to insure the agent against wage uncertainty.

By highlighting that the principal prefers to lump signals together into a bonus set, my findings also adds to the rich literature attempting to explain why wages are rigid relative to performance. Considering multiple tasks that are substitutes, Holmstrom and Milgrom (1991) shows that wages should not respond to performance because strong incentives for an observable task worsens the agent's performance on the other unmeasurable task. At large, several explanation for a fixed-wage contract have proposed, including monitoring cost (Lazear, 1986), relative performance and cooperation (Lazear, 1989), relational contracts (e.g., MacLeod and Malcomson, 1989; Levin, 2003), and reciprocal preferences (Englmaier and Leider, 2012).

1.3 The Model

I consider a principal-agent model in a moral hazard and loss aversion setting. The principal (she) offers an one-period employment contract to the agent (he), which the agent either accepts or rejects. If the agent rejects, he receives his reservation utility which is assumed to be zero.[2] If the agent accepts the contract, he then makes a binary action $a \in \{a_H, a_L\}$, i.e., he either "works" ($a = a_H$) or "shirks" ($a = a_L$). The cost of working for the agent is $c(a_H) = c$, for $c > 0$, and the cost of shirking is normalized at zero $c(a_L) = 0$.

The action a is private information of the agent that the principal cannot observe. Instead, the principal is assumed to observe a contractible signal for the agent's action. The signal $s \in S = \{1, 2\}$ is good ($s = 2$) or bad ($s = 1$). The agent receives the good signal with probability q_H if he works and with probability q_L if he shirks, where $1 > q_H > q_L > 0$. The signal distribution is common knowledge.

The agent exhibits expectation-based loss aversion as defined in Kőszegi and Rabin (2006, 2007). The agent's utility has two additively separable components: the standard "consumption utility" and the reference-dependent "gain-loss utility". The agent's consumption utility, denoted by $u(\cdot)$, is assumed to be strictly increasing, (weakly) concave,

[2] Assuming the reservation utility is zero is consistent with the "quitting" constraint. This assumption is made for the sake of simplicity of analysis. The main results would continue to hold when the reservation utility is positive.

and unbounded, i.e., $u'(\cdot) > 0$ and $u''(\cdot) \leq 0$. The second component comes from reference-dependent preferences: the agent compares a realized outcome to a stochastic reference point, and how his overall utility is affected depends on whether this comparison is perceived as a gain or a loss. The gain-loss function $\mu(\cdot)$ satisfies the assumptions on the "value function" by Tversky and Kahneman (1991). I assume that the gain-loss function is piecewise linear,

$$\mu(m) = \begin{cases} m & \text{for } m \geq 0 \\ \lambda m & \text{for } m < 0 \end{cases}$$

where $\lambda \geq 1$ represents the degree of loss aversion.

To determine the reference point, I apply the concept of choice-acclimating personal equilibrium (CPE) in the sense of Kőszegi and Rabin (2007), which makes two important assumptions. First, the agent forms the reference point, to which realized outcomes are evaluated, *after* making the decision, and thus his decision affects his reference point. As mentioned by Kőszegi and Rabin (2007), CPE considers outcomes that are resolved long after all decisions are made. Thus, the reference point is endogenously determined as the agent's rational expectation about the outcomes given his decision. Second, the reference point is stochastic if the decision's outcome is stochastic. To form a stochastic reference point, it is assumed that the agent knows the set of possible outcomes and its probability distribution conditional on his decisions. These two assumptions give rise to a crucial feature of CPE: a stochastic outcome is evaluated to a stochastic reference point by comparing outcome by outcome, where each comparison is weighted with the joint probability with which a certain outcome is realized and an alternative outcome is expected.

On the other hand, the principal is assumed to be risk and loss neutral. I assume that the agent's "work" generates sufficient profit to the principal that she strictly prefers to implement the high action a_H. Thus I focus on the principal's cost minimization problem, and inquire into the optimal contract design under moral hazard with loss aversion.

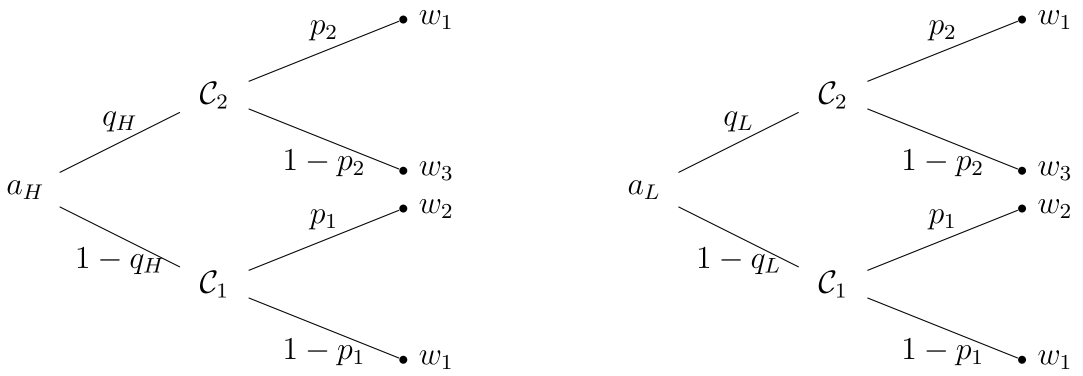
In designing the optimal contract, the principal can distort the outcome distribution by adding noise to the performance signals. Put differently, she can fully employ stochastic contracts to implement the desired action. A stochastic contract specifies wage payments contingent not only on the contractible signals but also on a stochastic device that does not depend on the agent's action. Formally, the principal offers the agent a state-contingent stochastic contract $(\mathcal{C}_s)_{s \in S}$, in which each $\mathcal{C}_s$ entails a stochastic device — uncorrelated with the agent's action — that specifies wage payments within the contract.

In the setting of two signals, the principal offers a stochastic contract $(\mathcal{C}_1, \mathcal{C}_2)$. If the principal observes the good signal $s = 2$, then the agent receives $\mathcal{C}_2$ that specifies a lottery $(p_2, 1 - p_2)$ over wage payments.[3] Analogously, $\mathcal{C}_1$ with a lottery $(p_1, 1 - p_1)$ is realized if

[3] The assumption that a lottery specifies two outcomes is without loss of generality. Even when the lottery specifies more than two outcomes, the principal prefers to lump outcomes into two distinct sets. This is in line with the finding by Herweg, Müller and Weinschenk (2010) that the optimal contract specifies two levels of wages.

the bad signal $s = 1$ is observed. Importantly, the principal has full control over the design of these lotteries (p_1, p_2) that I refer to as the "stochastic structure".

Figure 1.1: Distribution over wage payments under stochastic contracts



Notes: The left diagram depicts the distribution of wage payments conditional on the agent's high action a_H. The right diagram depicts the distribution of wage payments conditional on the agent's low action a_L.

As shown in Figure 1.1, the distribution over the outcomes $i \in \{1, \ldots, 4\}$ depends on both the agent's action and the principal's choice of stochastic structure. Figure 1.1 represents how the distribution over the wage payments $(w_i)_{i=1}^4$ depends on the agent's action $a \in \{a_H, a_L\}$ under the stochastic contract. By committing to the stochastic structure (p_1, p_2) in the contract, the principal makes the wage distribution common knowledge to the agent before he chooses his action. Thus, in the process of choosing an action, the agent incorporates the structure of the stochastic contract and forms a rational expectation about monetary outcomes.

More precisely, consider a particular case in which the agent chooses the high action a_H and that a certain outcome i is realized. The agent receives w_i and incurs effort cost c. Given that w_i is realized, he compares the realized outcome w_i to all alternative outcomes. Although w_i is realized, with some probability $f_j(a_H)$ he expects an alternative outcome $j \neq i$ to be observed. If $w_i > w_j$, the agent experiences a gain of $u(w_i) - u(w_j)$, whereas if $w_i < w_j$, the agent experiences a loss of $\lambda(u(w_i) - u(w_j))$. If $w_i = w_j$, there is no gain or loss involved. The agent's utility in this particular case is given by

$$u(w_i) + \sum_{j|w_i > w_j} f_j(a_H)(u(w_i) - u(w_j)) + \sum_{j|w_i < w_j} f_j(a_H)\lambda(u(w_i) - u(w_j)) - c$$

Notice that this particular comparison occurs with the probability $f_i(a_H)$ that outcome i is realized. When there is uncertainty in the decision's outcome, the agent's expected utility is obtained by averaging over all possible comparisons.

1.4 The Principal's Problem

Denote $u_i = u(w_i)$. With this notation, the agent's expected utility from choosing action $a \in \{a_H, a_L\}$ is given by

$$EU(a) = \sum_i f_i(a)u_i - (\lambda - 1)\sum_i \sum_{j|u_i>u_j} f_i(a)f_j(a)(u_i - u_j) - c(a)$$

The first term captures the agent's expected consumption utility. For $\lambda = 1$, we are back in the standard case without loss aversion. The second term captures the gain-loss utility. While the agent expects a high wage u_i to come up with probability $f_i(a)$, with probability $f_j(a)$ he receives a low wage u_j and experiences a loss of $\lambda(u_i - u_j)$. On the other hand, if the agent expects the low wage with probability $f_j(a)$, with probability $f_i(a)$ he receives the high wage and experiences a gain of $u_i - u_j$. Since losses loom larger than gains of equal size ($\lambda \geq 1$), the gain-loss utility is always negative in expectation. Following Herweg, Müller and Weinschenk (2010), I refer to this expected net loss as the agent's "loss premium". For an agent with a higher degree of loss aversion, the principal has to pay a higher loss premium in a given contract.

Let $h(\cdot) := u^{-1}(\cdot)$ be the wage that the principal offers the agent to obtain utility u_i, i.e., $h(u_i) = w_i$. Due to the assumptions on $u(\cdot)$, $h(\cdot)$ is strictly increasing and (weakly) convex. Following Grossman and Hart (1983), I regard $\mathbf{u} = (u_1, \ldots, u_4)$ as the principal's control variables in her cost minimization problem. The principal specifies a wage payment w_i for each outcome i in the employment contract, equivalently an utility level u_i.

The key assumption is that, besides the wage payments, the principal controls the stochastic structure $\mathbf{p} = (p_1, p_2)$. In sharp contrast to deterministic contracts, stochastic contracts allows the principal to manipulate the outcome distribution. Her problem is thus to minimize the expected wage payment that implements a_H subject to the participation and incentive compatibility constraints.

$$\begin{aligned} &\min_{\mathbf{u},\mathbf{p}} \; E(h(u_i)) \\ \text{subject to} \quad & EU(a_H) \geq 0 \qquad \text{(PC)} \\ & EU(a_H) \geq EU(a_L) \qquad \text{(IC)} \end{aligned}$$

In deterministic contracts, it is well-established that if the agent is sufficiently loss averse, i.e. $\lambda > 2$, then the agent might choose the stochastically dominated action, and the principal, facing a severe implementation problem, might be unable to induce the high action (Herweg, Müller and Weinschenk, 2010). I now examine if there are incentive-compatible wage payments under stochastic contracts to implement a_H and show that, in sharp contrast to deterministic contracts, stochastic contracts do not suffer from the implementation problem.[4]

Lemma 1. *Suppose $u''(\cdot) \leq 0$ and $\lambda \geq 1$. For every λ, there exists a stochastic contract such that the action a_H can be implemented.*

[4] All proofs of lemmas and propositions are provided in the Appendix.

Lemma 1 states that given any degree of loss aversion there are incentive-compatible wages and a stochastic structure such that the agent accepts the stochastic contract and chooses the high action. In particular, the principal pays out a high wage whenever she observes a good signal, while after observing a bad signal she adds a lottery that gives either the high wage or a low wage. This means, in the stochastic contract, the principal turns a blind eye on the agent's receiving a bad signal and insures the agent against wage uncertainty. The stochastic contract circumvents the implementation problem of deterministic contracts, because, by increasing the probability of getting the high wage, the principal simultaneously reduces the agent's expected net loss when he works and increases his expected net loss when he shirks. For a sufficiently loss-averse agent, whose primary concern is to minimize the expected net loss, the stochastic contract makes working more attractive than shirking.

So far it is established that the constraint set of the principal's cost minimization problem is non-empty for the high action a_H given any degree of loss aversion. I restrict attention to the stochastic contract of the turning-a-blind-eye structure for the following analysis.[5]

1.5 The Optimal Contract

In this section, I examine the existence and the characteristics of the optimal contract. First, I focus on the case of a loss-averse but risk-neutral agent. I will show that under a weak condition there exists a stochastic contract that strictly dominates deterministic contracts. The principal can lower the cost of implementing the desired action by employing stochastic contracts rather than deterministic contracts. Surprisingly, this holds true even when deterministic contracts do not face the implementation problem. The dominance of stochastic contracts, however, implies that for many cases the second-best optimal stochastic contract does not exist. With agents being expectation-based loss averse, an existence problem, which does not prevail in the standard model, arises. Second, I examine whether limited liability mitigates the non-existence issue of stochastic contracts and characterize the second-best optimal stochastic contract. Third, I consider the general case of a risk- and loss-averse agent and show that the first-best can be approximated closely, but not attained, by stochastic contracts that provide the bonus almost certainly.

1.5.1 Strict Dominance of Stochastic Contracts

Consider an agent who is risk neutral in the standard notion, $u''(\cdot) = 0$, but exhibits loss aversion $\lambda > 1$.

[5] The strategy "turing a blind eye" was first discussed in Herweg, Müller and Weinschenk (2010), who show that indeed when facing an implementation problem, the principal can still implement the desired action by stochastically ignoring the agent's bad performance. In this chapter, I focus more on the situations in which the implementation problem does not prevail and the principal can use deterministic contracts to induce the agent to work.

If the principal is restricted to offer deterministic contracts, with two possible signals $s \in \{1, 2\}$, the deterministic contract takes the form of a bonus contract: the agent is paid a base wage $\underline{w}$ if the bad signal is realized, and he is paid the base wage $\underline{w}$ plus a bonus $b > 0$ if the good signal is realized.

Under this deterministic contract, the agent prefers the high action a_H over the low action a_L if his utility from the high action exceeds his utility from the low action. This is the case if and only if

$$\begin{aligned} & \underline{w} + q_H b - (\lambda - 1) q_H (1 - q_H) b - c \geq \underline{w} + q_L b - (\lambda - 1) q_L (1 - q_L) b \\ \Leftrightarrow \; & (q_H - q_L) b - (\lambda - 1) \left[q_H (1 - q_H) - q_L (1 - q_L) \right] b \geq c \qquad \text{(IC-D)} \end{aligned}$$

Because both the participation and incentive constraints are binding, the principal's cost minimization problem is equivalent to minimizing the agent's loss premium conditional on a_H subject to the incentive constraint. I examine whether there exists a stochastic contract that satisfies the incentive constraint and at the same time reduces the loss premium that the principal has to pay.

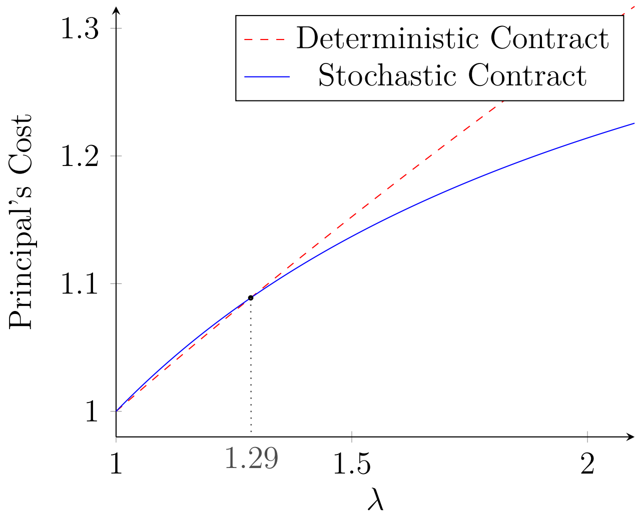
Assuming that the principal can employ stochastic contracts, I consider the stochastic contract that takes the turning-a-blind-eye structure: the principal pays a high wage with probability 1 if she observes the good signal, while if she observes the bad signal she stochastically ignores it by paying the high wage with probability p_1 and paying a low wage with probability $1 - p_1$. It follows directly from Lemma 1 that the stochastic contract satisfies the incentive constraint and implements the high action. I examine whether the stochastic contract benefits the principal from a cost perspective in the following proposition.

Proposition 1. *Suppose $u''(\cdot) = 0$ and $\lambda - 1 > \frac{1-q_H}{1-q_L}$. Then, there exists a stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$ that strictly dominates the optimal deterministic contract.*

Besides remedying the implementation problem, the stochastic contract benefits the principal from a cost perspective: the principal pays a lower loss premium to the agent in the stochastic contract. To see the intuition for Proposition 1, note first that the agent's loss premium depends on two variables: (i) the bonus size b and (ii) the probability with which the agent feels a loss when a deviation from his reference point occurs $q_H(1 - q_H)$, which following Herweg, Müller and Weinschenk (2010) I refer to as "loss probabiliy". The loss probability is an inverted U-shaped function; it reaches its maximum when getting a bonus is completely random, i.e. $q_H = 1/2$, and it reaches its minimum of zero as the bonus probability moves to the extremes, i.e. $q_H = 0$ or $q_H = 1$. By employing the stochastic contract that pays the low wage only if the worst outcome ($i = 1$) is realized and pays the high wage for all other outcomes, the principal increases the bonus probability closer to one and thereby reduces the associated loss probability closer to zero.

Although the stochastic contract decreases the probability that the agent feels a loss, it increases the bonus size b required to incentivize the agent to work. As the probability of getting a bonus increases, the outcome distribution under the high action resembles that under the low action. Thus, to satisfy the incentive constraint, the principal needs a

Figure 1.2: Principal's cost under stochastic contracts versus deterministic contracts



Notes: The figure shows an illustration of the principal's cost under stochastic contracts and deterministic contracts for $q_H = 0.8, q_L = 0.3$, $p_1 = 0.75$, $p_2 = 1$, and $c = 1$. The dashed line shows the principal's implementation cost in the optimal deterministic contract. The solid line shows the the principal's minimum cost in the stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$.

higher bonus. Put together, the stochastic contract has two opposing effects on the loss probability and the bonus size. While the insurance against wage uncertainty may come at the cost of a larger expected bonus required to induce the agent to work, the positive effect of the reduced loss probability outweighs the negative effect of the increased bonus size if the agent is sufficiently loss averse.

Figure 1.2 illustrates the dominance of the stochastic contract for a simple example with $q_H = 0.8, q_L = 0.3$, and $p_1 = 0.75$. The dashed line in Figure 1.2 shows the principal's implementation cost under the optimal deterministic contract, and the solid line shows the minimum cost under the stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$. Given $q_H = 0.8$ and $q_L = 0.3$, the condition $\lambda - 1 > \frac{1-q_H}{1-q_L}$ in Proposition 1 translates to $\lambda > 1.29$. As shown in Figure 1.2, for $\lambda \in [1, 1.29]$, the optimal deterministic contract yields a lower cost for the principal, while for $\lambda > 1.29$, the stochastic contract strictly dominates the optimal deterministic contract. The higher the degree of loss aversion, the larger the relative benefit of using the stochastic contract for the principal.

Interestingly, the condition on the degree of loss aversion in Proposition 1 is much weaker than that previously established in the literature. Herweg, Müller and Weinschenk (2010) establish that turning a blind eye enables the principal to achieve a lower cost if and only if $\lambda > 2$.[6] Notice that in Proposition 1 the condition $\frac{1-q_H}{1-q_L} + 1$ is strictly smaller

[6]In particular, Herweg, Müller and Weinschenk (2010) assume an incomplete contracting environment, which implies that performance measures are inherently noisy. Thus, this limits the extent to which the

than 2; this would imply a larger set of degrees of loss aversion than previously thought under which stochastic contracts strictly dominate deterministic contracts.

A second interesting observation is that as the performance signals become more informative about the agent's action, the principal favors the stochastic contract under a wider range of the degree of loss aversion. Let us consider two extreme cases. If the signals are highly uninformative, i.e. $\frac{1-q_H}{1-q_L} \to 1$, then the most restrictive condition under which the stochastic contract dominates deterministic contracts becomes $\lambda > 2$, which coincides with the well-established condition in the literature. The condition on the degree of loss aversion, however, gets weaker as the performance signals provide more information about the agent's action. At the other extreme, if the signals are highly informative, i.e. $\frac{1-q_H}{1-q_L} \to 0$, then the condition becomes $\lambda > 1$. This means if the signals provide almost precise information about the agent's action, then the principal benefits from using the stochastic contract almost all the time. The logic is that when the given signals are very informative, the principal provides further wage certainty at a negligible cost and prefers to do so to a large extent. Put differently, in the limit the stochastic contract strictly dominates deterministic contracts for almost any degree of loss aversion.

1.5.2 Non-Existence of The Second-Best Optimal Contract

In this part, I focus on the cases where stochastic contracts strictly dominate deterministic contracts, and attempt to characterize the second-best optimal stochastic contract, assuming for now that the solution exists. Formally, I assume that $u''(\cdot) = 0$ and $\lambda - 1 > \frac{1-q_H}{1-q_L}$.

Similar to the finding by Herweg, Müller and Weinschenk (2010), a first important observation is that the optimal stochastic contract should take the form of a bonus contract. When an agent is risk neutral but loss averse, it is optimal for the principal to pool as many informative signals as possible into a bonus set and pay a high wage only if the realized signal lies in this bonus set. The logic is that when facing the risk-neutral agent, the principal cannot capitalize on a higher degree of wage differentiation. On the other hand, pooling wages together helps the loss-averse agent avoid unfavourable comparisons and yields him a higher expected utility. To satisfy the incentive constraint, the optimal contract requires a minimum degree of wage differentiation in that the principal offers two wage levels – a base wage and a bonus – no matter how rich the signal space is.

It remains to determine which outcomes $i \in \{1, \dots, 4\}$ should be included in the bonus set. Given any contract $(\hat{w}_i)_{i=1}^4$ that the principal offers, I can relabel the outcomes i such that this contract is equivalent to a contract $(w_i)_{i=1}^4$ of an (weakly) increasing wage profile with $w_{i-1} \leq w_i$ for all $i \in \{2, 3, 4\}$. Thus the bonus set can be one of the three options: (i) the bonus set includes only the highest outcome $\{w_4\}$, or (ii) the bonus set includes two highest outcomes $\{w_4, w_3\}$, or (iii) the bonus set includes all but the lowest outcome $\{w_4, w_3, w_2\}$. I examine the option (i) in the following lemma.

principal can add noise in the optimal contract as compared to the complete contracting setting in my model.

Lemma 2. *Suppose* $u''(\cdot) = 0$ *and* $\lambda > 1$. *Then, any stochastic contract with the wage structure* $w_1 = w_2 = w_3 < w_4$ *is weakly dominated by the optimal deterministic contract.*

A stochastic contract that rewards only the highest outcome reduces the probability of getting a bonus; a slim chance of getting a bonus in turn simultaneously increases the agent's expected net loss when he works and decreases his expected net loss when he shirks. Because the agent cares sufficiently about minimizing the expected loss, this implies that the stochastic contract of the wage structure $w_1 = w_2 = w_3 < w_4$ worsens the implementation problem under loss aversion. Moreover, the principal requires a substantially higher bonus to motivate the agent to work. Due to the worsened implementation problem, the negative effects of an increased bonus outweighs the positive effects of a reduced loss probability, leading to that the principal's implementation cost actually increases with such a stochastic contract.

Note that the option (ii) coincides with the deterministic contract. As in Proposition 1, the optimal deterministic contract is strictly dominated by the stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$. Taken these two observations together, it is thus optimal to include all but the worst outcome in the bonus set.

With the bonus set including all except for the worst outcome $i = 1$, I derive the principal's implementation cost for a given stochastic structure. The comparative statics of the principal's implementation cost with respect to the probability of getting a bonus p_1 reveals an insight about the existence of the second-best optimal stochastic contract, which is covered in the following proposition.

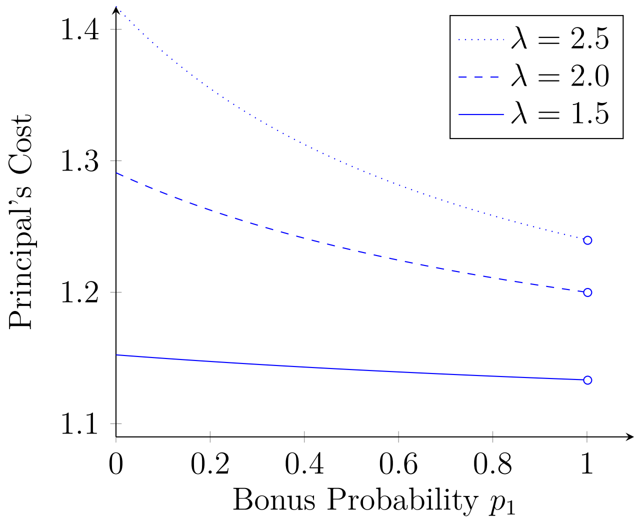
Proposition 2. *Suppose* $u''(\cdot) = 0$ *and* $\lambda - 1 > \frac{1-q_H}{1-q_L}$. *Then, the second-best optimal stochastic contract does not exist.*

The solution to the principal's problem with the above stochastic contract is not well-defined. The reason is that the principal can always achieve a lower cost by further increasing the probability of getting a bonus p_1 close to one and rendering the penalty harsher in the event of the bad signal. However, p_1 cannot reach the value of one, as the contract then becomes a fixed wage contract that does not satisfy the incentive constraint. In the limit, the principal's cost C_r in the stochastic contract is given by

$$\lim_{p_1 \to 1} C_r = c + \frac{\lambda - 1}{\lambda} \cdot \frac{(1 - q_H)c}{(q_H - q_L)}$$

Figure 1.3 illustrates how the principal's implementation cost changes with respect to the probability of getting a bonus p_1 for a simple example with $q_H = 0.8$ and $q_L = 0.3$. The solid, dashed, and dotted lines correspond to the principal's cost for $\lambda = 1.5$, $\lambda = 2$, and $\lambda = 2.5$ respectively. All the lines exhibit a downward trend, implying that the principal's cost decreases as p_1 increases. However, there is a discontinuity, depicted as empty circles, at $p_1 = 1$. If $p_1 = 1$, the principal cannot induce the agent to work, her implementation cost becomes prohibitively high.

Figure 1.3: Principal's cost as a function of the bonus probability



Notes: The figure shows an illustration of the principal's cost under the stochastic contract of the wage structure $w_1 < w_2 = w_3 = w_4$ for $q_H = 0.8, q_L = 0.3$, $p_2 = 1$, and $c = 1$.

1.5.3 Limited Liability

The non-existence of the second-best optimal stochastic contract hinges on the principal's desire to insure the agent against wage uncertainty to the largest possible extent, and thereby to further reduce her cost, if the agent is sufficiently loss averse. On the other hand, to motivate the agent to work in the face of such insurance, the principal punishes the agent indefinitely when the worst outcome is realized. If the punishment for the worst outcome is, however, limited, the principal faces an upper bound of how much wage certainty she can provide to the agent. In this part, I show that the second-best optimal stochastic contract exists if the principal faces a limited liability constraint, and characterize the second-best optimal contract.

Analogous to the previous analysis, it can be shown that the optimal bonus set consists of all but the worst outcome. I thus restrict my attention to stochastic contracts of the wage structure $w_1 < w_2 = w_3 = w_4$. Let f_H and f_L be the probability of getting a bonus conditional on the agent's high and low action respectively, i.e., $f_H = P[i > 1|a_H] = q_H + p_1(1 - q_H)$ and $f_L = P[i > 1|a_L] = q_L + p_1(1 - q_L)$. The principal's problem becomes

$$\min_{\underline{w},b,p_1} \underline{w} + f_H b$$

subject to

$$\underline{w} + f_H b - (\lambda - 1) b f_H (1 - f_H) \geq c \qquad \text{(PC)}$$

$$b(f_H - f_L) - (\lambda - 1) b[f_H(1 - f_H) - f_L(1 - f_L)] \geq c \qquad \text{(IC)}$$

$$\underline{w} \geq 0 \qquad \text{(LL)}$$

Because the (IC) binds at optimum (else, the principal can reduce b by a small amount), the optimal bonus size can be written as a function of p_1:

$$b^*(p_1) = \frac{c}{(q_H - q_L)(1 - p_1)[1 - (\lambda - 1)(1 - q_H - q_L - p_1(2 - q_H - q_L))]}$$

The (LL) constraint is also binding at optimum. Else, by reducing $\underline{w}$ by a small amount, the principal decreases the expected payment without changing (IC) or violating (LL). Thus, the principal's cost in the stochastic contract is given by $C_r(p_1) = f_H b^*$. Note that at $p_1 = 0$, the stochastic contract coincides with the deterministic contract such that the principal's minimum cost remains unchanged. The principal reduces her implementation cost by using the stochastic contract if the following assumption holds.

Assumption 1 (A1)**.** $(\lambda - 1)(1 - q_H - q_L + q_H(2 - q_H - q_L)) > 1$

Assumption (A1) is a sufficient and necessary condition for the principal's minimum cost function to be locally decreasing at $p_1 = 0$. Given (A1), there exists a stochastic contract that strictly dominates the optimal deterministic contract under limited liability. Solving for the optimal p_1^* that minimizes $C_r(p_1)$, I characterize the second-best optimal stochastic contract in the following proposition.

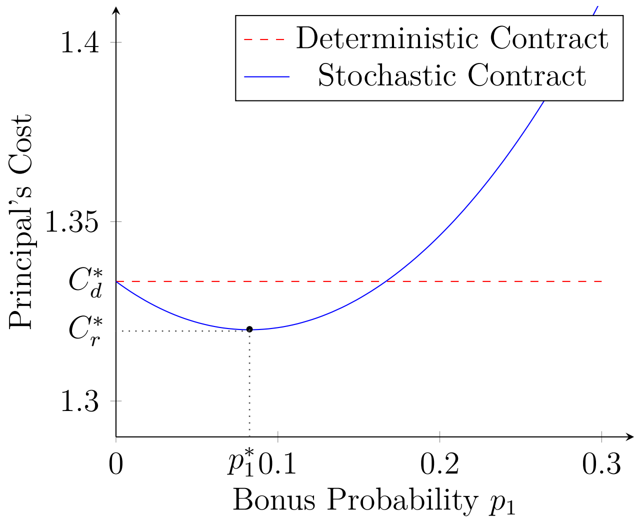
Proposition 3. *Suppose (A1) holds, $u''(\cdot) = 0$, and $w \geq 0$. Then, the second-best optimal stochastic contract exists. The optimal stochastic contract pays $b^*(p_1^*)$ with probability one when the good signal is realized and with probability p_1^* when the bad signal is realized. The optimal p_1^* is given by*

$$p_1^* = \frac{1}{1 - q_H}\left(\sqrt{1 - \frac{\lambda}{\lambda - 1} \cdot \frac{1 - q_H}{2 - q_H - q_L}} - q_H\right)$$

Figure 1.4 illustrates the second-best optimal stochastic contract under limited liability with a simple example of $q_H = 0.8$, $q_L = 0.3$ and $\lambda = 3$. With this parameter specification, the principal can implement the desired action with a deterministic contract that reaches the lowest cost of $C_d^* = 1.33$. The Assumption (A1), translating to $\lambda > 2.61$, is satisfied under the specification of $\lambda = 3$. The second-best optimal stochastic contract pays $b^*(p_1^*) = 1.62$ with probability one if the principal observes the good signal $s = 2$ and with probability $p_1^* = 0.08$ if she observes the bad signal $s = 1$. Thus, the principal yields the optimal cost of $C_r^* = 1.32$, which is strictly lower than C_d^*.

If the agent is subject to limited liability, the solution of the principal's problem is well-defined. Intuitively, limited liability limits the extent to which the principal can punish the agent in the event of bad outcomes, and in turn her ability to insure the agent against wage uncertainty. Put differently, the principal does not benefit from increasing the bonus probability p_1 close to 1 under the limited liability constraint. As the base wage $\underline{w}$ is bounded by zero, in order to motivate the agent to work, the bonus b becomes substantially large after a certain level of wage certainty.

Figure 1.4: Principal's cost under limited liability



Notes: The figure shows an illustration of the principal's cost under stochastic contracts and deterministic contracts under limited liability for $q_H = 0.8, q_L = 0.3$, $p_2 = 1$, $c = 1$ and $\lambda = 3$. The dashed line shows the principal's implementation cost in the optimal deterministic contract. The solid line shows the the principal's minimum cost in the stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$.

1.5.4 Alternative Notions of Loss Aversion

The notion of loss aversion crucially depends on how the reference point is conceptualized. In my model the reference point has two important features. First, it allows for stochastic reference points; the agent compares a realized outcome with all possible outcomes. This pairwise comparison implies a possibility of "mixed feeling", i.e., the same realized outcome can be perceived as both a gain and a loss at the same time, depending on which possible outcomes the agent expects. Second, the reference point is formed after the decision is made, and hence is influenced by the chosen decision. Thus, the reference point is endogenously determined by recent expectations.

A related notion to the CPE concept is the forward-looking disappointment aversion according to Bell (1985), Loomes and Sugden (1986), or Gul (1991). Under the disappointment aversion model, the reference point is also formed after the decision is made, but the reference point takes the form of certainty equivalent of the prospect, and hence it admits only static reference points. The certainty equivalent of the prospect is a point estimate and does not allow for mixed feelings; the agent feels a gain if the realized outcome is above it, and vice versa. As it turns out, even in this case, stochastic contracts help the principal reduce the implementation cost beyond what is achieved under deterministic contracts.

Again, stochastic contracts add noise after the worst outcome to insure the agent that he is more likely to receive the high wage.[7]

Proposition 4. *Suppose the agent exhibits disappointment aversion according to Bell (1985), $u''(\cdot) = 0$, and $\lambda - 1 > \frac{1-q_H}{1-q_L}$. Consider two actions and two signals. Then, there exists a stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$ that strictly dominates the optimal deterministic contract.*

The forward-looking disappointment according to Bell (1985) implies that the agent first calculates an expected outcome, and then compares the realized outcome with his expectation. Under a deterministic contract, if a bonus is realized, the agent feels elated as the realized outcome is higher than the expected one. While, if a bonus is not realized, the agent instead feels disappointed as the realized outcome is lower than the expected one. By increasing the bonus probability in the stochastic contract, the principal simultaneously increases the probability that the agent feels elated and reduces the probability that he feels disappointed. Because the agent prioritizes minimizing the feeling of disappointment, if he is sufficiently disappointment averse, the principal can capitalize on the stochastic contract to reduce her implementation cost.

An alternative specification of the reference point is that it is given exogenously and does not internalize the effect of the decision, namely the *preferred personal equilibrium* (PPE) notion. In PPE, the agent can choose his optimal action only from the actions he knows he will follow through, whereas in CPE he can commit to the action. The analysis of the optimal contract is very similar and gives rise to the similar result. However, it is known that the distaste for the risk is stronger when the decision is made up front, as in CPE, than when the decision is made later, as in PPE. The principal benefits from stochastic contracts that insure the agent with wage certainty to a lesser extent.

Proposition 5. *Suppose the agent exhibits the PPE loss aversion, $u''(\cdot) = 0$, $q_H + 2q_L \leq 2$, and $\lambda - 1 > \frac{1-q_H}{1-q_L}$. Consider two actions and two signals. Then, there exists a stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$ that strictly dominates the optimal deterministic contract.*

The robustness of the dominance of stochastic contracts suggests that noise should be generally added to performance measures in the optimal contract for loss averse agents. Put differently, loss aversion implies a first-order aversion to wage uncertainty, and this creates incentives for the principal to insure the agent against this uncertainty. By employing stochastic contracts, the principal manipulates the outcome distribution to her favor and provides the agent a higher wage certainty. When loss aversion plays a role, the principal capitalizes on this reduction in uncertainty and achieves a lower cost.

[7] De Meza and Webb (2007) examine the concept of Gul (1991), which is closely related to Bell (1985), and finds that the optimal contracts have intermediate intervals in which wages are insensitive to performance.

1.6 Conclusion

This chapter studies the optimal contract design under moral hazard and loss aversion, and finds that the optimal contract adds noise in the event of bad outcomes to insure the loss-averse agent against wage uncertainty. To reach this finding, I modify the standard moral hazard model with two departures: the agent is expectation-based loss averse, and the principal can add noise in the contract to manipulate the outcome distribution in her favor. Importantly, the principal fully controls where to add noise and how to structure noise in the contract, i.e., the structure of stochastic contracts.

There are three key takeaways from this chapter. First, the principal is strictly better off with stochastic contracts, as compared to deterministic contracts, in implementing the desired action if the agent is loss averse. This result relates to the literature on behavioral contract theory, which has pointed out that if deterministic contracts face an implementation problem, turning a blind eye (Herweg, Müller and Weinschenk, 2010) or team incentives (Daido and Murooka, 2016) help the principal induce the agent to work. Contributing to this literature strand, I find that even if deterministic contracts do not face the implementation problem, the principal can still reduce her cost by employing stochastic contracts. In fact, if the signals are highly informative about the agent's action, stochastic contracts strictly dominate deterministic contracts for almost any degree of loss aversion. Thus, this finding has an important implication for designing contracts for loss-averse agents: the principal has an incentive to add noise after the bad signal is realized to insure the agent against wage uncertainty.

Second, limited liability mitigates the non-existence problem of the second-best optimal stochastic contract. Instead of the implementation problem, stochastic contracts face a non-existence problem that the optimal contract does not exist, because the principal has an incentive to insure the agent to the largest possible extent. Given a wide range of loss aversion over which stochastic contracts dominates deterministic contracts, the non-existence problem proves to be severe. To solve the non-existence problem, I find that limited liability helps restore the existence of the second-best optimal contract. This finding highlights the importance of limited liability in stochastic contracts to ensure that the second-best optimal contract exists.

Given that loss aversion is an important and well-established behavioral trait, this chapter helps explain the relevance of stochastic contracts (e.g., dismissal contracts) in the real world. Going forward, it would be interesting to examine the interaction of loss aversion with other behavioral or cognitive biases, such as overconfidence, that may induce the agent to have an incorrect model of the world. The interaction of these biases and their implications on the optimal contract design is an exciting research topic.

Chapter 2

Wage-Setting Mechanisms with Reciprocal Workers

2.1 Introduction

Wage setting is at the heart of any matches between firms and employees, where two prevalent mechanisms with which firms determine wages with workers emerge: public wage and private negotiation. In practice, both forms of wage-setting mechanisms coexist in many labor markets, with approximately one-third of hirings being characterized by private negotiations.[1] Despite their widespread use, it is not clear how a firm determines its wage-setting mechanism in the choice between a public wage offer and private negotiations.

The standard paradigm assumes that a public wage offer makes the firm better off. This theory, as put forward by Lieberman and Montgomery (1988), argues that a public wage offer provides the firm with a "first-mover advantage" and helps the firm reduce wages in the wage-setting process. Yet, in practice we do observe that firms engage in private negotiations with workers. The gap between theory and practice suggests that the standard theory provides an incomplete picture of what determines the firm's choice of wage-setting mechanisms. Arguably, one reason is that it has failed to incorporate one of the most prominent workers' characteristics: *reciprocity*.[2]

[1]Hall and Krueger (2010, 2012) survey a representative sample of around 1300 workers in the US and find that wage bargaining characterizes approximately one-third of matches and wage posting represents almost two-thirds. Examining the firm's perspective from an extensive survey of more than 9000 establishments, Brenzel, Gartner and Schnabel (2014) find a similar result—both wage bargaining and wage posting coexist in the German labor market, with approximately one-third of workers bargaining individually for their wages.

[2]Reciprocity is a well-established concept in behavioral economics and psychology (Geanakoplos, Pearce and Stacchetti, 1989; Rabin, 1993). There is ample experimental and empirical evidence showing that workers are reciprocal to the firm's generosity (Leuven et al., 2005; Gneezy and List, 2006; Bellemare and Shearer, 2009; Kube, Maréchal and Puppe, 2012; Englmaier, Kolaska and Leider, 2016). While reciprocity has been incorporated in many models (for example, in sequential games (Dufwenberg and Kirchsteiger, 2004; Falk and Fischbacher, 2006), in demand theory (Cox, Friedman and Sadiraj, 2008),

To fill the gap, this chapter provides a theory of wage-setting mechanisms with reciprocal workers and proposes a behavioral explanation for why firms engage in private negotiations with workers. In this chapter, I examine how a firm determines its wage-setting mechanism—posting a public wage or negotiating wages with workers—and, more specifically, what influences a firm's choice between a public wage offer and private negotiations. Building on the wage bargaining literature, I extend the standard bargaining model, where a single firm meets a unit mass of workers, by incorporating a behavioral assumption that workers are reciprocal, i.e., the more rent workers receive from the firm at the stage of wage bargaining, the higher effort workers give back to the firm at the latter stage of effort provision.

The model has two stages: In the first stage of wage bargaining, the firm and workers negotiate wages according to a given wage-setting mechanism–public wage or private negotiation. In a public wage offer, the firm commits and announces to all prospective workers a public wage, which workers can accept or reject. In a private negotiation, each worker privately bargains wages with the firm and makes a wage offer, which the firm can accept or reject. In the second stage of effort provision, taking the agreed-upon wage in the first stage as fixed, workers choose their level of effort, which directly translates to the firm's quality.

The findings highlight that workers' reciprocity plays an important role in shaping the firm's choice of wage-setting mechanisms. In sharp contrast to the standard theory which predicts that the firm prefers a public wage offer to suppress wages, workers' reciprocity prompts the firm to engage in private negotiations in order to give more rents to workers. Consequently, the equilibrium wage for workers increases, as workers become more reciprocal. The resulting wage increase in turn improves the probability of hiring, and thus partially mitigates pre-existing friction in the labor market.

In essence, when negotiating wages with reciprocal workers, the firm faces a trade-off between *net surplus* and *quality* in the choice between a public wage offer and private negotiations. On the one hand, a public wage offer, through the "first-mover advantage", suppresses wages and improves the firm's net surplus—the share of the surplus that is left after paying wages. On the other hand, private negotiations, by allowing workers to aggressively bargain wages, induce workers' reciprocity and improve the firm's quality.

The trade-off brings about a separating equilibrium in which, facing strongly reciprocal workers, the low-surplus firm self-selects into a public wage offer and the high-surplus self-selects into private negotiations. Intuitively, the low-surplus firm focuses on increasing its hiring probability and its net surplus, and thus prefers a public wage offer; while the high-surplus firm shifts its priority to induce workers' reciprocity and improve quality, and thus prefers private negotiations. Importantly, the separating equilibrium is unique. I show that alternative pure equilibria—such as a pooling equilibrium at public wage, a pooling equilibrium at private negotiation, and a separating equilibrium where the low-surplus firm

and in contract theory (Englmaier and Leider, 2012)), it has not yet been considered in a model of wage bargaining.

chooses private negotiations and the high-surplus firm chooses a public wage offer—do not exist.

Lastly, I consider how the shape of the workers' gift exchange function affects the equilibrium wage. The intensity of workers' reciprocity, i.e. the slope of the gift exchange function, influences the firm's wage strategy in a public wage offer. As the intensity of workers' reciprocity increases, the firm sets a higher public wage. Furthermore, the concavity of the gift exchange function affects the workers' wage strategy in private negotiations. A concave gift exchange function implies that workers bargain even more aggressively in private negotiations.

The rest of the article is organized as follows. Section 2.2 discusses the related literature. Section 2.3 introduces the model. Section 2.4 examines a benchmark case of self-serving workers, and Section 2.5 provides an example of fully reciprocal workers. Section 2.6 analyzes how workers' reciprocity affects the firm's choice of wage-setting mechanisms. Section 2.7 discusses two important features of the workers' gift exchange function, namely its slope and its curvature. Finally, Section 2.8 concludes. All proofs of lemmas and propositions are relegated to the Appendix.

2.2 Related Literature

With respect to the theory, my analysis builds on the literature that examines the use of wage bargaining. Earlier works apply labor models in the directed search tradition, including Montgomery (1991), Peters (1991), Moen (1997), Acemoglu and Shimer (1999*a*,*b*), Shi (2001, 2002), and Shimer (2005), which all predict that firms can efficiently optimize the trade-off between higher wages and higher hiring probability by publicly posting the terms of the employment contract up front. In contrast, bargaining wages with workers tends to result in too high wages or too low hiring probability, which are known as "search inefficiencies" associated with bargaining. More recently, Michelacci and Suarez (2006) have put the standard prediction in question and argue with a directed search model that firms may choose to bargain wages with workers if workers differ in their productivity that can be subjectively assessed on the job but cannot be verified by courts. Similarly, Ellingsen and Rosén (2003) and Camera and Delacroix (2004) use random search models to analyze firms' choice between bargaining and posting, and also find that unverifiable heterogeneity in workers' productivity provides firms an incentive to engage in wage negotiations as the bargained wage can be tailored to the worker's productivity.[3] Contributing to this literature, this chapter provides a behavioral explanation—that workers are reciprocal—for why firms may self-select into bargaining.

[3]Habibi (2020) examines when a firm prefers to be transparent or discreet about their bonus, using a simple multidimensional signaling model. He finds that when a worker can learn about their own productivity from another worker's bonus, transparency benefits the firm if the value of retaining its most productive worker is high. While in his paper a transparent bonus reflects an internal pay disclosure, a public wage in this chapter mirrors an external pay disclosure to prospective workers.

With respect to the application, as one can think of posting a public wage equivalent to the firm making pay transparent, this chapter also adds to the literature on pay transparency, especially in the strand that studies the effects of pay transparency on firms' outcomes (Brenzel, Gartner and Schnabel, 2014; Kim, 2015; Mas, 2017; Baker et al., 2019; Bennedsen et al., 2019). Examining wage posting in the US, the UK, and Slovenia, Brenčič (2012) find that employers are less likely to post a public wage when searching for a skilled workers. Brenzel, Gartner and Schnabel (2014) study the German labor market and suggest that bargaining may result in higher wages for workers than wage posting. Cullen and Pakzad-Hurson (2019) focus on online labor markets for low-skill, temporary jobs and find that, under transparency, wages are lower but more equal, and employer profits are higher. Not only that my model's predictions are broadly consistent with the empirical findings on the effects of transparency on firms' outcomes, my model also contributes to the literature by theoretically examining the determinants of pay transparency for firms, namely workers' reciprocity and the surplus generated from the match between workers and the firm.[4]

On the other hand, given that a take-it-or-leave-it public wage can be interpreted as firms' commitment to pay negotiation bans, this chapter relates to the literature on negotiation bans. Most of the literature on negotiation bans has so far focused on the effects of the bans on workers' outcomes, especially whether the bans help eliminate women's disadvantages in negotiations and reduce the gender pay gap (Recalde and Vesterlund, 2020; Gihleb, Landsman and Vesterlund, 2020). Adding to the literature, this chapter looks at the effects of negotiation bans on firms' outcomes and suggests that negotiation bans might benefit a low-surplus firm but hurt a high-surplus firm that prefers to negotiate with reciprocal workers.

2.3 The Model

2.3.1 Setup

Consider a labor market in which a single firm meets with a unit mass of workers. All workers are equally productive and thus generate a same surplus to the firm. If matched, workers create the surplus v, which directly benefits the firm and the value of the surplus v is only known to the firm. Workers, on the other hand, know the distribution of the surplus $v \sim U[0,1]$. Each worker i has a privately known outside option $\theta_i \overset{i.i.d}{\sim} U[0,1]$. If workers are not matched with the firm, they receive their outside options θ_i.

The model of this chapter builds on a simple bargaining model by incorporating a key assumption that workers are reciprocal, i.e., the more rent they receive above their outside options, the higher effort they are willing to exert. With reciprocal workers, the firm faces a trade-off between net surplus and quality when determining wages. A high wage decreases

[4]Fahn and Zanarone (2020) analyze how firms choose between pay secrecy and transparency. Looking from the worker's perspective, they argue that the trade-off of transparency for workers lies between enduring envious social comparisons and holding the firm accountable on promised pay.

the firm's net surplus because the firm transfers a larger share of the surplus to workers. However, a high wage induces reciprocal workers to exert high effort and in turn increases the quality.

The firm can determine wages through two wage-setting mechanisms: public wage or private negotiation. In a public wage offer, the firm posts a public wage to all prospective workers; while in private negotiations, each individual worker bargains wages with the firm.

The match between the firm and workers mimics the hiring process in practice: the firm negotiates with workers on their wages, and workers exert effort upon accepting the job. The model thus has two stages. In stage 1, the firm and workers bargain over wages according to a given wage-setting mechanism. In stage 2, taking the agreed-upon wage at stage 1 as given, workers choose a level of effort. The details of these two stages are described in the following sections.

2.3.2 Stage 1: Wage Bargaining

The firm determines wages with workers at stage 1, according to the wage-setting mechanism. The wage-setting mechanism can be either a public wage offer or private negotiations. The choice of the wage-setting mechanism also determines the timing of wage bargaining between the firm and workers.

In a public wage offer, the firm posts a public wage $\overline{w}(v) \in [0, 1]$ to all prospective workers. Workers observe the public wage $\overline{w}$ and decides whether to accept or reject it. Here, I assume that the firm can commit to this public wage $\overline{w}$, i.e., the firm cannot increase or decrease the public wage after its announcement. This assumption rules out the possibility that the firm increases the offered wage to attract more workers, or the possibility that the firm decreases the offered wage after screening workers with the public wage. In other words, the public wage is a commitment device to the firm.

In private negotiations, workers do not receive any prior information on wages before entering the wage bargaining process. Workers bargain wages through a take-it-or-leave-it offer to the firm. Each worker i makes an initial offer $w_i(\theta_i) \in [0, 1]$. If the initial offer w_i does not exceed an maximum amount the firm is willing to pay, worker i is matched with the firm and is paid his offer w_i. Otherwise, workers are permanently unmatched with the firm and receive their outside options θ_i.

2.3.3 Stage 2: Effort Provision

Upon being matched with the firm, workers take the agreed-upon wage at stage 1 as given and decide how much effort e_i to exert in stage 2. For simplicity, I assume that workers' effort e_i directly translates to the work quality q_i, but does not affect the surplus v between the firm and workers. For example, in a garment factory, the surplus v represents a constant marginal profit of a sold garment, and workers' effort e_i contributes to the garment's quality (i.e., whether the garment is sewed without mistakes or with minor mistakes). The firm cares about both its net surplus and quality equally. The profit accruing to the firm is the sum of its net surplus $\pi_i = v - w_i$ and quality $q_i = e_i$.

Workers are reciprocal in that the more rent, $r_i = w_i - \theta_i$, they receive, the higher effort e_i they are willing to exert. I assume that the workers' gift exchange function—a mapping from the rent r_i to the optimal effort e_i^*—is linear and takes the form of $e_i^* = \tau r_i$, where $\tau \geq 0$ represents the degree of reciprocity.[5] A linear gift exchange function assumes that the optimal effort is proportional to the rent received at stage 1 and the marginal return to rent in terms of effort is constant.

Assumption 1. *No dominance of reciprocity,* $\tau < 2$*.*

Assumption 1 states that the degree of reciprocity τ is bounded above at 2, implying that workers do not over-generously reciprocate to the firm in terms of quality. If workers are too strongly reciprocal ($\tau \geq 2$), they produce a too high level of quality that the firm finds it optimal to push the wages to the highest possible level and hire all workers in the labor market. On the other hand, if there is no dominance of reciprocity ($\tau < 2$), the firm faces a trade-off between net surplus and quality when setting wages.

In the following section, I consider four levels of reciprocity: (1) a benchmark case of the standard utility in which workers are self-serving and not reciprocal: $\tau = 0$; (2) an example in which workers are fully reciprocal in that they give back the same amount as the received rent: $\tau = 1$; (3) the main analysis focusing on strongly reciprocal workers in that they give back more than the received rent: $\tau > 1$; and (4) a discussion of weakly reciprocal workers in that they give back less than the received rent: $\tau < 1$. For each level of reciprocity, I consider three wage-setting mechanisms: (i) the firm posts a public wage $\overline{w}$ for all realizations of the surplus v—exogenous public wage, (ii) the firm enters a private negotiation for all realizations of the surplus v—exogenous private negotiation, and (iii) the firm chooses between a public wage offer and private negotiations for each realization of the surplus v—endogenous private negotiation. In the discussion section, I also consider the implications of a concave gift exchange function.

2.4 Benchmark – Self-Serving Workers

As a benchmark, I consider the case when workers are self-serving in the standard sense and are not reciprocal ($\tau = 0$). At stage 2, the firm knows that workers are self-serving and correctly infers that workers optimally choose zero effort regardless of the rent they receive. Thus, the firm obtains a quality of zero, $q_i = 0$, for any level of agreed-upon wages. The firm, as a result, solely focuses on maximizing its net surplus in the wage bargaining stage. I analyze three wage-setting mechanisms: exogenous public wage, exogenous private negotiation, and endogenous private negotiation.

[5] I relax this linearity assumption in the discussion section, and consider a concave gift exchange function $e_i^* = \sqrt{r_i}$.

2.4.1 Exogenous Public Wage

In exogenous public wage offer, the firm has to employ a public wage offer as a wage-setting mechanism. The firm posts a public wage $\overline{w}$ to all prospective workers for all realizations of the surplus v.

In the last period of the wage bargaining stage, workers observe the public wage. Knowing that the firm is committed to the public wage, workers' decision is a binary choice of accepting or rejecting the public wage. In particular, workers accept the public wage if the public wage is at least as good as the outside option $\theta_i \leq \overline{w}$. Otherwise, workers reject the public wage if the outside option exceeds the public wage $\theta_i > \overline{w}$.

At the beginning of the wage bargaining, the firm expects workers with outside options up to the public wage $\theta_i \leq \overline{w}$ to accept, and chooses the public wage $\overline{w}$ to maximize its expected profit. The firm's objective is given by

$$\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})(v - \overline{w})$$

In the case of self-serving workers, I reproduce the standard finding in the literature that the firm acts as a monopoly and suppresses the equilibrium wage below the surplus, $\overline{w}^* = \frac{v}{2}$.

Lemma 1. *Assume that the wage-setting mechanism is exogenous public wage, and workers are self-serving with $\tau = 0$. Then, in equilibrium, the equilibrium wage is set below the surplus, $\overline{w}^* = \frac{v}{2}$, and workers with $\theta_i \leq \frac{v}{2}$ are employed*

When facing self-serving workers, the firm has an incentive to suppress the wage in order to maximize its net surplus. In particular, the firm bargains wages aggressively, setting the equilibrium wage below the surplus $\overline{w}^* = \frac{v}{2}$. Consequently, a hiring inefficiency exists in the labor market in that workers with outside options less than the surplus $\theta_i \in (\frac{v}{2}, v]$, who should be employed if the market is efficient, are not employed.

The equilibrium under exogenous public wage with self-serving workers is characterized by the equilibrium wage of $\frac{v}{2}$. In equilibrium, the hiring probability $P(\theta_i \leq \overline{w}^*) = \frac{v}{2} \leq v$. Conditional on hiring, the firm yields a profit of $\frac{v}{2}$.

2.4.2 Exogenous Private Negotiation

In exogenous private negotiation, the firm has to employ private negotiations as a wage-setting mechanism, i.e., the firm directly enters private negotiations with workers without providing prior wage information. Workers bargain by proposing a take-it-or-leave-it offer w_i, which the firm can either accept or reject. In particular, workers choose an initial offer w_i to maximize their wages and the hiring probability. Worker i's objective is given by

$$\arg\max_{w_i} P(v \geq w_i)w_i + P(v < w_i)\theta_i$$

For any level of initial offer w_i, the firm hires worker i if the benefit exceeds the cost of hiring $v \geq w_i$. If being hired, worker i receives the initial offer w_i. Otherwise, worker

i receives the outside option θ_i. Given the objective function, worker i sets the optimal initial offer $w_i^*(\theta_i) = \frac{\theta_i}{2} + \frac{1}{2}$.

Lemma 2. *Assume that the wage-setting mechanism is exogenous private negotiation, and workers are self-serving with $\tau = 0$. Then, in equilibrium, the equilibrium wage is set above worker's outside option, $w_i^*(\theta_i) = \frac{\theta_i}{2} + \frac{1}{2}$, and workers with $\theta_i \leq 2v - 1$ are employed*

As the wage-setting mechanism changes from a public wage offer to private negotiations, the power to set the wage shifts from the firm to workers. This power shift creates an incentive for workers to bargain aggressively, setting the initial offer above their outside option, $w_i^*(\theta_i) = \frac{\theta_i}{2} + \frac{1}{2} \geq \theta_i$, for all possible outside options $\theta_i \in [0, 1]$.

Private negotiations with self-serving workers creates inefficiencies for both the firm and workers. From the firm's side, because workers set wages too high $w_i^* \geq \frac{1}{2}$ for any outside option $\theta_i \in [0, 1]$, the firm with a low surplus $v < \frac{1}{2}$ cannot afford to hire workers and has to stay out of the labor market. From the workers' side, some workers with outside options below the surplus $\theta_i \in (2v - 1, v]$, who should be employed if the market is efficient, are not employed.

The equilibrium under exogenous private negotiation with self-serving workers is characterized by the equilibrium wage $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$. In equilibrium, the hiring probability $P(v \geq w_i^*) = P(\theta_i \leq 2v - 1)$ is zero if the firm has a low surplus $v < \frac{1}{2}$ and equals $2v - 1$ if the firm has a sufficiently high surplus $v \geq \frac{1}{2}$. Conditional on hiring, the firm yields a net surplus of $\pi_i = v - E(w_i^* | v \geq w_i^*) = \frac{v}{2} - \frac{1}{4}$.

2.4.3 Endogenous Private Negotiation

What if the firm can choose between a public wage offer and private negotiations for each realization of the surplus? For a low-surplus firm $v < \frac{1}{2}$, it cannot afford to hire workers in private negotiations because workers set wages too high. Thus, the low-surplus firm prefers posting a public wage to stay in the labor market. On the other hand, the high-surplus firm, $v \geq \frac{1}{2}$, is able to hire workers under both wage-setting mechanisms, but achieves a higher profit with a public wage offer than with private negotiations.

Lemma 3. *Assume that the wage-setting mechanism is endogenous, and workers are self-serving with $\tau = 0$. There exists a unique pooling equilibrium in which the firm posts a public wage for any realization of the surplus.*

Facing self-serving workers, the firm always prefers posting a public wage than privately negotiating wages with workers for any level of surplus. A public wage offer helps the low-surplus firm stay in the labor market, and helps the high-surplus firm increase both the hiring probability and the expected profit. The advantage of a public wage offer is also known as the "first-mover advantage" in the negotiation literature.

In other words, the standard theory predicts a unique pooling equilibrium at public wage for any realized surplus. This prediction, however, is in sharp contrast with what we observe in common hiring practices in which firms often engage in private negotiations with workers. Arguably, one reason is that the standard theory has failed to incorporate one of the most prominent characteristics of workers: *reciprocity.* In the next sections, I consider the cases of reciprocal workers in that if workers receive positive rents from the firm, they are willing to give back in terms of effort and quality. I will show that when workers are reciprocal, there exists a separating equilibrium in which the high-surplus firm opts for private negotiations.

2.5 An Example – Full Reciprocity

Before going into the general analysis in Section 2.6, I first consider an example of $\tau = 1$, i.e., workers give back the full received rent in terms of effort. At stage 2, the optimal effort is given by $e_i^* = r_i$.

2.5.1 Exogenous Public Wage

Suppose the firm posts a public wage $\overline{w}$ to all prospective workers for all realizations of the surplus v. Let us analyze the case of exogenous public wage using backward induction.

At stage 2 of effort provision, workers receive the public wage $\overline{w}$, and equivalently a rent $r_i = \overline{w} - \theta_i$. Thus, workers' effort is given by $e_i^* = r_i = \overline{w} - \theta_i$.

At the end of the wage bargaining stage, workers observe the public wage. Knowing that the firm is committed to the public wage, workers' decision is a binary choice of accepting or rejecting the public wage. In particular, workers accept the public wage if the public wage is at least as good as the outside option $\theta_i \leq \overline{w}$. Otherwise, workers reject the public wage if the outside option exceeds the public wage $\theta_i > \overline{w}$.

At the beginning of the wage bargaining, the firm expects workers with outside options up to the public wage $\theta_i \leq \overline{w}$ to accept, and chooses the public wage $\overline{w}$ to maximize its expected profit, which is a sum of its net surplus and quality. The firm's objective is given by

$$\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v - \overline{w}) + (\overline{w} - E(\theta_i|\theta_i \leq \overline{w}))]$$

The firm expects to hire worker i with probability $P(\theta_i \leq \overline{w}) = \overline{w}$ under a uniform distribution of θ_i. The first term in the square brackets $(v - \overline{w})$ is the net surplus after paying the public wage $\overline{w}$. The second term in the square brackets $(\overline{w} - E(\theta_i|\theta_i \leq \overline{w}))$ is the expected quality conditional on hiring. Under a uniform distribution of θ_i, the expected quality equals to $\frac{\overline{w}}{2}$. Solving for the first-order condition of the firm's objective, I get the optimal public wage that maximizes the firm's expected payoff: $\overline{w}^* = v$

Proposition 1. *Assume that the wage-setting mechanism is exogenous public wage. Suppose that workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ and workers give back the full rent they receive $\tau = 1$. Then, in equilibrium, the equilibrium wage equals to the surplus $\overline{w}^* = v$, and workers with $\theta_i \leq v$ are employed.*

In exogenous public wage, the firm posts a public wage equal to the realized surplus $\overline{w}^* = v$. In contrast to the equilibrium with self-serving workers in which the firm prefers to suppress the public wage below the surplus, workers' reciprocity brings back the efficiency in the labor market in that all workers with outside options below the surplus $\theta_i \leq v$ are employed. Intuitively, the firm expects reciprocal workers to give back in terms of effort and quality. It thus shifts the firm's focus from maximizing its net surplus (in the standard setting) to maximizing the hiring probability (in the full reciprocity setting). To maximize the hiring probability of a profitable match, the firm sets the public wage equal to the surplus.

The equilibrium under exogenous public wage and a linear gift exchange function with $\tau = 1$ is characterized by the equilibrium wage of v. In equilibrium, the probability of hiring is $P(\theta_i \leq v) = v$. Conditional on hiring, the firm yields a net surplus of zero and expected quality of $\frac{v}{2}$. Employed workers (i.e. workers with $\theta_i \leq v$) receive positive rents $r_i = v - \theta_i$.

2.5.2 Exogenous Private Negotiation

Let us turn to exogenous private negotiation. In exogenous private negotiation, the firm does not post a wage, and thus workers do not have any prior wage information before bargaining their wages.[6] Workers bargain through a take-it-or-leave-it initial offer w_i. In particular, workers choose an initial offer w_i to maximize their wages and the probability of being hired. Worker i's objective is given by

$$\arg\max_{w_i} P(v \geq \tilde{\theta}_i(w_i))w_i + P(v < \tilde{\theta}_i(w_i))\theta_i$$

where the perceived outside option $\tilde{\theta}_i(w_i)$ is the firm's posterior belief about worker's outside option θ_i after observing the initial offer w_i.

The probability that the firm hires worker i after receiving an initial offer w_i depends on whether the firm thinks that hiring at the initial offer is profitable. The firm's expected gain from hiring includes the surplus v and the expected quality $w_i - \tilde{\theta}_i(w_i)$. Because worker i gives back the full rent in terms of quality, the firm hires worker i whenever the surplus exceeds the firm's belief about the worker's outside option, i.e., $v \geq \tilde{\theta}_i(w_i)$. Thus worker i expects to be employed whenever the surplus v exceeds the perceived outside option $\tilde{\theta}_i(w_i)$. If employed, worker i receives the initial offer w_i; otherwise, worker i receives the outside option θ_i.

Worker i's wage strategy $w_i(\theta_i)$ is a mapping from the outside option θ_i to an initial offer w_i. In equilibrium, the firm's belief about worker i's strategy coincides with worker i's strategy. Thus, given worker i's wage strategy $w_i(\theta_i)$, the firm's posterior belief about worker's outside option is given by $\tilde{\theta}_i(\cdot) := w_i^{-1}(\cdot)$.

I assume that worker i employs a linear wage strategy, that is, $w_i(\theta_i) = \alpha\theta_i + \beta$. Consequently, the firm's posterior belief about the outside option is given by $\tilde{\theta}_i(w_i) = \frac{w_i}{\alpha} -$

[6] The assumption that workers do not have any prior knowledge about potential wages in private negotiations is in line with the evidence that workers within an organization rarely discuss their wages and that access to wage information is often limited (Hegewisch, Williams and Drago, 2011; Edwards, 2005; Cullen and Perez-Truglia, 2018).

$\frac{\beta}{\alpha}$. Given the firm's posterior belief $\tilde{\theta}_i$, worker i sets the optimal initial offer $w_i^* = \frac{\theta_i}{2} + \frac{\alpha+\beta}{2}$. The optimal initial offer should coincide with the firm's belief about worker i's strategy $w_i = \alpha\theta_i + \beta$. Thus, the optimal wage strategy is given by $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$.

Proposition 2. *Assume that the wage-setting mechanism is exogenous private negotiation and workers employ a linear wage strategy. Suppose that workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ and workers give back the full rent they receive $\tau = 1$. Then, in equilibrium, the equilibrium wage $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$, and workers with $\theta_i \leq v$ are employed.*

In an exogenous private negotiation, workers set an initial offer $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$. Note that the wage offer w_i^* exceeds θ_i for all $\theta_i \in [0, 1]$, that means workers bargain aggressively in private negotiations, setting wages above their outside options. In equilibrium, the firm can correctly identify worker i's outside option. Upon receiving the initial wage w_i^*, the firm forms a posterior belief about worker i's outside option $\tilde{\theta}_i(w_i^*) = 2w_i^* - 1 = \theta_i$. The firm hires all workers with $\theta_i \leq v$, and is willing to overpay workers $w_i^* \geq \theta_i$.

From the firm's perspective, the equilibrium under exogenous private negotiation and a linear gift exchange function with $\tau = 1$ is characterized by the equilibrium wage $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$. In equilibrium, the probability of hiring is $P(\theta_i \leq v) = v$. Conditional on hiring worker i, the firm yields an expected net surplus of $\pi_i = v - E(w_i^* | \theta_i \leq v) = \frac{3v}{4} - \frac{1}{2}$. Employed workers (i.e. workers with $\theta_i \leq v$) receive positive rents $r_i = w_i^* - \theta_i = -\frac{\theta_i}{2} + \frac{1}{2}$. Thus, the firm expects quality of $E(-\frac{\theta_i}{2} + \frac{1}{2} | \theta_i \leq v) = \frac{1}{2} - \frac{v}{4}$.

Comparing the equilibrium of exogenous public wage and exogenous private negotiation under a linear gift exchange function with $\tau = 1$, the hiring probability remains unchanged at $P(\theta_i \leq v)$, as under both mechanisms the firm hires all workers with $\theta_i \leq v$. Recall that the firm retains a net surplus of zero and achieves the expected quality of $\frac{v}{2}$ in a public wage offer. With respect to net surplus, the firm yields a higher net surplus under private negotiations if the surplus is sufficiently high ($v \geq \frac{2}{3}$). However, with a high surplus ($v \geq \frac{2}{3}$), the quality is lower under private negotiations. Intuitively, a high surplus ensures that the firm can afford bargaining wages from workers and yield positive net surplus. On the other hand, with a high surplus, the firm could have paid more to workers by posting a public wage and achieved higher quality.

This observation highlights that, given a surplus v, the firm faces a trade-off between net surplus and quality when choosing between a public wage offer and private negotiations. In the next section, I examine how the surplus v influences the firm's endogenous choice of wage-setting mechanisms—endogenous private negotiation.

2.5.3 Endogenous Private Negotiation

In this part, I study the firm's choice between a public wage offer and private negotiations as a function of the surplus v. Different from exogenous public wage and exogenous private negotiation, in which the firm has no choice over the wage-setting mechanism, endogenous private negotiation allows the firm to specify a wage-setting mechanism for *each* realization of the surplus v. After knowing the surplus v, the firm can choose between a public wage offer or private negotiations to bargain wages with workers. The firm's choice of a wage-setting mechanism contingent on the surplus is characterized in the following Proposition.

Proposition 3. *Assume the wage-setting mechanism is endogenous private negotiation and workers employ a linear wage strategy. Suppose that workers exhibit a linear gift exchange function* $e_i^* = \tau r_i$ *and workers give back the full rent they receive* $\tau = 1$*. For each* $\overline{v} \in [0,1]$*, there exists a separating equilibrium in which the low-surplus firm* $v \in [0,\overline{v}]$ *self-selects into a public wage offer and the high-surplus firm* $v \in [\overline{v},1]$ *self-selects into private negotiations.*

Consider the firm's strategy when the surplus is low $v \in [0,\overline{v}]$. In the equilibrium, the firm optimally posts a public wage $\overline{w}^* = v$ and employs all workers with $\theta_i \le v$. If the firm stays on the equilibrium path, the firm hires workers with probability $P(\theta_i \le v) = v$, and yields a net surplus of zero and an expected quality of $\frac{v}{2}$. Thus, the firm's equilibrium payoff is given by $\frac{v^2}{2}$.

If the firm deviates to private negotiations, workers believe that the firm has a high surplus $v \in [\overline{v},1]$. When bargaining wages, workers would then demand at least $\overline{v}$ and optimally set the initial offer $w_i^* = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$.[7] As compared to exogenous private negotiation, workers with a low outside option (i.e., $\theta_i \le 2\overline{v} - 1$) bargain wages even more aggressively, setting a higher initial offer $w_i^* = \overline{v} \ge \frac{\theta_i}{2} + \frac{1}{2}$. While the firm prefers to hire all workers with $\theta_i \le v$, it cannot effectively identify the outside options of workers who demand $w_i^* = \overline{v}$.

Case 1. Suppose that $2\overline{v} - 1 > v$ such that the firm prefers to hire only those workers who demand $w_i^* = \overline{v}$. The expected profit of hiring at $w_i^* = \overline{v}$ is given by

$$P(\theta_i \le 2\overline{v} - 1)\Big[(v - \overline{v}) + (\overline{v} - E(\theta_i|\theta_i \le 2\overline{v} - 1))\Big]$$

This expected deviation payoff increases in v, so it is sufficient to check whether the firm of $v = \overline{v}$ has an incentive to deviate. At $v = \overline{v}$, the firm does not deviate if and only if the equilibrium payoff is at least as good as the expected payoff from deviating.

$$\begin{aligned} &\frac{\overline{v}^2}{2} \ge \overline{v} - \frac{1}{2} \\ \Leftrightarrow &(\overline{v} - 1)^2 \ge 0 \quad \text{(Always true)} \end{aligned}$$

Example 1. To understand this scenario better, let us consider an illustrative example. Suppose $\overline{v} = \frac{3}{4}$, then workers with $\theta_i \le 2\overline{v} - 1 = \frac{1}{2}$ demand $w_i^* = \overline{v} = \frac{3}{4}$; and workers with $\theta_i > \frac{1}{2}$ bargain $w_i^* = \frac{\theta_i}{2} + \frac{1}{2} > \frac{3}{4}$. Assume that $v = \frac{1}{4}$ such that the firm only hires workers at $w_i^* = \frac{3}{4}$. The firm's expected payoff from deviating to private negotiation is given by $P(\theta_i \le \frac{1}{2})\Big[v - E(\theta_i|\theta_i \le \frac{1}{2})\Big] = 0$. If the firm stays on the equilibrium path, the firm's expected equilibrium payoff from a public wage offer is $\frac{v^2}{2} = \frac{1}{32} > 0$

Intuitively, when $\overline{v}$ is sufficiently large, a fraction of workers set the initial offer $w_i^* = \overline{v}$, and the firm cannot precisely infer the workers' outside options. For the low-surplus firm,

[7] Note that workers with sufficiently low outside options $\theta_i \le 2\overline{v} - 1$ would demand $w_i^* = \overline{v}$, and workers with sufficiently high outside options $\theta_i > 2\overline{v} - 1$ would bargain $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$.

hiring at $w_i^* = \overline{v}$ entails a possibility that worker i's outside option exceeds the surplus. In this case, the quality produced by worker i cannot compensate the over-payment to worker i. Thus, the firm is better off with a public wage offer, because a public wage offer helps the firm screen out workers and effectively hire those workers with $\theta_i \leq v$.

Case 2. Suppose $\overline{v} \geq v \geq 2\overline{v} - 1$ such that the firm hires all workers with $\theta_i \leq v$, including those who demand $w_i^* = \overline{v}$. In this case, after observing the initial offer w_i^*, the firm can effectively identify the workers' outside options. Thus, the firm hires all workers with $\theta_i \leq v$ and yields the same expected profit if it deviates to private negotiations. In other words, the firm is indifferent between a public wage offer and private negotiations.

From the observations of case 1 and 2, the low-surplus firm does not have an incentive to deviate to private negotiations. Given a low surplus, the firm focuses on optimizing the hiring probability. This is best done with a public wage offer, as a public wage offer helps the firm effectively identify workers with $\theta_i \leq v$.

Consider now the firm's strategy when the surplus is high $v \in [\overline{v}, 1]$. I examine if the high-surplus firm has an incentive to deviate to a public wage offer. In the equilibrium, upon observing private negotiations, workers believe that the firm has a high surplus and set wages $w_i^* = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$. The expected benefit from hiring workers with a low outside option $\theta_i \in [0, 2\overline{v} - 1]$ at $w_i^* = \overline{v}$ is given by

$$P(\theta_i \leq 2\overline{v} - 1)\Big[v - E(\theta_i | \theta_i \leq 2\overline{v} - 1)\Big] \tag{2.1}$$

The expected benefit from hiring workers with a high outside option $\theta_i \in (2\overline{v} - 1, v]$ at $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$ is given by

$$P(2\overline{v} - 1 \leq \theta_i \leq v)\Big[v - E(\theta_i | 2\overline{v} - 1 \leq \theta_i \leq v)\Big] \tag{2.2}$$

The firm's equilibrium payoff from hiring all workers with $\theta_i \leq v$ is the sum of the expected benefits (2.1) and (2.2). In the equilibrium, the firm receives an expected profit of $\frac{v^2}{2}$. If the firm deviates to a public wage offer, it optimally posts a public wage equal to the surplus $\overline{w} = v$, and achieves an expected deviation payoff of $\frac{v^2}{2}$. Thus, in private negotiations the firm yields a payoff at least as good as in a public wage offer.

The indifference of the firm between private negotiations and a public wage offer crucially hinges on the assumptions that the workers' gift exchange function $e_i^* = r_i$ is linear and that workers are fully reciprocal $\tau = 1$. This implies that for every dollar the firm pays out as wages, the firm expects workers to give back a full rent no matter how high wages are. In the next section, I relax the assumption that workers are fully reciprocal and examine how the intensity of reciprocity influences the firm's choice between a public wage offer and private negotiations. In particular, I consider the case of strong reciprocity where workers strongly reciprocate by giving back more than the received rent ($\tau > 1$). In Section 2.7, I discuss the case of weak reciprocity where workers weakly reciprocate by giving back less than the received rent ($\tau < 1$).

2.6 Analysis – Reciprocal Workers

In this main part of the analysis, I consider a general setting in which worker's reciprocity is represented by the parameter $\tau \in [1, 2)$. The argument for the case of $\tau = 1$ coincides with the above example of fully reciprocal workers. Hence, in some instances, I will focus my attention on strong reciprocity ($\tau > 1$).

In what follows, I sequentially examine the cases of exogenous public wage, exogenous private negotiation, and endogenous private negotiation. I will show that when workers are strongly reciprocal, there exists a separating equilibrium when the firm can choose between a public wage offer and private negotiations. Different from the example of fully reciprocal workers, the separating equilibrium with strongly reciprocal workers is unique.

2.6.1 Exogenous Public Wage

In exogenous public wage, the firm does not have a choice between a public wage offer and private negotiations, but can only post a public wage $\overline{w}$ to all prospective workers.

Following closely the previous arguments, the firm chooses a public wage $\overline{w}$ to maximize the expected profit as a sum of its net surplus and quality. Announcing the public wage $\overline{w}$, the firm attracts all workers with $\theta_i \leq \overline{w}$. Thus, the firm's objective function is given by

$$\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v - \overline{w}) + \tau(\overline{w} - E(\theta_i|\theta_i \leq \overline{w}))]$$

The firm receives back the quality proportional to the rent $\tau(\overline{w} - E(\theta_i|\theta_i \leq \overline{w}))$. Solving for the first-order condition of the firm's objective, the optimal public wage is given by $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$.

Proposition 4. *Assume that the wage-setting mechanism is exogenous public wage. Suppose that workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ and workers give back more than the rent they receive $\tau > 1$. Then, in equilibrium, the equilibrium wage, $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$, exceeds the surplus, and workers with $\theta_i \leq \frac{v}{2-\tau}$ are employed.*

Note that for $\tau > 1$ the equilibrium wage $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\} \in (v, 1]$. When workers are strongly reciprocal in that they are willing to produce positive quality, and to a greater extent than the received rent, the firm sets a public wage above the surplus. The intuition is straight-forward. Recall that the firm sets the public wage equal to the surplus when workers are fully reciprocal. Now, as workers become strongly reciprocal ($\tau > 1$), the firm receives more quality for any given rent, and thus the firm is willing to set the public wage above the surplus to attract workers. Put differently, because of workers' strong reciprocity, the firm puts more weight to maximizing its quality relative to its net surplus. As a result, the firm posts a public wage above the surplus to induce reciprocity from workers.

The equilibrium under exogenous public wage and a linear gift exchange function with $\tau > 1$ is characterized by the equilibrium public wage $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$, which exceeds the surplus v. The firm offering $\overline{w}^* = \frac{v}{2-\tau}$ hires workers with probability $P(\theta_i \leq \frac{v}{2-\tau}) = \frac{v}{2-\tau}$. Conditional on hiring, the firm's net surplus is negative, i.e. $\pi_i = v - \overline{w}^* = \frac{1-\tau}{2-\tau}v \leq 0$, and the firm's quality is positive, i.e. $q_i = \tau \frac{\overline{w}^*}{2} = \tau \frac{v}{2(2-\tau)} \geq 0$. For any given surplus v, as workers' reciprocity τ increases, the hiring probability increases, the firm's net surplus decreases, and the firm's quality increases. As workers become more reciprocal, the firm is willing to post a higher public wage. The higher wage increases the hiring probability and the firm's quality, but decreases the firm's net surplus.

2.6.2 Exogenous Private Negotiation

In exogenous private negotiation, workers initiate by stating their wage offers w_i. The firm privately bargains wages with each worker and hires worker i if the benefit of hiring exceeds the cost of hiring at the initial offer w_i. The benefits of hiring include the surplus v and the quality $\tau(w_i - \tilde{\theta}_i(w_i))$, where $\tilde{\theta}_i(w_i)$ is the firm's belief about worker i's outside option θ_i upon observing the initial offer w_i.

I assume that worker i employs a linear wage strategy $w_i(\theta_i) = \alpha\theta_i + \beta$. It follows that the firm's belief about worker i's outside option is $\tilde{\theta}_i(w_i) = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$. Worker i chooses an initial offer w_i to maximize the chance of being hired and the wage.

$$\arg\max_{w_i} P((v + \tau(w_i - \tilde{\theta}_i)) \geq w_i)w_i + P((v + \tau(w_i - \tilde{\theta}_i)) < w_i)\theta_i$$

Solving for worker i's first-order condition, I characterize the optimal initial offer w_i^* in the following Proposition

Proposition 5. *Assume that the wage-setting mechanism is exogenous private negotiation and workers employ a linear wage strategy. Suppose that workers exhibit a linear gift exchange function* $e_i^* = \tau r_i$ *and workers give back more than the rent they receive* $\tau > 1$. *Then, in equilibrium, the equilibrium wage* $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$, *and workers with* $\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}$ *are employed.*

Similar to a fully reciprocal worker $\tau = 1$, a strongly reciprocal worker $\tau > 1$ sets the initial offer $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$. In other words, workers' reciprocity τ does not affect their wage strategy. Intuitively, on the one hand, as the firm receives back more quality from a strongly reciprocal worker, the worker might increase the wage. On the other hand, a higher wage signals to the firm that the worker has a higher outside option, and hurts the chance of being hired for the worker. The negative effect of a reduced hiring probability cancels out the positive effect of an increased wage, implying that the wage strategy remains identical regardless of the degree of reciprocity.

The fraction of employed workers, however, depends workers' reciprocity τ. If τ equals one, the firm faces fully reciprocal workers and hires all workers with $\theta_i \leq v$. If τ is between one and two, the firm hires workers with $\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}$, where $1 \geq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1} \geq v$ for all $\tau \in (1, 2)$. As the degree of reciprocity τ increases, the fraction of employed workers expands under exogenous private negotiation.

From the firm's perspective, the equilibrium under exogenous private negotiation and a linear gift exchange function with $\tau > 1$ is characterized by the equilibrium wage $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$. In equilibrium, the firm of any surplus $v \in [0, 1]$ can participate in private negotiations and the probability of hiring is $P(\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) \geq v$. Conditional on hiring, the firm achieves an expected net surplus of $\pi_i = v - E(w_i^*|\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) = \frac{2\tau+1}{2(\tau+1)}v - \frac{3\tau+1}{4(\tau+1)}$ and quality $q_i = \tau E(w_i^* - \theta_i|\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) = \frac{\tau(\tau+3-2v)}{4(\tau+1)}$. For any given surplus v, as the intensity of reciprocity τ increases, the probability of hiring and the firm's quality increase, but the firm's net surplus decreases. The resulting increases in the hiring probability and in the firm's quality outweigh the resulting decrease in the firm's net surplus and, as a consequence, the firm's payoff increases with more reciprocal workers.

Given a level of reciprocity τ, when comparing between exogenous public wage and exogenous private negotiation, for a firm with a sufficiently high surplus v, private negotiation yields a higher net surplus. However, with a high surplus, private negotiations result in lower quality. In the next section, I examine the trade-off between net surplus and quality when the firm endogenously chooses between a public wage offer and private negotiations.

2.6.3 Endogenous Private Negotiation

I now consider the endogenous case in which the firm can choose between private negotiations and a public wage offer after observing the surplus v. Put differently, the firm specifies a wage-setting mechanism, i.e. private negotiations or a public wage offer, for each realization of the surplus. I will show that there exists a separating equilibrium in which the low-surplus $v \in [0, \overline{v}]$ opts for a public wage offer and the high-surplus firm $v \in [\overline{v}, 1]$ opts for private negotiations. Moreover, in sharp contrast to the case of fully reciprocal workers, the separating equilibrium is unique. The main result is covered in the following Proposition.

Proposition 6. *Assume the wage-setting mechanism is endogenous private negotiation and workers employ a linear wage strategy. Suppose workers exhibit a linear gift exchange function* $e_i^* = \tau r_i$ *and workers give back more than the rent they receive* $\tau > 1$. *Then there exists a unique separating equilibrium in which the low-surplus firm* $v \in [0, \overline{v}]$ *self-selects into a public wage offer and the high-surplus firm* $v \in [\overline{v}, 1]$ *self-selects into private negotiations. The cutoff threshold* $\overline{v}$ *is given by*

$$\overline{v} = \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1}$$

To understand Proposition 6, I will provide the intuition in two steps: why such a separating equilibrium exists, and why it is unique. The complete proof of the proposition can be found in the appendix.

Regarding the existence of the separating equilibrium, consider first the low-surplus firm $v \in [0, \overline{v}]$ that chooses a public wage offer. Analogous to the above analysis, in equilibrium, the firm optimally posts a public wage $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$. The firm offering $\overline{w}^* = \frac{v}{2-\tau}$ receives an equilibrium payoff of $\frac{v^2}{2(2-\tau)}$, which is characterized by the hiring probability of $\frac{v}{2-\tau}$ and, conditional on hiring, the expected sum of net surplus and quality $\pi_i + q_i = v\frac{1-\tau}{2-\tau} + v\frac{\tau}{2(2-\tau)} = \frac{v}{2}$.

If the firm deviates to private negotiations, workers believe that the firm has a high surplus $v \in [\overline{v}, 1]$ and demand at least $w_i = \overline{v}$. In particular, worker i's wage strategy is given by $w_i = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$, that is, a fraction of workers having a low outside option $\theta_i \leq 2\overline{v} - 1$ demand $w_i = \overline{v}$, and another fraction of workers having a high outside option $\theta_i \geq 2\overline{v} - 1$ demand $w_i = \frac{\theta_i}{2} + \frac{1}{2} \geq \overline{v}$. Given the workers' wage strategy, the low-surplus firm has no incentive to deviate from a public wage offer to private negotiations if and only if the equilibrium payoff from the public wage offer exceeds the deviation payoff from private negotiations. This is the case if the cutoff threshold $\overline{v}$ is sufficiently large, i.e.,

$$\overline{v} \geq \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1} \tag{2.3}$$

In this case, if the firm deviates to private negotiations, workers would bargain too aggressively, demanding at least $\overline{v}$. Higher wages paid to workers imply that the low-surplus firm $v \in [0, \overline{v}]$ incurs a substantial negative net surplus, which cannot be compensated by the countering improvement in quality. Thus, the low-surplus firm prefers a public wage offer over private negotiations.

Turning attention to the firm with a high surplus $v \in [\overline{v}, 1]$, I show that the firm prefers private negotiations over a public wage offer if $\overline{v}$ is sufficiently small. In equilibrium, as the firm chooses private negotiations, workers believe that the firm has a high surplus $v \in [\overline{v}, 1]$ and optimally set their initial offer $w_i^* = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$. If the firm deviates to posting a public wage $\overline{w}$, workers with $\theta_i \leq \overline{w}$ would accept the offer. Yielding a net surplus of $\pi_i = v - \overline{w}$ and quality of $q_i = \tau(\overline{w} - E(\theta_i|\theta_i \leq \overline{w})) = \tau\frac{\overline{w}}{2}$, the firm sets the public wage $\overline{w} = \min\{\frac{v}{2-\tau}, 1\}$ and achieves a deviation payoff of $\frac{v^2}{2(2-\tau)}$. The high-surplus firm $v \in [\overline{v}, 1]$ prefers staying in the equilibrium than deviating if and only if the equilibrium payoff from private negotiations exceeds the deviation payoff from a public wage offer. This is the case if the cutoff threshold $\overline{v}$ is sufficiently small, i.e.,

$$\overline{v} \leq \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1} \tag{2.4}$$

Intuitively, the firm with a high surplus $v \in [\overline{v}, 1]$ enjoys double benefits under private negotiations. First, with a sufficiently high surplus v and a sufficiently small $\overline{v}$, the firm is able to afford workers' wage offers and yields a positive net surplus. Second, private negotiations allow workers to voice their wage offers, exceeding workers' outside options, and thus the firm yields positive quality. These advantages make the high-surplus firm prefer private negotiations over a public wage offer.

Simultaneously satisfying both conditions (2.3) and (2.4), the cutoff threshold is uniquely defined as

$$\overline{v} = \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1}$$

Regarding the uniqueness of the separating equilibrium, I examine three alternative pure equilibria: (i) a pooling equilibrium at public wage, (ii) a pooling equilibrium at private negotiation, and (iii) a separating equilibrium in which the low-surplus firm opts for private negotiations and the high-surplus firm opts for a public wage offer. In what follows, I will provide counterexamples to illustrate why such equilibria do not exist.

First, with respect to a pooling equilibrium at public wage, as in the previous analysis, in equilibrium the firm of any v posts a public wage $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$, and yields an expected equilibrium payoff of $\frac{v^2}{2(2-\tau)}$. If the firm deviates to private negotiations, workers do not receive any wage information before the negotiation, and set their initial offers $w_i = \frac{\theta_i}{2} + \frac{1}{2}$. In this case, the firm hires all workers with $\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}$ and, conditional on hiring, yields an expected sum of net surplus and quality of $\pi_i + q_i = \frac{2v+\tau-1}{4}$. The firm thus expects a deviation payoff of $\frac{(2v+\tau-1)^2}{4(\tau+1)}$. For the firm with $v = 0$, the deviation payoff from private negotiations $\frac{(\tau-1)^2}{4(\tau+1)}$ is higher than the equilibrium payoff 0 from the public wage offer. In other words, the firm with $v = 0$ has an incentive to deviate to private negotiation. Hence, a pooling equilibrium at public wage does not exist.

The pooling equilibrium at public wage differs from the separating equilibrium in Proposition 6 in two aspects. First, workers' wage strategy in private negotiations is less aggressive in the pooling ($w_i = \frac{\theta_i}{2} + \frac{1}{2}$) than in the separating equilibrium ($w_i = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$), with workers demanding at least $\overline{v}$ in the separating equilibrium. Second, upon observing workers' initial offers w_i, the firm in the pooling equilibrium can effectively identify workers' outside options, whereas the firm in the separating equilibrium cannot distinguish among workers demanding $\overline{v}$, which might lead to over-hiring for the low-surplus firm. These two aspects result in that the low-surplus firm has an incentive to deviate to private negotiations in the pooling at public wage equilibrium, but not in the separating one.

Second, with respect to a pooling equilibrium at private negotiation, in equilibrium workers enter negotiations without receiving any wage information, and set their initial offers $w_i = \frac{\theta_i}{2} + \frac{1}{2}$. Hiring all workers with $\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}$, the firm obtains an equilibrium payoff of $\frac{(2v+\tau-1)^2}{4(\tau+1)}$. If the firm deviates to a public wage offer, it posts a public wage $\overline{w} = \min\{\frac{v}{2-\tau}, 1\}$. The firm with $v = 1$ sets $\overline{w}^* = 1$ and yields an expected deviation payoff of $\frac{\tau}{2}$. Thus, at $v = 1$, the firm has an incentive to deviate to a public wage offer, because the equilibrium payoff from private negotiations falls short of the deviation payoff from a public wage offer. Thus, a pooling equilibrium at private negotiation does not exist.

The reason why the high-surplus firm prefers to deviate to posting a public wage in the pooling equilibrium at private negotiation, but not in the separating equilibrium in Proposition 6, is that the high-surplus firm can—and prefers to—pay high wages to workers in order to induce workers' reciprocity and improve quality. High wages can be achieved in the separating equilibrium due to workers' belief that the surplus is high $v \in [\overline{v}, 1]$, while in the pooling equilibrium at private negotiation, high wages can be reached with the firm deviating to a public wage offer and announcing a high public wage.

Last, I examine the existence of a separating equilibrium in which the low-surplus firm $v \in [0, \tilde{v}]$ opts for private negotiations and the high-surplus firm $v \in [\tilde{v}, 1]$ opts for a public wage offer. Consider the low-surplus firm $v \in [0, \tilde{v}]$ that chooses private negotiations. In equilibrium, workers believe that the surplus is low $v \in [0, \tilde{v}]$ and set their initial offers $w_i = \frac{\theta_i}{2} + \frac{\tilde{v}}{2}$. This implies that workers with $\theta_i > \tilde{v}$ are discouraged to apply because they are better off with their outside options $\theta_i > w_i$. Conditional on hiring workers with $\theta_i \leq \frac{2v}{\tau+1} + \frac{(\tau-1)\tilde{v}}{\tau+1}$, the firm yields an expected sum of net surplus and quality $\frac{2v+(\tau-1)\tilde{v}}{4}$, leading to an equilibrium payoff of $\frac{(2v+(\tau-1)\tilde{v})^2}{4(\tau+1)}$. If the firm deviates to a public wage offer, it posts a public wage $\overline{w} = \min\{\frac{v}{2-\tau}, 1\}$ and achieves a deviation payoff of $\frac{v^2}{2(2-\tau)}$. The firm with $v = \tilde{v}$ then has an incentive to deviate from private negotiations to a public wage offer. Thus, the separating equilibrium in which the low-surplus firm chooses private negotiations and the high-surplus firm chooses a public wage offer does not exist.

Taken together, these observations imply that the separating equilibrium in Proposition 6 is unique. Negotiating wages with reciprocal workers, the firm faces a trade-off between net surplus and quality when choosing between a public wage offer and private negotiations. On the one hand, the low-surplus firm has a slim chance of matching with workers, and thus prefers a public wage offer in order to maximize the hiring probability and its net surplus, however at the expense of forgoing quality. On the other hand, for the high-surplus firm, because the hiring probability is high, its priority shifts from maximizing its net surplus to inducing workers' reciprocity and improving quality. To achieve this objective, private negotiation serves as a better mechanism to tailor rents to workers by allowing them to voice their initial offers in proportion to their outside options.

2.7 Discussion

In the section, I will discuss how two crucial features of workers' reciprocity affect the equilibrium: the intensity of reciprocity—as captured by the parameter τ—and the curvature of the gift exchange function—whether it is linear or concave.

2.7.1 Weak Reciprocity

So far, I have covered the case of strong reciprocity $\tau \geq 1$. In this part, I examine the case of weak reciprocity, i.e., upon receiving a positive rent from the firm, workers return the favor in terms of quality, but the returned quality does not exceed the received rent. Put differently, workers' gift exchange function is given by $e_i^* = \tau r_i$, where $\tau < 1$.

Similar to the case of strong reciprocity, the exogenous public wage equilibrium in the case of weak reciprocity ($\tau < 1$) is characterized by the equilibrium public wage $\overline{w}^* = \frac{v}{2-\tau}$ and the fraction of employed workers $\theta_i \leq \frac{v}{2-\tau}$. However, subject to weaker intensity of reciprocity $0 < \tau < 1$, the equilibrium wage $\overline{w}^* = \frac{v}{2-\tau}$ falls below the surplus v. More specifically, when workers are weakly reciprocal in that they are willing to produce positive quality but to a lesser extent of the received rent, the firm sets a public wage $\overline{w}$ above that for self-serving workers $\frac{v}{2}$ but below that for fully reciprocal workers v. In short, the intensity of reciprocity affects the firm's wage strategy.

The exogenous private negotiation equilibrium, on the other hand, remains robust to the intensity of reciprocity. The equilibrium under exogenous private negotiation and weak reciprocity $\tau < 1$ is characterized by the equilibrium wage $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$ and the fraction of employed workers $\theta_i \leq \frac{2v}{\tau+1} - \frac{1-\tau}{\tau+1}$. While the intensity of reciprocity does not affect workers' wage strategy, it does however influence the fraction of workers being employed. As workers' reciprocity τ decreases, the firm employs a smaller fraction of workers because it receives less quality from workers. Furthermore, in the case of weak reciprocity, the firm with $v < \frac{1-\tau}{2}$ cannot participate in private negotiations because workers bargain wages too aggressively.

Yet, different from the case of strong reciprocity, a separating equilibrium in which the firm of a low surplus $v \in [0, \overline{v}]$ chooses a public wage offer and a high surplus $v \in [\overline{v}, 1]$ chooses private negotiations does not exist under weak reciprocity. The firm at the cutoff threshold $v = \overline{v}$ always prefers a public wage offer over private negotiations. Intuitively, when workers are weakly reciprocal, the firm focuses on maximizing its net surplus, rather than improving its quality, and thus prefers a public wage offer. In essence, a public wage offer serves as an efficient mechanism to suppress wages and to increase the hiring probability. At the extreme, when workers are self-serving $\tau = 0$, there exists a unique pooling equilibrium at public wage, which replicates the finding in the standard literature.

2.7.2 Concave Gift Exchange Function

In this section, I relax the assumption that the gift exchange function is linear and discuss the implication of a concave gift exchange function on the exogenous public wage and exogenous private negotiation equilibria. In particular, I assume that the gift exchange function is concave, i.e., the effort exerted by workers is concave in the rents they receive from the firm and takes the form of $e_i^* = \sqrt{r_i}$. The concavity of a gift exchange function implies that an increase in rent induces a higher optimal effort, but the marginal return to rent in terms of effort is diminishing. Simply put, as the firm initially gives rent to workers, they strongly reciprocate in terms of effort. However, as the firm increases rent further, workers increase their effort to a lesser extent.[8]

The optimal effort level $e_i^* = \sqrt{r_i}$ implies that workers are strongly reciprocal, i.e. for any level of rent $r_i \in [0, 1]$ workers receive, they are willing to give back in terms of quality more than the received rent. As a result, analogous to the analysis of strong reciprocity, the equilibrium under exogenous public wage and concave gift exchange is characterized by the equilibrium wage that exceeds the surplus $\overline{w}^* \geq v$. That said, the curvature of the gift exchange function does not qualitatively affect the firm's wage strategy.

On the other hand, the concavity of the gift exchange function influences the workers' wage strategy in the exogenous private negotiation equilibrium. Given the concave gift exchange function $e_i^* = \sqrt{r_i}$, workers bargain more aggressively than in the case of a linear gift exchange function $e_i^* = \tau r_i$. More specifically, workers set their wage offers $w_i^* > \frac{\theta_i}{2} + \frac{1}{2}$

[8]The concavity assumption of worker's gift exchange function is in line with List and Momeni (2020)'s finding that upfront payments induce a gift-exchange effect that is concave in the share of total wage paid upfront.

in private negotiations. Intuitively, for workers, the trade-off lies between the wage offer and the hiring probability. By demanding higher wages, workers might receive higher wages. However, higher wages signal higher outside options, which reduce the chance of being hired for the workers. In the case of a linear gift exchange, these two forces cancel each other out, leaving the workers' strategy unchanged. In the case of a concave gift exchange, the positive effect of receiving higher wages outweigh the negative effect of lowering the hiring probability, making workers bargain more aggressively.

All in all, the intensity of reciprocity matters for the firm: workers' reciprocity affects the firm's wage strategy in a public wage offer, but does not change the workers' wage strategy in private negotiations. On the other side, the curvature of the gift exchange function matters for the workers: the concavity of the gift exchange function influences the workers' wage strategy in private negotiations, but does not qualitatively affect the firm's wage strategy in a public wage offer.

2.8 Conclusion

In this chapter, I examine how the firm determines its wage-setting mechanism, i.e. posting a public wage or negotiating wages with workers. In particular, I show that the surplus generated from the match influences the firm's choice between a public wage offer and private negotiations. Contributing to the literature on wage bargaining, I incorporate a prominent behavior trait of workers—reciprocity—into the standard bargaining model.

I find that, when bargaining wages with reciprocal workers, the firm faces a trade-off between net surplus and quality in the choice between a public wage offer and private negotiations. On the one hand, a public wage offer creates the "first-mover" advantage, and thereby suppresses wages and improves the firm's net surplus. On the other hand, private negotiations, allowing workers to aggressively bargain wages, induce workers' reciprocity and improve the firm's quality.

The trade-off brings about a separating equilibrium in which, facing strongly reciprocal workers, the low-surplus firm self-selects into a public wage offer and the high-surplus firm self-selects into private negotiations. Intuitively, the low-surplus firm, with its focus on increasing the hiring probability and maximizing its net surplus, prefers a public wage offer; while the high-surplus firm shifts its priority to induce workers' reciprocity and improve quality, and thus prefers private negotiations. Importantly, the separating equilibrium is unique. I show that alternative pure equilibria—such as a pooling equilibrium at public wage, a pooling equilibrium at private negotiation, and a separating equilibrium where the low-surplus firm chooses private negotiation and the high-surplus firm chooses a public wage offer—do not exist.

Lastly, the shape of the gift exchange function plays an important role in determining the equilibrium wage. The intensity of workers' reciprocity, i.e. the slope of the gift exchange function, influences the firm's wage strategy in a public wage offer. Furthermore, the concavity of the gift exchange function affects the workers' wage strategy in private negotiations.

Chapter 3

Work Environment, Mental Health, and The Pandemic*

How COVID-19 affected loan officers' work in India

3.1 Introduction

Covid-19 has impacted and continues to affect life across the globe in various domains, ranging from work (e.g., Brodeur et al., 2020) to leisure (e.g., Lee and Tipoe, 2020) and mental health (e.g., Fetzer et al., 2020). This chapter focuses on issues related to working during the pandemic, in an industry that has been severely affected by the crisis and where work from home is hard to implement due to the nature of the tasks and technological restrictions: microfinance. We document how the work of loan officers changes during the pandemic as compared to before, how employees are impacted in terms of work organization and mental well-being, and whether leadership can play a mitigating role. To do so, we collect panel survey data from over 500 employees of a large Indian microfinance organization from December 2019 to December 2020 and use administrative records of performance indicators to characterize the work environment. We find i) even though the working environment has become more challenging, the tasks required from loan officers have not changed; ii) perceived stress worsened at the early stages of the pandemic, but showed signs of improvement at the later stages; and iii) leadership seems to be positively related to performance, and to loan officers' subjective well-being during the pandemic.

With over 140 million borrowers world-wide, the microfinance sector provides access to financial services to low-income clients who lack (easy) access to traditional banks. However, with the collapse of household incomes during the pandemic in especially this population, as documented e.g. by Kesar et al. (2020), repayment capacity of clients is low (Ogden and Bull, 2020), which threatens the collapse of the entire sector (Malik et al., 2020). In addition to issues related to re-financing, lockdowns and restrictions to gatherings pose severe limitations on the usual operating procedures of microfinance

*This chapter is based on joint work with Kristina Czura, Florian Englmaier, and Lisa Spantig.

institutions (MFIs) (Pandey and Ojha, 2020). Operations traditionally rely on frequent personal interactions (Breza, 2014; Giné and Karlan, 2014) and social pressure to ensure traditionally high repayment rates (Czura, John and Spantig, 2020). Loan officers, who constitute the largest share of staff within MFIs, function as the direct link between the organization and its customers, and thus assume a crucial role in this sector.

In India, the first Covid-19 case was reported on January 30, 2020 (Andrews et al., 2020) and a very restrictive nation-wide lockdown was in place from March 24 to April 20, with restrictions being slowly eased afterwards depending on the local situation. On March 26, a 1.7 trillion INR relief package was announced by the Ministry of Finance. One day later, the Reserve Bank of India announced a debt moratorium for an initial period of three months (until May 31), which was later extended until the end of August 2020. Despite all governmental efforts, poor workers and the urban poor showed daily income drops of 60% (Lee et al., 2020) to nearly 90% (Afridi, Dhillon and Roy, 2020) during the lockdown, related to high rates of job loss. Microfinance clients in India are thus likely to face similar problems as clients in other countries that have directly been linked to drastically reduced repayment capacity (Malik et al., 2020; Ogden and Bull, 2020).

Reflecting the severe drop in incomes in samples that are comparable to microfinance borrowers, we document a drastic drop in repayment collection rates from 92% in March to 3% in April 2020 using administrative records. The lockdown and the debt moratorium have led to a challenging work environment, not only with collection rates drastically dropping, but also portfolio-at-risk rates increasing and client numbers decreasing. Even with lockdown restrictions being eased, the administrative data shows a worsening of business conditions with a continuous decrease of client numbers and loan portfolios up to July.[1] These patterns might be related to the debt moratorium being in place until August 31. While the difficulty of performing the work has clearly increased during the pandemic, the main tasks of loan officers have not changed. Comparing time use for work tasks in December 2019 and in December 2020, around 44% of loan officers' time is spent on activities related to repayment collections. Another 40% of the time is dedicated to handling loan applications and disbursing new loans, and 16% is spent on marketing and acquiring of new clients. Consistent with similar tasks and time allocation, we do not see a change in self-reported work time. However, we find a decrease in effort and some indications that loan officers engage less in planning activities. This might be related to how loan officers perceive their work: the ease of working deteriorated in the second half of the year, which is also reflected in declining performance indicators in summer 2020.

The period in June and July when restrictions were eased further, operations in terms of personal interactions were possible to resume at least partially, but is still heavily affected by the moratorium, loan officers report increasing levels of stress (measured over six weeks in June and July), but no decline in subjective well-being. While levels of subjective well-being also remain stable towards the end of the year, perceived stress levels are lower in December than during summer. Consistent with this slight improvement, we document lower levels of job-related anxiety towards the end of the year.

[1] The administrative data is currently only available until the end of July 2020.

It is widely believed that work organization and implied work stress highly depend on leadership and management skills. How does leadership relate to performance and resilience during the crisis? In microfinance, institutions typically operate in branches. In our setting, branch managers are directly responsible for all activities of a branch, and branches comprise 3-5 loan officers. The management and leadership skills of branch managers, an intermediate management level in our organization, are most relevant for loan officer's work organization. We focus on leadership qualities of branch managers and their relationship with loan officers' performance and mental health. Pre-covid, loan officers with better leaders tend to have a lower share of their portfolio in arrear. This relationship persists during the pandemic, but there is no additional benefit of leadership during the pandemic in terms of performance. Similarly, leadership relates to more planning and higher effort provision before the onset of the pandemic, but has no additional benefit for these relationships during the pandemic. In terms of well-being and perceived stress, which we measure during the pandemic in June/July 2020 and December 2020, we find that leadership is related to better subjective well-being in both points in time, but only find weak evidence that leadership is associated with lower perceived stress levels.

This chapter contributes to several strands of literature. First, we focus on employees in a developing country and document how they and their work are affected by the pandemic over the course of a year. Most of the literature on working during the pandemic either focuses on employees in developed countries (see e.g. Baker et al. (2020); Bartik et al. (2020); Barrero, Bloom and Davis (2020); Von Gaudecker et al. (2020) and Brodeur et al. (2020) for a review) or on workers and self-employed business owners in developing countries (e.g. Lee et al. (2020) and Dai, Hu and Zhang (2020)). For example, comparing early labor market impacts in Germany, the UK and the US, Adams-Prassl et al. (2020*b*) find significant heterogeneity across those countries. This highlights the limited generizability of findings and the need to study different contexts. While most of the above articles examine labor market outcomes with a focus on the ability to work at all, they do not provide a detailed description of how work has changed, and the struggles employees face. Two exceptions are Etheridge, Wang and Tang (2020) and Lee and Tipoe (2020) who use representative survey data from the UK to document how the lockdown and work from home affect different segments of the population in terms of time use and productivity. Comparable evidence from developing countries is lacking and we see our study as a first step to better understand the continuity of work for employees who did not lose their job. The most comprehensive study of labor market impacts at the onset of the pandemic in developing countries across the globe is likely Khamis et al. (2021). They conduct phone surveys in 39 countries from April to July 2020 and report job loss for a third of the respondents. They also find that 20% of the wage workers who continue to work report partial or no payments, which corresponds to reports of partial or no payments for April or May in our sample. In contrast to the studies above, we are able to observe respondents before the start of the pandemic and at various points in time thereafter. This allows us to investigate how patterns change once lockdowns are eased.

Second, we provide detailed evidence on how loan officers, the crucial link between MFIs and borrowers, are handling the pandemic. The impact of Covid on microfinance has predominantly been described with respect to the industry and institutions as a whole (Ogden and Bull, 2020; Pandey and Ojha, 2020; Mujeri et al., 2020; Malik et al., 2020; Zheng and Zhang, 2021) and the issues that clients face (Malik et al., 2020; Ogden and Bull, 2020). Both of these aspects are important as they determine the financial stability of the sector. Smooth operations depends on staff's dedication in following up with clients and attracting new borrowers. It can hence be severely affected by frustration, demotivation and ultimately the lack of staff, which is why understanding loan officers' concerns is important. To the best of our knowledge, Malik et al. (2020) are the only ones who also interview 200 loan officers in Pakistan in April 2020. While most of the survey questions to loan officers are related to client welfare, the authors also document high levels of stress of loan officers related to the drop in repayment rates and potential job loss, consistent with our findings.

Third, this chapter provides a nuanced description in which aspects leadership might help during a crisis. In general, leaders have been shown to foster trust and cooperation (Tyler, 2013), and promote a share sense of identity and responsibility (Haslam and Platow, 2001; Reicher, Haslam and Hopkins, 2005; Fransen et al., 2015), which might explain why loan officers with appear to perform better under better leadership. Based on evidence from the 2018/19 Ebola outbreak, Van Bavel et al. (2020) argue that leadership can play a crucial role in times of the pandemic. Leaders can coordinate individuals and encourage them to engage in socially responsible behaviours such as, honouring mandated social distancing (Blair, Morse and Tsai, 2017; Tsai, Morse and Blair, 2020), or adopting preventive measures (Vinck et al., 2019). Relatedly, Dirani et al. (2020) conduct a literature review and argue that leadership competencies in times of crisis should adapt and further extend to providing guidance in response to fast-changing situations, integrating technology within the organization, and ensuring employees' emotional stability and well-being. Evidence from the current crisis is still scarce. In the context of integrating technology, Bartsch et al. (2020) survey 206 service employees in Germany who, due to the COVID-19 pandemic, unexpectedly had to transform to a virtual work environment. They find that leadership matters for crisis-induce digital transformation at workplace and helps employees perform in a virtual work environment. Being able to compare effects of leadership on performance before and during the pandemic, we find that leadership is generally associated with better performance, but not differentially so during the crisis. Moreover, leadership is related to higher subjective well-being during a very stressful period, but not to perceived stress per se.

Lastly, we document constant levels of subjective well-being and changing patterns in perceived stress levels with panel data from six weeks in June and July and a one-time measurement in December 2020. A large bulk of the literature investigating the relationship of mental health and the pandemic focuses on early outcomes, in particular effects of lockdowns (e.g. Adams-Prassl et al. (2020*a*); Fetzer et al. (2020) for the US, Sibley et al. (2020) for New Zealand, and Durizzo et al. (2021) for Ghana and South Africa). Consistent with experiences from previous pandemics (SARS, Ebola, H1N1) reviewed in Brooks et al. (2020), most studies report negative psychological effects, including (post-traumatic) stress symptoms and anxiety (see e.g. Rajkumar (2020) for a review of early evidence during

Covid). We complement this literature with evidence from a time period in which the lockdown is already lifted, but other pandemic-related policy measures (in our case the debt moratorium) can still impact the (work) life. We provide suggestive evidence that towards the end of the first year of the pandemic, stress levels have decreased in comparison to summer and that from June onward, levels of subjective well-being remained constant.[2]

The remainder of this chapter is structured as follows. In Section 3.2 we describe the setting and our data sources. In Section 3.3 we first provide descriptive statistics of the work and tasks of loan officers pre-Covid, before we document changes to the work during Covid. We then discuss the role of leadership before and after Covid and briefly present robustness checks for our results. Section 3.4 concludes.

3.2 Background and Data

3.2.1 Organizational Setting

We partner with one large Indian microfinance institution (MFI) that operates mostly in Northern India. In 2019, this MFI served 1.3 million clients who held a total of 801,594 loans worth about 16.5 billion INR (approx. 225 million USD). Responsible for client acquisition and ensuring repayments are loan officers (hereafter LOs), who constitute the largest share of the 2850 employees of the organization. Three to six LOs are located at one branch. The geographical dispersion of branches ensures that especially rural clients can be served. LOs in one branch are supervised by a branch manager, who reports to a hub manager. A hub consists of four to five branches and the hub manager reports to a regional manager. The organization thus is very hierarchical and branches usually only interact at the manager level.

Joint liability clients are grouped and organized in borrower centers (with a median of 88 clients per center), based on geographical proximity. On average, one LO is responsible for 24 borrower centers, each meets weekly at a designated time and location. LOs lead those meetings with the main purpose of ensuring repayment of outstanding loans. In addition to ensuring repayment, the official job description for a LO entails many other tasks, such as selecting potential villages for expanding operations, targeting new customers and forming groups and centers, verifying and recommending loan proposals, as well as monitoring the loan utilization. The tasks require both field and office work. The regular work week extends from Monday morning until Saturday afternoon, with Saturdays being the only days that do not usually require field visits.

Since all LOs in a branch have their 'own' clients and centers, the tasks can be thought of as individual tasks. Exchanging ideas about work, for example regarding organizational issues, remains at the discretion of each LO and, according to qualitative interviews, varies by branch. Given the crucial role of LOs in ensuring lending operations and to prevent collusion with clients due to familiarity, LOs are assigned to a new branch every 2-3 years.

[2] We use the same measure of subjective well-being as Adams-Prassl et al. (2020*a*) who find a significant decrease in well-being during lockdowns in the US.

Moreover, they will never be assigned to a branch that is within a 50km radius of their hometown. Assignment to branches is decided by the central administration.

3.2.2 Covid-19, economic impacts, and early policy responses in India

The first Covid-19 case in India was reported on January 30, 2020 (Andrews et al., 2020). A nation-wide lockdown was announced on March 24 that was partially lifted a month later, starting from April 20 with several relaxation measures in non-hotspot areas. Other areas remained under a strict lockdown until the end of May. Notably, the Indian lockdown was much stricter than lockdowns in other countries.[3] Severe restrictions applied to leaving the home. In addition, all but essential transport, services, and factories were suspended. On April 20, India had 914 new confirmed cases and a cumulative of 18,540 cases. The peak was reached on September 16 with 97,894 daily new cases (see Figure C.1 and Max Roser and Hasell (2020)).

On March 24, the Finance Minister announced an economic relief package, but the early impacts of the lockdown were drastic, especially for the working poor. Lee et al. (2020) conduct phone surveys with a representative sample of poor and non-migrant workers (1400 respondents) in Delhi between March and May and report a drop in income and days worked of 57% and 73%, respectively. Using a large-scale survey of nearly 5000 respondents across 12 states of India between April and May, Kesar et al. (2020) find that two-thirds of respondents lost their work. The few informal workers who were still employed during the lockdown experienced a larger than 50% drop in their incomes. Similarly, Afridi, Dhillon and Roy (2020) conduct a phone survey of 413 respondents in India during April 2020, and report the impact of Covid on the urban poor's economic livelihood, physical and emotional well-being. The vast majority (90%) of respondents were unable to continue working and those who were employed before the lockdown saw their daily income fall by 87%. Afridi, Dhillon and Roy (2020) also document an increase in anxiety associated with these economic impacts.

On March 27, the Reserve Bank of India announced a debt moratorium for an initial three months (until May 31), that was later extended until the end of August 2020. This moratorium on term loans allowed all banks, financial institutions and non-banking finance companies to grant a three-months repayment break for installment payments of loans outstanding as of March 1, 2020. Such a repayment break would imply that interest on the outstanding loan amount continues to accrue, but the non-payment of installments would not be classified as "default" nor would it result in an asset classification downgrade. Offering and implementing those moratoria in practice was challenging especially for MFIs, as terms and conditions were hard to explain to clients during the initial lockdown with the corresponding travel restrictions. Nonetheless, it is estimated that under this moratorium,

[3]The government stringency index (Hale and Webster, 2020) was at its maximum for the lockdown period (100), as compared to a maximum of 65 in Germany or 72 in the UK during the first wave.

70-90% of the loans issued by small finance banks and MFIs were rescheduled (see Covid-19 Briefing (2020) for a more detailed analysis of the moratorium in India).

3.2.3 Data

Data comes from two main sources: administrative data from the firm about employee performance and online survey data of employees. The most recent online survey data was collected in January 2021.

Administrative Data

The data currently cover the period March 2019 to July 2020.[4] On the month-LO level, these data indicate i) how many clients are being handled, ii) how many new clients start a loan (net of those who fully settle their loans), iii) the percentage of complete repayments as a fraction of outstanding repayment, iv) the portfolio at risk (PAR) as the percentage of the gross loan portfolio that is overdue by more than 30 days, and v) the total loan portfolio. In addition, the data contain information about basic demographic characteristics of LOs.

Survey Data

Several quantitative surveys have been administered online at different points in time shortly before and during the pandemic. All variables are described in detail in Appendix C.2.

- **Baseline, December 2019** This survey covers the work of LOs and its environment, such as the tasks and time allocation, work organization, subjective measurement of effort and knowledge of the incentive structure. In addition, it elicits reciprocal preferences, locus of control and a measure of leadership.

- **Additional Survey, May 2020** This additional survey entails questions about cognitive abilities, financial literacy and the understanding of the incentive structure.

- **Weekly Surveys, June–July 2020** Over a period of six weeks, we collected short, high-frequency weekly data on workload, well-being and perceived stress.

- **Follow-Up Survey, October 2020** This follow-up survey elicits (work-related) issues during and after the nation-wide lockdown.

- **Endline, December 2020/January 2021** This survey contains the same as the one from December 2019 regarding work. It also includes questions on subjective well-being, stress (as during the summer) and current work-related issues (as during the October survey).

[4]Data for August 2020 to January 2021 is requested, but pending.

Data Collection

Survey links (in Hindi, programmed in SurveyCTO) were sent via whatsapp to LOs and they were given a week to fill in the respective survey. Since no monetary compensation was allowed by the partner organization, all respondents who completed at least 80% of the surveys received a certificate of participation. Before the start of the first survey round, a video explaining the details and procedures of the study was sent to all LOS in the sample. All participants provided written consent before the start of the first survey.

Sample

We focus on the two states Uttar Pradesh and Madhya Pradesh, in which most of our partner's branches are located. All branches are located in Northern India, in (the surroundings of) the following cities: Allahabad, Gwalior, Jabalpur, Jaipur, Lucknow, Moradabad, Saharanpur and Varanasi (see Figure C.3). We restrict population branches to ones that have at least three LOs and that offer the standard group loan.[5] From branches that fulfill these criteria, we randomly selected 150 and invite all 655 LOs of these branches to participate in the study. Table C.1 presents summary statistics of branch and LO characteristics and Table C.2 presents an overview of response rates in all surveys. On average, LOs are 26 years old, most of them have a college degree (84%) and half of them are married. Nearly all LOs are men (91%). At their current branch, they have been for a little less than 2 years on average and they have worked for the organization for an average of 2.7 years. In the first survey, we have 596 responses of LOs and thus a response rate of 91%.[6]

3.3 Results

We start by presenting descriptive statistics of LOs' work before the onset of the pandemic in Section 3.3.1 and then move to a more detailed description of how LOs and their work were affected by Covid-19 in Section 3.3.2. In Section 3.3.3, the main analysis focuses on heterogeneous effects by leadership before and during the pandemic. We briefly address robustness of our results in Section 3.3.4.

3.3.1 Work pre-Covid

LOs are the organization's link to the clients, such that their work consists of many different tasks that can broadly be classified into three categories. The first one is to organize loan disbursement. This includes verifying and checking loan application documents, collecting additional information on borrowers and their creditworthiness, and informing clients about different products. All surveyed LOs stated having engaged in at least one of those activities

[5] Other types of branches focus exclusively on individual-liability clients or serve as a branch of business correspondence for a large commercial bank. Since operations and incentives work differently in those branches, we do not include them in our sample.

[6] We present a detailed discussion of attrition and reasons for it in Section 3.3.4.

during the last working day, while the most common task within this category is the verification of loan applications. The second task is to ensure high repayment rates. This includes preparing and conducting the weekly meetings, reminding clients about upcoming and outstanding repayments, and providing financial advice broadly speaking. When asked about activities during the last working day, 99% state that they have completed at least one of the tasks that contribute to ensuring repayment (see Panel A of Table 3.1). Most commonly, LOs spend time on preparing meetings and reminding clients of repayments. Lastly, in addition to ensuring smooth business operations with existing clients, LOs are tasked to acquire new clients. This includes identifying potential new clients and new villages to expand operations to. Ninety-six percent completed a related task during the last working day.

Table 3.1: Summary Statistics—Work pre-Covid

Panel A. Task and Time Use (December 2019)						
	LO%	Time spent %				
		Mean	S.D.	p25	p50	p75
Disburse Loans	100	40	10	36	42	44
Collect Repayments	99	44	11	40	43	49
Acquist Clients	96	16	7.1	13	14	17
N (LOs)	583					

Panel B. Performance indicators (October 2019 - February 2020)					
	Mean	S.D.	p25	p50	p75
Total Caseload	545	244	421	562	703
Monthly Acquisition	15	24	0	10	25
Collection Percent	92	23	97	99	100
Portfolio-at-Risk (PAR)	11	12	1.8	7.7	17
Loan Portfolio	11,021,047	5,093,824	7,919,367	11,386,569	14,353,652
Observations	2876				
N (LOs)	592				

Notes: Panel A: Summary statistics of how LOs allocate their time among three main tasks and the components of each main task at baseline collected in December 2019. Out of our sample, 583 LOs answered the task and time use questionnaire. The variable *LO%* shows the fraction of LOs performing at least one component of the task (in percentage). The variable *Time spent %* captures the percentage of the total working time that LOs spend performing the task.
Panel B: Descriptive statistics of key performance indicators, namely total caseload, monthly acquisition, collection percentage, portfolio-at-risk (PAR), and loan portfolio, for LOs in our sample. The variable *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees) that has yet to be repaid.

While all three categories of tasks are performed on a daily basis, client acquisition requires field work and is more likely to be conducted Monday–Friday during the official meetings. This can explain the slightly lower percentage of LOs engaging in this category of tasks.[7] The relative importance of the tasks is reflected in the time LOs spend on each of the categories: collection (44% of the time) and disbursement (40%) are clearly at the heart of the operations, while expanding the client base is a secondary task. This is also reflected in the potential bonus payments: if collection rates do not clear a certain threshold, no bonus is paid for any task, whereas the acquisition of clients entails a comparatively small piece-rate bonus. This bonus scheme might also explain why time use patterns appear to be relatively homogeneous across LOs (as indicated by the percentiles).

On average, LOs handle 545 clients and acquire 15 new clients per month (see Panel B of Table 3.1). However, this number masks substantial heterogeneity, with LOs handling the total of clients ranging from 421 to 703, which corresponds to the 25^{th} and 75^{th} percentile, respectively. The number of clients is correlated with seniority, both at the organization (Pearson's $r = 0.046$ $p < 0.001$) and at the branch (Pearson's $r = 0.070$ $p < 0.001$). As usual in the microfinance sector (Armendáriz and Morduch, 2010), the mean collection percentage is above 90%, with a median of 99%. The average PAR is 11% and the portfolio of an average LO is worth 11 million INR (about 125,000 EUR at the time of writing).

3.3.2 Work during Covid

How do the above described patterns change with the pandemic? In addition to the views of LOs collected via the surveys, we also aimed at understanding the perspective of the organization. We thus conducted a qualitative interview with the managing director on May 12, 2020. In line with the findings of Malik et al. (2020) that clients struggle to make ends meet, the director expressed concerns about the livelihoods of clients and the resulting drop in repayments. In addition to clients often not being able to work from home, many rural households face the burden of return migration from workers who usually live in the cities and send money back to their families. While clients inquire about additional loans for more liquidity, the organization struggles to meet its own refinancing requirements.

In addition, the director pointed out that LOs struggle to keep in touch with their clients and that the work done at home was difficult to monitor. That is why the organization started to require LO-client interactions to be conducted via a specific app that would produce statistics to monitor LOs' effort, e.g. in terms of how many clients have been contacted in a given day. According to official guidelines, salaries for work at home would range between 80% and 100% depending on effort, while not working at home during the lockdown would still result in a 80% salary. In practice however, the organization decided to delay salary payments in April for those who would not come to the office. After the first lockdown restrictions were lifted on April 20, only 15% of employees came to the office. In the interview, the director acknowledges that most LOs were scared to come to the office, but also reported that paying salaries only for those who worked from the branch substantially increased attendance rates. To the organization, this return to the offices was

[7] 97% of LOs who are surveyed such that the reference day for the time use elicitation is a weekday report engaging in client acquisition, whereas 93% who are surveyed with Saturday being the reference day indicate engaging in this activity.

important because some operations such as loan disbursement can only be done from the branches, not from home.

We use survey data from December 2020 and administrative data (currently only available until July 2020) to study changes in performance and work organization. We first describe how performance indicators develop after the onset of the pandemic in Table 3.2. For each indicator shown in Panel B of Table 3.1, we present results from OLS regressions with March 2020 as the reference month. The average caseload steadily decreases over time, such that the difference to March becomes significant in later months (Column 1). When controlling for individual fixed effects in Column 2, this pattern becomes more pronounced. Where does this drop in client numbers come from? Columns 3 and 4 show a decline in the net acquisition of clients.[8] Given the debt moratorium enacted by the Indian government on March 27, the impact on finance-related performance indicators is both more immediate and more pronounced: As shown in Columns 5 and 6, collection rates dropped from above 90% in March by 89 percentage points to around 3% in April and remained at this low level until July. This is reflected in an increase in PAR over time (Columns 7 and 8).[9] Related to the drop in client numbers, the average loan portfolio shrinks by around 13% from March to July (Columns 9 and 10).

While a more informative comparison will need to include further administrative data for later months, we now turn to a comparison of tasks and time allocation in December 2019 (as described in Panel A of Table 3.1) and December 2020. Table 3.3 presents a comparison for i) all responses (Columns 1-5) and ii) individuals who completed both surveys (Columns 6-8).[10] Despite the change in work environment, at least for the first half of 2020, that is suggested by Table 3.2, there are no statistically significant changes in tasks that are being performed and the relative share of time allocated to each category of tasks. This holds true in aggregate numbers and when restricting the sample to those who answer both surveys.

The above discussion relies on measurable performance indicators or tasks that directly map into them. In addition, we are interested in work organization, perceived effort and subjective issues that LOs face while performing their tasks during the pandemic. Especially during the nation-wide lockdown that was imposed on March 25 and gradually lifted starting from April 20, various problems arose. Due to the short notice of the lockdown, around 24% of LOs could not travel home and had to stay at or close to the branch. Having to stay close to work, however, does not predict whether LOs worked: 88% stated they continued to work during April and May (91% of those who traveled home). Examining more closely from where BROs worked during April and May, we find that 29% worked only from home; 32% only worked at the branch but not in the field; 21% worked in the branch and in the field, i.e. interacting with clients face-to-face; 10% worked from home, in the branch, and in the field; and 8% work from home and in the branch, but not in

[8]Note that this number can be negative if settled clients exceed new clients.

[9]The relief measures announced by the Reserve Bank of India on 27 March 2020 also entailed that the moratorium period can be excluded from the computation of non-performing loans.

[10]The differences in respondents is due to job rotations, resignations, promotions and higher non-response rates in December 2020.

Table 3.2: Performance since the lockdown (March 2020 - July 2020)

	(1) Total Caseload	(2) Total Caseload	(3) Monthly Acquisition	(4) Monthly Acquisition	(5) Collection Percent	(6) Collection Percent	(7) PAR	(8) PAR	(9) Loan Portfolio	(10) Loan Portfolio
April	-8.471	-14.78	-7.503***	-7.602***	-88.57***	-89.60***	1.692**	1.562***	-0.198	-0.322
	(16.44)	(10.08)	(0.788)	(0.750)	(0.870)	(0.698)	(0.674)	(0.342)	(0.332)	(0.200)
May	-16.72	-27.82***	-9.988***	-10.10***	-88.98***	-90.38***	7.033***	6.757***	-0.438	-0.667***
	(15.09)	(8.627)	(0.803)	(0.746)	(0.823)	(0.611)	(0.659)	(0.298)	(0.306)	(0.172)
June	-28.32*	-42.73***	-15.83***	-15.86***	-88.27***	-89.72***	9.062***	8.723***	-0.995***	-1.283***
	(15.08)	(9.074)	(0.845)	(0.761)	(0.829)	(0.607)	(0.655)	(0.311)	(0.300)	(0.177)
July	-42.11***	-59.81***	-19.02***	-19.11***	-87.49***	-88.95***	12.09***	11.70***	-1.663***	-2.034***
	(14.58)	(9.087)	(0.874)	(0.795)	(0.837)	(0.617)	(0.719)	(0.406)	(0.287)	(0.180)
Constant	616.0***	625.8***	7.273***	7.340***	91.88***	92.94***	10.35***	10.58***	12.50***	12.70***
	(10.92)	(6.418)	(0.788)	(0.708)	(0.810)	(0.581)	(0.462)	(0.207)	(0.222)	(0.127)
Observations	2635	2635	2635	2635	2635	2635	2635	2635	2635	2635
N (LOs)	543	543	543	543	543	543	543	543	543	543
R^2	0.00354	0.708	0.317	0.510	0.931	0.963	0.140	0.812	0.0146	0.714
Individual FE		✓		✓		✓		✓		✓

Notes: The table shows the dynamics of performance indicators over the period from March 2020 to July 2020, using OLS regressions. The reference month is March 2020. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in millions, Indian Rupees) that has yet to be repaid. Robust standard errors are used in all regressions. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table 3.3: Task and Time Use (December 2019 vs. December 2020)

	Fraction of LOs performing the task (%)		Time spent %			Time spent %		
	(1) Baseline (all)	(2) Endline (all)	(3) Baseline (all)	(4) Endline (all)	(5) Difference (all)	(6) Baseline (restricted)	(7) Endline (restricted)	(8) Difference (restricted)
Disburse Loans	100	98.6	40.4	39.6	-0.83	39.6	39.0	-0.60
			[10.0]	[10.6]	(0.65)	[9.37]	[11.1]	(0.87)
Collect Repayments	99.0	98.6	43.9	44.1	0.21	44.1	44.2	0.060
			[10.8]	[11.9]	(0.71)	[11.0]	[11.9]	(0.98)
Acquist Clients	96.2	96.1	15.7	16.3	0.62	16.3	16.9	0.54
			[7.12]	[9.14]	(0.51)	[7.91]	[10.2]	(0.78)
Observations	583	434	583	434	1,017	276	276	552

Notes: This table compares how LOs allocate their time among three main tasks: collect repayments, disburse loans, and acquist clients at baseline and endline. The variable *Time spent %* captures the percentage of the total working time that LOs spend performing the task. Column (1)-(5) include all responses to the task and time use questionnaire in the baseline and endline surveys, and Column (6)-(8) restricts to those LOs answering the task and time use questionnaire both at the baseline and the endline surveys. Standard deviation are reported for Column (3),(4),(6), and (7) in square parentheses. Standard errors are reported for Column (5) and (8) in parentheses. Asterisks in the *Difference* column refer to p-values from two-tailed t-tests of equality between baseline and endline $^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$.

the field. In contrast to what the interview with the managing director would suggest, we do not find a statistically significant relationship between working at the branch and receiving salary payments. For those who indicated working during April and May, only 42% indicated having received their salaries for both months and 30% reported they have not been paid for either. While we do not have administrative data on salary payments to cross-check LOs' self-reports, we interpret the discrepancies with the views expressed in the qualitative interview as indications that especially these two months were chaotic and stressful in several dimensions.

Table 3.4 presents summary statistics and differences in various features of working styles between December 2019 and December 2020. All four variables are z-scores and explained in detail in the table notes. Baseline values for the full sample are standardized to have a mean of zero and a standard deviation of one. The raw data for December 2019 (not shown) indicates that 89% of LOs engage in at least one planning activity such as using reminders or checklists. Consistent with the task priorities shown in Panel A of Table 3.1, 93% of LOs exert effort in both marketing loan products and enforcing repayments. As far as subjective work time is concerned, 94% of LOs feel that they often have to work overtime or skip lunches to get the task done. Column 3 presents differences between values measured in December 2019 and December 2020 for all LOs that completed either the baseline and/or the endline survey. The only dimension with a statistically significant drop is effort. As this comparison might be confounded by attrition or selection into the sample, we restrict the analysis to the 277 LOs who completed both surveys in Columns 4 to 6 (see Section 3.3.4 for a more detailed discussion of attrition). Due to the drop in observations, the estimates of the difference in Column 6 become more noisy. We find weak evidence that both planning and effort decreased by about 0.15 standard deviations.

The above shows that especially the early stages of the pandemic were difficult due to movement restrictions, the moratorium and corresponding missing repayments and that some aspects of work such as planning or effort might have changed permanently or are

Table 3.4: Working Styles (December 2019 vs. December 2020)

	(1) Baseline (all)	(2) Endline (all)	(3) Difference (all)	(4) Baseline (restricted)	(5) Endline (restricted)	(6) Difference (restricted)
Planning	0.00	-0.08	-0.08	0.07	-0.07	-0.15*
	[1.00]	[0.97]	(0.063)	[0.95]	[0.96]	(0.081)
Effort	-0.00	-0.17	-0.17**	0.02	-0.16	-0.17*
	[1.00]	[1.21]	(0.070)	[0.95]	[1.18]	(0.092)
Obj. Work Time	-0.00	0.09	0.09	-0.04	-0.14	-0.11
	[1.00]	[1.67]	(0.082)	[0.96]	[1.08]	(0.087)
Subj. Work Time	-0.00	-0.03	-0.03	-0.01	-0.03	-0.01
	[1.00]	[1.12]	(0.066)	[0.98]	[1.07]	(0.087)
Observations	594	494	1,088	277	277	554

Notes: This table shows how LOs' working styles have changed at the endline, as compared to the baseline. The *Planning* is a z-score of the planning index that captures how well LOs plan their work (e.g., using reminders and checklists, and following through with their plans). The *Effort* is a z-score of the effort index that captures how much effort LO exerts on main work dimensions (enforcing repayments, marketing, and assessing clients). The variable *Objective Work Time* is a z-score of self-reported working time. The variable *Subjective Work Time* is a z-score of the subjective work time index that captures how much time LOs subjectively perceive they are working (e.g., often working overtime or skipping lunches). The z-scores for the endline in Column (2) and (5) are created using the mean and standard deviation of the baseline indices. Column (1)-(3) include all responses to the working style questionnaire in the baseline and endline surveys, and Column (4)-(6) restricts to those LOs answering the working style questionnaire both at the baseline and the endline surveys. Standard deviation are reported for Column (1),(2),(4), and (5) in square parentheses. Standard errors are reported for Column (3) and (4) in parentheses. Asterisks in the *Difference* column refer to p-values from two-tailed t-tests of equality between baseline and endline. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

affected for at least the medium run and not only the lockdown period. We now turn to changes in LOs' perceptions of the ease of working, the support they receive from the organization and job-related anxiety in earlier vs later stages of the pandemic (Table 3.5). The earlier survey was conducted in October 2020 and asked LOs to recall their experiences during and shortly after lockdown. The raw data from the earlier survey (shown standardized in the table) indicates that during the lockdown, 73% of LOs reported that they had a hard time concentrating on their tasks or that work became more stressful. Despite these setbacks during the lockdown, 56% report feeling supported by both their managers and their colleagues during the period of March to October. Nonetheless, 69% of LOs felt demotivated or feared that the organization might close its business when asked to consider the period of March to October. We assess how these views have changed in December 2020. First, we compare the ease of working during lockdown (March–May 2020) with the ease of working afterwards (June–December 2020). We find a large drop in the perceived ease of working of around 0.75 standard deviations (Column 3) that is even larger when we restrict the sample to those who complete both surveys (Column 6). How well do LOs feel supported by their organization in these difficult times? We compare the perceived fairness and support by the organization for March–October 2020 vs November–December 2020. While the overall data suggest an increase in perceived support for the last two months of 2020, this conclusion is not supported in the restricted sample. Job anxiety and demotivation are measured for the same time spans as perceived support. We find significantly lower levels of job-related anxiety in November and December 2020 as compared to March–October 2020. This might be explained with higher levels of certainty that the organization will not go bankrupt due to the pandemic, which was not clear in the early months during and after the lockdown.

Table 3.5: Work Perceptions (earlier vs later months, 2020)

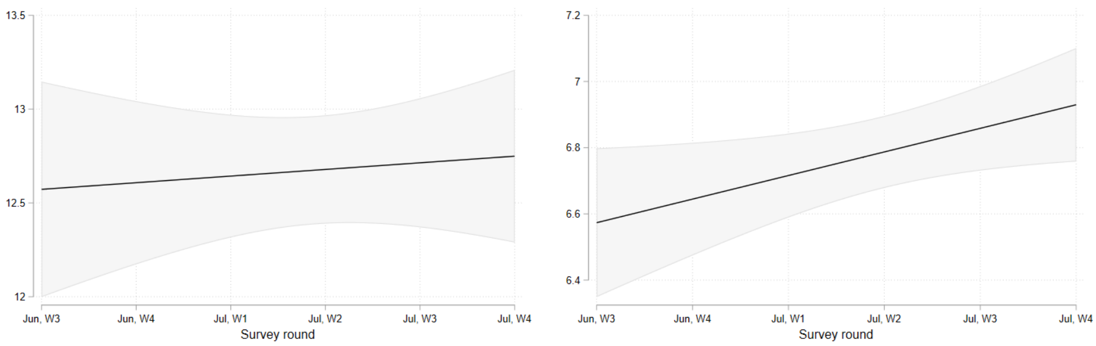
	(1) Earlier (all)	(2) Later (all)	(3) Difference (all)	(4) Earlier (restricted)	(5) Later (restricted)	(6) Difference (restricted)
Work Ease	-0.00	-0.76	-0.76***	0.01	-0.86	-0.87***
Earlier=Mar-May, Later=Jun-Dec	[1.00]	[1.41]	(0.10)	[1.04]	[1.41]	(0.13)
Fairness & Support	-0.00	0.28	0.28***	0.08	0.20	0.12
Earlier=Mar-Oct, Later=Nov-Dec	[1.00]	[0.95]	(0.07)	[1.00]	[0.93]	(0.10)
Job Anxiety	-0.00	-0.74	-0.74***	-0.03	-0.69	-0.65***
Earlier=Mar-Oct, Later=Nov-Dec	[1.00]	[1.33]	(0.09)	[1.05]	[1.19]	(0.12)
Observations	327	419	746	187	187	374

Notes: This table shows how LOs' perceptions at work have changed in our December 2020 survey, as compared to the October 2020 survey. The variable *Work Ease* is a z-score of the work ease index captures the perceived ease of working in our October survey during the lockdown, i.e. for March-May 2020, and in our December survey after the lockdown, i.e. for June-December 2020. The variable *Fair & Support* is a z-score of the fair and support index captures the perceived fairness and support in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. The variable *Job Anxiety* is a z-score of the job anxiety index captures the perceived job anxiety and demotivation in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. All outcome variables are positively coded, i.e., a higher score indicates a higher perception. The z-scores for December 2020 in Column (2) and (5) are created using the mean and standard deviation of the October indices. Column (1)-(3) include all responses to the perception questionnaire in the October and December surveys, and Column (4)-(6) restricts to those LOs answering the perception questionnaire in both the October and December surveys. Standard deviation are reported for Column (1),(2),(4), and (5) in square parentheses. Standard errors are reported for Column (3) and (4) in parentheses. Asterisks in the *Difference* column refer to p-values from two-tailed t-tests of equality between October and December. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

Overall, 2020 appears to have been a very stressful year for LOs with high levels of uncertainty especially in the first half. Given the abundant evidence that the pandemic has had and continues to have substantial impact on mental health, we also examine mental health in terms of subjective well-being and perceived stress. Data for this come from two sources, six weekly surveys in June and July 2020 and a one-time measurement in December 2020. Recall that based on what we know from the administrative data, June and July appear to be a difficult time: caseloads continue to decrease, collection percentages remain very low and PAR keeps increasing (see Table 3.2). How does this affect mental health of LOs? Panel a) of Figure 3.1 shows that subjective well-being did not change during these six weeks. However, Panel b) indicates an increase in perceived stress over time. As Table C.3 shows, these patterns also hold when examining changes at the individual level. How do levels of well-being and stress in summer compare to those in December 2020? Table 3.6 compares the average well-being and stress scores in June and July to the ones measured in December 2020. Similar to the patterns observed in June/July, subjective well-being appears to remain stable over time. In contrast, perceived stress decreases in

Figure 3.1: Development of Mental Health in June and July 2020

(a) Subjective Well-Being **(b)** Perceived Stress



Notes: The figures show the development of mental health in terms of subjective well-being and perceived stress for 6 consecutive weeks, from the third week of June to the fourth week of July 2020. Subjective well-being is elicited through a self-reported questionnaire WHO-5 Well-Being Index, which has 5 items and a range from 0 to 25. Perceived stress is elicited through a self-reported questionnaire Perceived Stress Scale 4 (PSS-4), which includes 4 items and has a range from 0 to 16. In Panel A, the black line shows a linear fit of raw subjective well-being score over 6 survey rounds, using robust standard error and inverse probability weighting. The grey shade represents the 95% confidence interval. In Panel B, the black line shows a linear fit of raw perceived stress score over 6 survey rounds, using robust standard error and inverse probability weighting. The grey shade represents the 95% confidence interval.

December as compared to summer. This finding is robust to restricting the sample to LOs who responded to both surveys.

To summarize, the lockdown and the moratorium have led to a challenging work environment with collection rates drastically dropping, PAR rates increasing and client numbers decreasing. As far as the administrative data allows us to analyze, the summer period was an even more challenging environment than the lockdown months March and April. However, our rich survey data also shows that many LOs struggle and report even worse ease of work towards the end of the year. The type of work required from LOs has not changed when looking at aggregate categories of tasks, but we find some indication of somewhat lower effort and planning activities in December 2020 as compared to the previous year. Mental health in terms of perceived stress appears to be impacted by the challenging work environment: during the time of deteriorating performance indicators in June and July, we find a significant increase in stress levels. Toward the end of the year, perceived stress has declined compared to summer and LOs report lower levels of job-related anxiety.

3.3.3 Heterogeneous Effects by Leadership

We now turn to the role of leadership in work performance before and during the pandemic. For each LO, we elicit a perceived leadership index that captures the assessment of their branch manager, using the Global Tranformational Leadership (GTL) developed

Table 3.6: Mental Heath (June 2020 vs. December 2020)

	(1) June (all)	(2) December (all)	(3) Difference (all)	(4) June (restricted)	(5) December (restricted)	(6) Difference (restricted)
Subjective Well-Being	12.60	13.09	0.49	12.76	13.51	0.75
	[5.08]	[8.04]	(0.41)	[4.92]	[7.67]	(0.51)
Perceived Stress	6.85	5.70	-1.15***	6.78	5.94	-0.84***
	[1.68]	[3.19]	(0.16)	[1.61]	[2.98]	(0.19)
Observations	534	509	1,043	320	320	640

Notes: This table compares LOs' mental health in terms of subjective well-being and perceived stress in June 2020 versus in December 2020. Subjective well-being is elicited through a self-reported questionnaire WHO-5 Well-Being Index, which has 5 items and a range from 0 to 25. Perceived stress is elicited through a self-reported questionnaire Perceived Stress Scale 4 (PSS-4), which includes 4 items and has a range from 0 to 16. Columns *June* shows the average well-being and perceived stress scores over 6 survey rounds in June and July 2020. Columns *December* shows the scores measured in our December 2020 survey. Column (1)-(3) include all responses to the mental health questionnaire in the June/July and December surveys, and Column (4)-(6) restricts to those LOs answering the mental health questionnaire in both the June/July and December surveys. Standard deviation are reported for Column (1),(2),(4), and (5) in square parentheses. Standard errors are reported for Column (3) and (4) in parentheses. Asterisks in the *Difference* column refer to p-values from two-tailed t-tests of equality between June and December. $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$.

by Carless, Wearing and Mann (2000). Leadership is measured in December 2019 by 8 survey items and combined into one leadership score per LO. In each item, LOs are asked to evaluate how often their branch manager engages in leadership activities such as giving encouragement and recognition to LOs, or communicating a clear vision (see also Appendix C.2). For our analyses, we calculate the average leadership score at the branch level across all LOs. Depending on the type of data we analyze, we estimate two different main specifications.

Administrative Data We will analyze the monthly administrative data using OLS estimatation of the following differences-in-differences specification:

$$y_{itb} = \alpha_0 + \beta_1 \text{leadership}_b + \beta_2 \text{post}_t + \beta_3 \text{leadership}_b * \text{post}_t + \varepsilon_{itb} \quad (3.1)$$

where y_{itb} is the outcome of interest, i.e. y_{itb} = {total caseload, monthly acquisition, collection percentage, PAR, and loan portfolio}, $leadership_b$ is the branch manager's average leadership rating of all LOs within the branch, $post_t$ a time indicator taking value 1 for observations after the start of the pandemic (March 2020 and later), and 0 for observations before, i.e. February 2020 and earlier.[11] The variables are defined for individual i, time t and branch b, respectively. Thus, in this model, β_1 identifies the relationship of leadership and individual performance measures before the pandemic and β_3 captures any differential effect of leadership during the pandemic, i.e. a statistically significant estimate would indicate that leadership during the pandemic has a stronger relationship with the variable of interest than leadership before the pandemic. We use robust standard errors ε_{itb}.

[11] In the main specification, we restrict the before period to include October 2019 and later months only, as moving back in time makes the leadership measure less precise due to rotations. We provide a discussion of alternative reference periods in Section 3.3.4.

Survey Data The survey data is generally available for two points in time, so we will estimate an ANCOVA specification to increase power (McKenzie, 2012) when estimating the effect of leadership during the pandemic (β_1):

$$Y_{ib1} = \alpha_0 + \beta_1 \text{leadership}_b + \beta_2 Y_{ib0} + \varepsilon_{ib1} \qquad (3.2)$$

where Y_1 is the outcome of interest for individual i in branch b during the pandemic, Y_0 the corresponding baseline value of the outcome. We use robust standard errors ε_{ib1}. To assess the relationship of leadership and outcome variables of interest, we simply regress leadership on the respective variable.

Results We start with the correlation of leadership and performance indicators as measured by the administrative data. Figure C.2 presents evidence that the parallel-trend assumption holds for all performance indicators: the different performance measures moved in similar patterns for those with above and those with below median leadership.[12] Table 3.7 presents results for the period covering five months before and five months after the start of the pandemic.[13] In the months before the start of the pandemic, better leadership scores for the branch manager are related to LOs both handling and acquiring *fewer* clients (Columns 1 and 2). We also see a weak association with lower PAR (Column 4). One possible explanation for this pattern might be that relatively fewer clients allow a better focus on each client. We do not find evidence that leadership is related differently to performance indicators after February 2020. However, when considering the overall relationship of leadership during the pandemic, we only find a relationship between better leadership and lower PAR. Including month fixed effects rather than the post dummy reinforces these effects (see Panel A of Table C.4).[14]

In terms of working styles presented in Table 3.8, we find a positive relationship between planning, effort and subjective working time in December 2019 (odd columns).[15] Consistent with similar relationships of leadership and performance before and during the pandemic, we do not find a stronger association of leadership and working styles in December 2020 (even columns).

Regarding perceptions of work, leadership does not have a systematic relationship, neither for earlier periods of the pandemic (odd columns of Table 3.9), nor for later ones (even columns). Restricting the sample to those who answer both surveys does not change this conclusion (see Table C.6).

[12] For the purpose of illustration, we binarize the leadership variable for this graph. In all analyses, we use the average leadership rating within a branch unless indicated otherwise.

[13] Note that this specification classifies March 2020 as post-pandemic, whereas Table 3.2 uses March 2020 as the reference month. We discuss the impact of different classifications and reference periods in Section 3.3.4.

[14] Adding baseline characteristics of LOs as control variables to the regression strengthens the relationship between good leadership and lower PAR, both for the before and during the pandemic (see Panel B of Table C.4 and Panel C for a specification including controls and month fixed effects). The remaining effects become insignificant.

[15] The results for baseline are robust to restricting the sample to those who also appear in the endline (Table C.5).

Table 3.7: Performance and Leadership (Oct'19-Feb'20 vs. Mar'20-Jul'20)

	(1) Total Caseload	(2) Monthly Acquisition	(3) Collection Percent	(4) PAR	(5) Loan Portfolio
Leadership	-2.212**	-0.251**	-0.163	-0.0834*	-4411.4
	(1.091)	(0.102)	(0.101)	(0.0481)	(22580.1)
Leadership*Post	0.461	0.175	0.104	-0.0410	8765.7
	(1.574)	(0.115)	(0.194)	(0.0705)	(32253.8)
Post	38.96	-23.18***	-73.66***	6.399***	585711.9
	(46.16)	(3.427)	(5.748)	(2.129)	(946434.9)
Observations	5481	5481	5481	5481	5481
N (LOs)	589	589	589	589	589
R^2	0.0125	0.184	0.573	0.0463	0.00698
p-value leadership (total)	0.123	0.144	0.721	0.0157	0.850

Notes: The table covers the period from October 2019 to July 2020, where pre-lockdown refers to 5 months before the lockdown (from October 2019 to February 2020) and post-lockdown refers to 5 months after the lockdown (from March 2020 to July 2020). The indicator *Post* is 1 for March 2020 to July 2020. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees) that has yet to be repaid. The scalar *p-value leadership (total)* reports the p-value for the total effect of leadership, i.e., the sum of the coefficients of *Leadership* and *Leadership*Post*. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Lastly, we investigate the relationship of leadership and mental health in Table 3.10. While subjective well-being did not change significantly over time (see Figure 3.1 and Table 3.6), we find a robust association between higher leadership and better well-being in our six-wave survey conducted in June and July 2020 (Column 1). Similarly, we observe a weak, positive relationship between leadership and the fraction of times LOs reported an increase in well-being from one survey to the next during the summer (Column 2), but no association with the fraction of times a well-being decrease was reported (Column 3). We see a similarly-sized, albeit lower-powered correlation in December 2020 (Column 4). Recall that in contrast to well-being, perceived stress changed significantly over time, with an increase from June to July (see Figure 3.1) and a decrease from summer averages to December (Table 3.6). However, we do not see a strong or consistent association of leadership and perceived stress (Columns 5-8).

In sum, we find a relationship between leadership and performance pre-pandemic and this relationship does not appear to be differentially affected by the pandemic. Moreover, we find that leadership seems to be positively related to subjective well-being during the pandemic, but do not find a relationship with perceived stress.

3.3.4 Robustness

Several aspects of our analysis merit further discussion. First, as Table C.2 shows, our main sample of initially 655 LOs shrinks over time. Part of this is driven by rotation of LOs in and out of our sample branches, LOs leaving the organization or being promoted to branch manager. These fluctuations imply that we only retain 65% of the original sample up to the point of the endline preparations and that we collect responses from LOs who

Table 3.8: Working Styles and Leadership

	Planning		Effort		Objective Work Time		Subjective Work Time	
	(1) Baseline	(2) Endline	(3) Baseline	(4) Endline	(5) Baseline	(6) Endline	(7) Baseline	(8) Endline
Leadership	0.0252***	0.0148	0.0532***	-0.0115	-0.0101	0.0196	0.0480***	-0.00118
	(0.00946)	(0.0153)	(0.0111)	(0.0147)	(0.00942)	(0.0159)	(0.0109)	(0.0151)
Observations	581	275	581	268	588	299	590	285
R^2	0.0117	0.0491	0.0531	0.0710	0.00194	0.0153	0.0428	0.0726
Baseline Index		✓		✓		✓		✓

Notes: The table shows the results of regressing various working styles indices on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The *Planning* is a z-score of the planning index that captures how well LOs plan their work (e.g., using reminders and checklists, and following through with their plans). The *Effort* is a z-score of the effort index that captures how much effort LO exerts on main work dimensions (enforcing repayments, marketing, and assessing clients). The variable *Objective Work Time* is a z-score of self-reported working time. The variable *Subjective Work Time* is a z-score of the subjective work time index that captures how much time LOs subjectively perceive they are working (e.g., often working overtime or skipping lunches). Odd columns (1), (3), (5), and (7) show the results for the baseline value of the outcomes. Even columns (2), (4), (6), and (8) show the results for the endline value of the outcomes, controlling for the baseline value of the outcomes. The z-scores at the endline are created using the mean and standard deviation of the endline indices. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$

Table 3.9: Perceptions and Leadership (earlier and later months, 2020)

	Work Ease		Fair & Support		Job Anxiety	
	(1) Mar–May	(2) Jun–Dec	(3) Mar–Oct	(4) Nov–Dec	(5) Mar–Oct	(6) Nov–Dec
Leadership	0.00520	-0.0164	0.0166	0.0321*	0.0281**	0.00191
	(0.0163)	(0.0153)	(0.0150)	(0.0179)	(0.0134)	(0.0167)
Observations	246	267	278	268	278	267
R^2	0.000467	0.00395	0.00523	0.0151	0.0138	0.0000534

Notes: The table shows the results of regressing various work perception indices on leadership at the earlier and later stages of the pandemic. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The variable *Work Ease* is a z-score of the work ease index captures the perceived ease of working in our October survey during the lockdown, i.e. for March-May 2020, and in our December survey after the lockdown, i.e. for June-December 2020. The variable *Fair & Support* is a z-score of the fair and support index captures the perceived fairness and support in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. The variable *Job Anxiety* is a z-score of the job anxiety index captures the perceived job anxiety and demotivation in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. All outcome variables are positively coded, i.e., a higher score indicates a higher perception. The z-scores for the later months (in even columns 2, 4, and 6) are created using the mean and standard deviation of the indices from our December survey. Robust standard errors are used in all regressions. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$

Table 3.10: Mental Health and Leadership

	Subjective Well-Being				Perceived Stress			
	(1) z-score (Jun)	(2) Increase (0-1)	(3) Decrease (0-1)	(4) z-score (Dec)	(5) z-score (Jun)	(6) Increase (0-1)	(7) Decrease (0-1)	(8) z-score (Dec)
Leadership	0.0249***	0.00652*	-0.00384	0.0270*	-0.00602	0.00299	0.00602*	0.00217
	(0.00588)	(0.00342)	(0.00338)	(0.0163)	(0.00588)	(0.00324)	(0.00321)	(0.0160)
Observations	1751	414	414	305	1751	414	414	305
N (LOs)	456	414	414	305	456	414	414	305
R^2	0.0128	0.00929	0.00314	0.0110	0.00552	0.00211	0.00839	0.0000701
Wave FE	✓				✓			

Notes: The table shows the results of regressing the subjective well-being and perceived stress indicators on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. Subjective well-being and perceived stress are elicited through self-reported questionnaire WHO-5 Well-Being Index and Perceived Stress Scale 4 (PSS-4), respectively. Column (1) and (5) look at the z-scores elicited in our June 2020 survey, controlling for wave fixed effects and weighted with the inverse probability of answering the weekly surveys. Column (2) and (6) examine the fraction of increases, where *Increase (0-1)* captures the fraction of increases among all fluctuations during the survey period. Column (3) and (7) examine the fraction of decreases, where *Decrease (0-1)* captures the fraction of decreases among all fluctuations during the survey period. Column (4) and (8) look at the one-time z-score elicited in our December 2020 survey. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$

joined the sample after the baseline. The other part of attrition is driven by LOs who remain in the sample, but do not take the survey.

While Tables 3.3 and 3.6 suggest that there are no major differences between overall and restricted samples, Tables 3.4 and 3.5 show that some conclusions change when the sample is restricted to those who answer both of the surveys that are being compared. We therefore analyze attrition more formally. For each of the follow-up surveys that we conduct after the baseline in December 2019, we use baseline or administrative data to predict attrition from baseline to the respective survey. Table C.7 present results from probit regressions. For attrition in June 2020 and October 2020, we find little evidence that baseline characteristics are predictive of leaving the sample (Columns 1 and 4). However, not responding to the December 2020 survey appears to be related to lower financial literacy and higher intelligence as measured by Raven's matrices. A more systematic (and problematic) pattern emerges when we repeat the same analysis for the administrative data. In all specifications, we find that those who leave the sample have worse average performance in the ten months before the start of the study, especially with regard to the collection percentage (Columns 2, 5 and 8). These effects are more pronounced when controlling for the performance in the month before the baseline (Columns 3, 6, and 9). This implies that performance-related analyses are conservative in that they are likely to *underestimate* the effect of the pandemic because we retain better performing LOs. Importantly, we do not find leadership to be predictive of attrition.

Second, to avoid single leadership ratings being very influential in our analysis, we explore an alternative definition of leadership that relies on comparing the leadership rating of a given branch manager to the average rating in our sample. In particular, we compare the leadership rating of the manager to the average manager rating across all other branches, and define objective leadership to be one if the manager is rated higher than average. This very rough measure of leadership is arguably more robust to individual ratings than the branch-level average. Table C.8 replicates Table 3.7. The results that LOs with better leaders acquire fewer new clients per month is robust to this more coarse definition of leadership. For the remaining estimates, we lack statistical power to detect any effects. Results for working styles become much stronger for the baseline and with the alternative definition, we find an additional positive relationship between leadership and objective work time (Table C.9). Similarly, results for perceptions are confirmed and strengthened, with more support that leadership is positively correlated with perceiving the work environment during the pandemic as supportive (Table C.10). Results for mental health are also robust to the alternative definition of leadership and show that leadership is positively correlated with well-being, especially in the stressful summer period (Table C.11). However, both measures used so far contain LOs' individual perception of their leader, which might be influenced by performance, leading to reverse causation. We thus also create a branch-level measure that excludes the own rating. Given that all other BROs in the branch have the same manager, this rating should be informative of actual leadership a given LO faces. Indeed, both measures are significantly correlated (Pearson's $r = 0.235$ $p < 0.001$). It is thus not surprising that most of the results are robust to using this different definition of leadersip: Table C.12 shows that effects for performance are robust. Similarly, effects for effort and subjective work time at baseline are robust (Table C.13), whereas effects of perceptions are weakened (Table C.14) and conclusions for mental health remain unchanged (Table C.15). We conclude that our results regarding leadership are robust to alternative definitions of the leadership measure.

Third, we vary the definition of the start of the pandemic and the reference period to which the performance during the pandemic is compared to. Comparing Tables 3.2 and 3.7 suggests that the classification of March as either before or after the pandemic might matter and it is plausible that seasonal patterns exist in performance data. We thus replicate Table 3.7 in different versions, i) using March to July 2019 as the reference period to keep the months that are being compared constant (Table C.16), ii) using all available data from December 2018 to February 2020 as the reference period (Table C.17), iii) using the same reference period as in the main table, but classifying March as "before" (Table C.18), and iv) replicating the main table, but including control variables from the baseline (Table C.4). Across all specifications we find a robust relationship between better leadership and lower PAR both before and after the onset of the pandemic (β_1 is consistently negative and β_3 is indistinguishable from zero). For other performance indicators, the evidence is mixed and depends on the specification. The additional administrative data that we have requested will help us understand those patterns in more detail. Overall, we do not find consistent evidence that leadership has a different effect during the pandemic as compared to before.

3.4 Conclusion

In this chapter, we provide insights into how the work and work environment of crucial microfinance employees have changed with the pandemic, that led to a crisis of the entire sector. We collect panel survey data of more than 500 loan officers of an Indian microfinance organization at various points in time between December 2019 and December 2020 and complement these data with monthly administrative records of performance indicators. While required tasks and the relative time allocation to them have not changed, they become more difficult to complete. The administrative data show that this is not a mere lockdown effect, but likely a combination of the debt moratorium and the substantial negative impact of the crisis on the livelihood of clients. While the moratorium has expired end of August 2020, the economic crisis is far from being over and it is currently not clear to what extent the rescheduled debt can be recovered and how microfinance organizations will be able to absorb this shock. Consistent with this, ease of work has decreased in December as compared to earlier during the year. Also in line with this evidence is the fact that attrition over the year is very high. If we interpreted attrition as an outcome variable rather than a robustness check, the low level of sample retention (65% of the baseline respondents are still in the endline sample; this is irrespective of the response rate) would be illustrative of an additional issue that microfinance organizations might face: retention rates.

While the increased digitization of the lending process might lower staffing requirements, it is still unclear to what extent the microfinance model will be sustainable with reduced personal interactions. For example, Kaffenberger, Totolo and Soursourian (2018) report substantially lower repayment rates for digital credit in Kenya and Tanzania than for traditional microcredit loans and findings from Czura, John and Spantig (2020); Giné and Karlan (2014) suggest that the strong repayment norm is sustained by regular meetings. loan officers as the direct link to the client are thus likely to continue to be of crucial importance for MFIs' operations and might merit more attention. With tight budgets that limit the scope for bonus payments, soft-factors such as well-being can play an important role. We find that only 56% of loan officers feel supported by their manager and colleagues, while 73% report a more stressful work environment. Given that the health impact of the current pandemic will also be related to mental health, this should also be reflected in personnel policies, not only in MFIs, but more generally (Hamouche, 2020). These policies can include, but are not limited to transparent communication and social support, e.g. through one-on-one counseling, mentoring or (virtual) mindfulness workshops and apps. One additional way to achieve better mental health of employees might be by investing in leadership skills of managers. For example, Dirani et al. (2020) suggest that leadership skills such as adaptability, stress management, and social awareness might be desirable during the post-Covid period to help employees overcome personal and emotional problems. We find that leadership might help to a certain degree in that it appears to be associated with better subjective well-being. However, we find no benefit of leadership in terms of stress reduction. More research is needed to understand which components of leadership matter, which actions of managers can help improve which aspects of mental health and how those behaviors can effectively be trained.

Appendix A

Loss Aversion, Moral Hazard, and Stochastic Contracts

A.1 Lemma 1

Lemma 1. Suppose $u''(\cdot) \leq 0$ and $\lambda \geq 1$. For every λ, there exists a stochastic contract such that the action a_H can be implemented.

Without loss of generality, assume $1 > p_1 \geq 1/2$. Consider a contract of the form

$$u_i = \begin{cases} \underline{u} + b & \text{for } i > 1 \\ \underline{u} & \text{for } i = 1 \end{cases}$$

where $b > 0$.

Let f_1^H and f_1^L be the probability of getting a bonus conditional on the agent's high and low action respectively, i.e., $f_1^H = P[i > 1|a_H] = q_H + p_1(1 - q_H)$ and $f_1^L = P[i > 1|a_L] = q_L + p_1(1 - q_L)$. Under this contractual form, (IC) is given by

$$b(f_1^H - f_1^L) - (\lambda - 1)b[f_1^H(1 - f_1^H) - f_1^L(1 - f_1^L)] = c \tag{IC}$$

which can be rewritten as

$$b\{(f_1^H - f_1^L)[1 - (\lambda - 1)(1 - f_1^H - f_1^L)]\} = c \tag{IC'}$$

Under this stochastic contract, $f_1^H = q_H + p_1(1 - q_H)$ and $f_1^L = q_L + p_1(1 - q_L)$. It is straight-forward to see that $f_1^H > f_1^L$ as $q_H > q_L$ and $p_1 < 1$.
Consider

$$\begin{aligned} 1 - f_1^H - f_1^L &= 1 - (q_H + p_1(1 - q_H)) - (q_L + p_1(1 - q_L)) \\ &= 1 - q_H - q_L - p_1(2 - q_H - q_L) \end{aligned}$$

Notice for $p_1 \geq 1/2$, this above term is strictly negative. This implies the term in curly brackets in (IC') is strictly positive for $1 > p_1 \geq 1/2$. Hence, with $c > 0$, b can always be

chosen such that (IC) is met.
The binding participation constraint can be written as follows

$$\underline{u} + bf_1^H - (\lambda - 1)bf_1^H(1 - f_1^H) = c$$

(PC) is satisfied whenever $\underline{u}$ is chosen as above.

□

A.2 Proposition 1

Proposition 1. Suppose $u''(\cdot) = 0$ and $\lambda - 1 > \frac{1-q_H}{1-q_L}$. Then, there exists a stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$ that strictly dominates the optimal deterministic contract.

Without loss of generality, assume $1 > p_1 \geq 1/2$. Consider a stochastic contract of the form

$$w_i = \begin{cases} \underline{w} + b & \text{for } i > 1 \\ \underline{w} & \text{for } i = 1 \end{cases}$$

where $b > 0$. The non-emptiness of the constraint set follows from Lemma 1.

Let f_1^H and f_1^L be the probability of getting a bonus conditional on the agent's high and low action respectively, i.e., $f_1^H = P[i > 1|a_H] = q_H + p_1(1 - q_H)$ and $f_1^L = P[i > 1|a_L] = q_L + p_1(1 - q_L)$.
Consider any $p_1 \in [\frac{1}{2}, 1)$. The principal's problem becomes

$$\min_{\underline{w},b} \ \underline{w} + f_1^H b$$

subject to

$$\underline{w} + f_1^H b - (\lambda - 1)bf_1^H(1 - f_1^H) = c \qquad \text{(PC)}$$

$$b(f_1^H - f_1^L) - (\lambda - 1)b[f_1^H(1 - f_1^H) - f_1^L(1 - f_1^L)] = c \qquad \text{(IC)}$$

From (IC), the optimal bonus size is given by

$$b = \frac{c}{(f_1^H - f_1^L)[1 - (\lambda - 1)(1 - f_1^H - f_1^L)]}$$

Recall that $f_1^H = q_H + p_1(1 - q_H)$ and $f_1^L = q_L + p_1(1 - q_L)$. Under the stochastic contract of this form, the principal's cost, $C_r = c + (\lambda - 1)f_1^H(1 - f_1^H)b$, is given by

$$C_r = c + \frac{(\lambda - 1)[q_H + p_1(1 - q_H)](1 - q_H)(1 - p_1)c}{(q_H - q_L)(1 - p_1)[1 - (\lambda - 1)(1 - q_H - q_L - p_1(2 - q_H - q_L))]}$$

Suppose that the optimal deterministic contract exists.[1] Then the principal's cost under the optimal deterministic contract (i.e., $p_1 = 0$) is given by

$$C_d = c + \frac{(\lambda - 1)q_H(1 - q_H)c}{(q_H - q_L)[1 - (\lambda - 1)(1 - q_H - q_L)]}$$

The stochastic contract reduces the principal's cost if and only if $C_d \geq C_r$.

$$\Leftrightarrow \frac{q_H}{1 - (\lambda - 1)(1 - q_H - q_L)} \geq \frac{q_H + p_1(1 - q_H)}{1 - (\lambda - 1)(1 - q_H - q_L - p_1(2 - q_H - q_L))}$$

Since the solution exists for both deterministic and stochastic contracts, both denominators are positive. Cross multiply the inequalities.
Notice the term $q_H[1 - (\lambda - 1)(1 - q_H - q_L)]$ is present on both sides. The inequality is reduced to

$$\Leftrightarrow q_H(\lambda - 1)p_1(2 - q_H - q_L) \geq p_1(1 - q_H)[1 - (\lambda - 1)(1 - q_H - q_L)]$$
$$\Leftrightarrow q_H(\lambda - 1)(2 - q_H - q_L) \geq (1 - q_H)[1 - (\lambda - 1)(1 - q_H - q_L)]$$

Removing the term $q_H(\lambda - 1)(1 - q_H - q_L)$ on both sides, I have

$$\Leftrightarrow q_H(\lambda - 1) \geq 1 - (\lambda - 1)(1 - q_H - q_L) - q_H$$
$$\Leftrightarrow 0 \geq 1 - q_H - (\lambda - 1)(1 - q_L)$$
$$\Leftrightarrow \lambda - 1 \geq \frac{1 - q_H}{1 - q_L}$$

Since $\lambda - 1 > \frac{1-q_H}{1-q_L}$, $C_r < C_d$. This completes the proof. □

A.3 Lemma 2

Lemma 2. Suppose $u''(\cdot) = 0$ and $\lambda \geq 1$. Then, any stochastic contract with the wage structure $w_1 = w_2 = w_3 < w_4$ is weakly dominated by the optimal deterministic contract.

Consider a stochastic contract of the form

$$w_i = \begin{cases} \underline{w} + b & \text{for } i = 4 \\ \underline{w} & \text{for } i < 4 \end{cases}$$

where $b > 0$. Let f_4^H and f_4^L be the probability of getting a bonus conditional on the agent's high and low action respectively, i.e., $f_4^H = P[i = 4|a_H] = p_2 q_H$ and $f_4^L = P[i =$

[1] If the principal's constraint set is empty under deterministic contracts, then it is assumed that the principal's cost becomes prohibitively high. It follows directly that stochastic contracts, which enable the principal to implement the desired action, strictly dominate deterministic contracts.

$4|a_L] = p_2 q_L$.
The principal's problem becomes

$$\min_{\underline{w},b} \; \underline{w} + f_4^H b$$

subject to

$$\underline{w} + f_4^H b - (\lambda - 1) b f_4^H (1 - f_4^H) = c \tag{PC}$$

$$b(f_4^H - f_4^L) - (\lambda - 1) b [f_4^H (1 - f_4^H) - f_4^L (1 - f_4^L)] = c \tag{IC}$$

Suppose that the above constraint set is non-empty, the optimal bonus size is given by

$$b = \frac{c}{(f_4^H - f_4^L)[1 - (\lambda - 1)(1 - f_4^H - f_4^L)]}$$

Recall that $f_4^H = p_2 q_H$ and $f_4^L = p_2 q_L$. Under the stochastic contract of this form, the principal's cost, $C = c + (\lambda - 1) f_4^H (1 - f_4^H) b$, is given by

$$C = c + \frac{(\lambda - 1) p_2 q_H (1 - p_2 q_H) c}{p_2 (q_H - q_L)[1 - (\lambda - 1)(1 - p_2 q_H - p_2 q_L)]}$$

Note that if the constraint set for the above stochastic contract is non-empty, then the constraint set for the deterministic contract is also non-empty. Thus, the principal's cost under the optimal deterministic contract (i.e., $p_2 = 1$) is given by

$$C_d = c + \frac{(\lambda - 1) q_H (1 - q_H) c}{(q_H - q_L)[1 - (\lambda - 1)(1 - q_H - q_L)]}$$

It is straight-forward to see that $C \geq C_d$ for any $1 \geq p_2 > 0$.

□

A.4 Proposition 2

Proposition 2. Suppose $u''(\cdot) = 0$ and $\lambda - 1 > \frac{1-q_H}{1-q_L}$. Then, the second-best optimal stochastic contract does not exist.

Suppose, by contradiction, the solution for the principal's problem exists.

I decompose the principal's problem into two subproblems. First, for a given stochastic structure (p_1, p_2), I derive the optimal wage payments that implement a_H. Second, I choose the stochastic structure to achieve the lowest cost.

Step 1: Given any contract $(\hat{w}_i)_{i=1}^4$ the principal offers, I can relabel the states such that this contract is equivalent to a contract $(w_i)_{i=1}^4$ of an (weakly) increasing wage profile with $w_{i-1} \leq w_i$ for all $i \in \{2, 3, 4\}$. Let $b_i = w_i - w_{i-1} \geq 0$ for all $i \in \{2, 3, 4\}$. Let f_i^H and f_i^L be the probability that state i is realized conditional on a_H and a_L respectively.

The principal's problem can be rewritten as

$$\min_{b_2,\ldots,b_4} (\lambda-1)\sum_{i=2}^{4} b_i \sum_{\tau=i}^{4} f_\tau^H \sum_{t=1}^{i-1} f_t^H$$

subject to

$$\sum_{i=2}^{4} b_i\beta_i = c \tag{IC}$$

$$b_i \geq 0 \;\; \forall i \in \{2,3,4\}$$

where

$$\beta_i := \left(\sum_{\tau=i}^{4}(f_\tau^H - f_\tau^L)\right) - (\lambda-1)\left(\sum_{\tau=i}^{4} f_\tau^H \sum_{t=1}^{i-1} f_t^H - \sum_{\tau=i}^{4} f_\tau^L \sum_{t=1}^{i-1} f_t^L\right)$$

The principal's problem is a linear programming problem. It is well known that if a linear programming has a solution, this (unique) solution is an extreme point of the constraint set. All extreme points of the constraint set are characterised by the following property: $b_i > 0$ for exactly one state $i \in \{2,3,4\}$ and $b_t = 0$ for all $t \neq i, t \in \{2,3,4\}$.

It remains to determine for which state $i \in \{2,3,4\}$ the bonus is set strictly positive. From Lemma 2 and Proposition 1 if $\lambda - 1 > \frac{1-q_H}{1-q_L}$, the second-best optimal stochastic contract has the optimal wage structure $w_1 < w_2 = w_3 = w_4$.

Step 2: I now consider the optimal stochastic structure p_1 to achieve the lowest cost. Recall that under the stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$, the principal's cost is given by

$$C_r = c + \frac{(\lambda-1)[q_H + p_1(1-q_H)][1-q_H]c}{(q_H - q_L)[1-(\lambda-1)(1-q_H-q_L-p_1(2-q_H-q_L))]}$$

Differentiation of C_r with respect to p_1 yields

$$\frac{\partial C_r}{\partial p_1} = \frac{c(\lambda-1)(1-q_H)[2-q_H-q_L-\lambda(1-q_L)]}{(q_H-q_L)[1-(\lambda-1)(1-q_H-q_L-p_1(2-q_H-q_L))]^2}$$

Obviously, $\partial C_r/\partial p_1 < 0$ for all p_1 as $\lambda > \frac{2-q_H-q_L}{1-q_L}$. The principal can always achieve a lower cost by increasing p_1 close to 1, i.e., the probability of bonus is almost 1. However, p_1 can not reach 1 due to the incentive constraint. Hence, the second-best optimal stochastic contract does not exist. □

A.5 Proposition 3

Proposition 3. Suppose (A1) holds, $u''(\cdot) = 0$, and $w \geq 0$. Then, the second-best optimal stochastic contract exists. The optimal stochastic contract pays $b^*(p_1^*)$ with probability one *when the good signal is realized and with probability* p_1^* *when the bad signal is realized. The optimal* p_1^* *is given by*

$$p_1^* = \frac{1}{1-q_H}\left(\sqrt{1-\frac{\lambda}{\lambda-1}\cdot\frac{1-q_H}{2-q_H-q_L}}-q_H\right)$$

Consider a stochastic contract of the form

$$w_i = \begin{cases} \underline{w}+b & \text{for } i>1 \\ \underline{w} & \text{for } i=1 \end{cases}$$

where $b>0$. Let f_1^H and f_1^L be the probability of getting a bonus conditional on the agent's high and low action respectively, i.e., $f_1^H = P[i>1|a_H] = q_H + p_1(1-q_H)$ and $f_1^L = P[i>1|a_L] = q_L + p_1(1-q_L)$.

The principal's problem becomes

$$\min_{\underline{w},b}\ \underline{w} + f_1^H b$$

subject to

$$\underline{w} + f_1^H b - (\lambda-1)bf_1^H(1-f_1^H) \geq c \quad \text{(PC)}$$

$$b(f_1^H - f_1^L) - (\lambda-1)b[f_1^H(1-f_1^H) - f_1^L(1-f_1^L)] \geq c \quad \text{(IC)}$$

$$\underline{w} \geq 0 \quad \text{(LL)}$$

Notice first that the (LL) constraint is binding. Suppose, by contradiction, $\underline{w}>0$ is the optimal wage scheme. Reducing $\underline{w}$ by a small amount ϵ, the principal decreases the expected payment without changing (IC) or violating (LL) constraint. Thus, $\underline{w}^*=0$.

Notice also that the (IC) constraint is binding. Suppose, by contradiction, (IC) is slack. Reducing b by a small amount ϵ, the principal decreases the expected payment without changing (LL) or violating (IC) constraint.

Assume that the optimal deterministic contract exists, then the constraint set for the above stochastic contract is non-empty.[2] Thus, at optimum, the bonus is given by

$$b^* = \frac{c}{(f_1^H - f_1^L)[1-(\lambda-1)(1-f_1^H-f_1^L)]}$$

Under the stochastic contract of this form, the principal's cost, $C_r = \underline{w}^* + f_1^H b^* = f_1^H b^*$, is given by

$$C_r = \frac{(q_H + p_1(1-q_H))c}{(q_H-q_L)(1-p_1)[1-(\lambda-1)(1-q_H-q_L-p_1(2-q_H-q_L))]}$$

[2]If the deterministic contract has no solution, the dominance of the stochastic contract is trivial. The reason is that the principal can always implement a_H under the stochastic contract by setting $p_1 \in [1/2, 1)$ (Lemma 1). On the other hand, if the optimal deterministic contract exists, i.e., $(\lambda-1)(1-q_H-q_L)<1$, it follows that $(\lambda-1)(1-q_H-q_L-p_1(2-q_H-q_L))<1$. Thus, the constraint set under the stochastic contract is non-empty for all p_1.

Analogously, the principal's cost under the optimal deterministic contract with limited liability is given by

$$C_d = \frac{q_H c}{(q_H - q_L)[1 - (\lambda - 1)(1 - q_H - q_L)]}$$

Note that if $p_1 = 0$, then $C_r = C_d$

Differentiating C_r with respect to p_1 yields

$$\frac{\partial C_r}{\partial p_1} = \frac{c}{q_H - q_L} \frac{1-(\lambda-1)(1-q_H-q_L+q_H(2-q_H-q_L))+p_1 2 q_H(\lambda-1)(2-q_H-q_L)+p_1^2(1-q_H)(\lambda-1)(2-q_H-q_L)}{(1-p_1)^2[1-(\lambda-1)(1-q_H-q_L-p_1(2-q_H-q_L))]^2}$$

The stochastic contract reduces the principal's cost, i.e., $C_d > C_r$ if

$$\left.\frac{\partial C_r}{\partial p_1}\right|_{p_1=0} < 0 \Leftrightarrow (\lambda - 1)(1 - q_H - q_L + q_H(2 - q_H - q_L)) > 1 \tag{A1}$$

Provided that (A1) holds, there exists a stochastic contract of the wage structure $w_1 < w_2 = w_3 = w_4$ that strictly dominates the optimal deterministic contract.[3] Solving for the first order condition, I obtain the optimal p_1^*

$$p_1^* = \frac{1}{1 - q_H} \left(\sqrt{1 - \frac{\lambda}{\lambda - 1} \cdot \frac{1 - q_H}{2 - q_H - q_L}} - q_H \right)$$

The second-best optimal stochastic contract is characterized by $\underline{w}^* = 0$, $b^*(p_1^*)$, and p_1^*. This completes the proof. □

A.6 Proposition 4

Proposition 4. Suppose the agent exhibits disappointment aversion according to Bell (1985), $u''(\cdot) = 0$, and $\lambda - 1 > \frac{1-q_H}{1-q_L}$. Consider two actions and two signals. Then, there exists a stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$ that strictly dominates the optimal deterministic contract.

The proof of Proposition **??** closely follows the proof of Proposition 1. I first show that the principal's problem remains the same regardless of whether the agent exhibits disappointment aversion (Bell, 1985) or loss aversion (Kőszegi and Rabin, 2006, 2007).

[3]Analogous to the proof of Lemma 2, it can be shown that under limited liability, adding noise to the good outcome is weakly dominated by the optimal deterministic contract. The cost of a stochastic contract with the wage structure $w_1 = w_2 = w_3 < w_4$ under limited liability is given by $C = \frac{q_H c}{(q_H - q_L)(1-(\lambda-1)(1-p_2 q_H - p_2 q_L))}$, which is weakly larger than C_d – the cost under the optimal deterministic contract – for all $p_2 \in [0, 1]$. Thus, the second-best optimal stochastic contract has the wage structure of $w_1 < w_2 = w_3 = w_4$.

Consider a stochastic contract of the form

$$w_i = \begin{cases} \underline{w} + b & \text{for } i > 1 \\ \underline{w} & \text{for } i = 1 \end{cases}$$

where $b > 0$. Let f_1^H and f_1^L be the probability of getting a bonus conditional on the agent's high and low action respectively, i.e., $f_1^H = P[i > 1|a_H] = q_H + p_1(1 - q_H)$ and $f_1^L = P[i > 1|a_L] = q_L + p_1(1 - q_L)$.

Under the disappointment aversion, the agent compares a realized outcome to the certainty equivalence of the prospect, which is given by $\text{CE}_r(a_H) = \underline{w} + f_1^H b$. With probability f_1^H a bonus is realized, the agent feels elated by receiving $(1 - f_1^H)b$ more than the certainty equivalence. With probability $(1 - f_1^H)$ a bonus is not realized, the agent feels disappointed by receiving $f_1^H b$ less than the certainty equivalence. The agent's utility from choosing a_H is given by

$$\underline{w} + f_1^H b + f_1^H(1 - f_1^H)b - \lambda(1 - f_1^H)f_1^H b = \underline{w} + f_1^H b - (\lambda - 1)f_1^H(1 - f_1^H)b$$

The (IC) constraint is given by

$$b(f_1^H - f_1^L) - (\lambda - 1)b[f_1^H(1 - f_1^H) - f_1^L(1 - f_1^L)] = c$$

Notice that the above (PC) and (IC) constraints coincide with the principal's constraints under CPE loss aversion.

Assume w.l.o.g. $1 > p_1 \geq 1/2$, the non-emptiness of the constraint set follows from Lemma 1, and the dominance of the stochastic contract analogously follows from Proposition 1.

□

A.7 Proposition 5

Proposition 5. Suppose the agent exhibits the PPE loss aversion, $u''(\cdot) = 0$, $q_H + 2q_L \leq 2$ and $\lambda - 1 > \frac{1-q_H}{1-q_L}$. Consider two actions and two signals. Then, there exists a stochastic contract with the wage structure $w_1 < w_2 = w_3 = w_4$ that strictly dominates the optimal deterministic contract.

Consider a stochastic contract of the form

$$w_i = \begin{cases} \underline{w} + b & \text{for } i > 1 \\ \underline{w} & \text{for } i = 1 \end{cases}$$

where $b > 0$. Let f_1^H and f_1^L be the probability of getting a bonus conditional on the agent's high and low action respectively, i.e., $f_1^H = P[i > 1|a_H] = q_H + p_1(1 - q_H)$ and $f_1^L = P[i > 1|a_L] = q_L + p_1(1 - q_L)$.

Under PPE loss aversion, the agent identifies (i) the set of personal equilibrium (PE) that includes all actions the agent can follow through, and (ii) the preferred action among the set of personal equilibrium (PPE).

$$a \in \text{PE} \Leftrightarrow EU(a|a) \geq EU(a'|a) \; \forall a' \neq a$$
$$a \in \text{PPE} \Leftrightarrow EU(a|a) \geq EU(a'|a') \; \forall a' \in \text{PE}$$

For $a_H \in \text{PE}$, $EU(a_H|a_H) \geq EU(a_L|a_H)$, the latter refers to the expected utility when the agent expects to choose a_H but actually chooses a_L, is given by

$$\underline{w} + f_1^H b - (\lambda - 1) f_1^H (1 - f_1^H) b - c \geq \underline{w} + f_1^L b + f_1^L (1 - f_1^H) b - \lambda (1 - f_1^L) f_1^H b + c$$

This is equivalent to

$$b \geq \frac{2c}{(f_1^H - f_1^L)[2 + f_1^H(\lambda - 1)]} := \underline{b} \qquad (a_H\text{-PE})$$

Analogously, for $a_L \in \text{PE}$

$$b \leq \frac{(\lambda + 1)c}{(f_1^H - f_1^L)[2 + f_1^L(\lambda - 1)]} := \overline{b} \qquad (a_L\text{-PE})$$

Note that $\overline{b} > \underline{b}$ for all $\lambda \geq 1$.

The principal's problem becomes

$$\min_{\underline{w}, b} \; \underline{w} + f_1^H b$$

subject to

$$\underline{w} + f_1^H b - (\lambda - 1) b f_1^H (1 - f_1^H) = c \qquad (\text{PC})$$
$$b \geq \frac{c}{(f_1^H - f_1^L)[1 - (\lambda - 1)(1 - f_1^H - f_1^L)]} := \tilde{b} \qquad (a_H\text{-PPE})$$
$$b \geq \underline{b} \qquad (a_H\text{-PE})$$

Assume that the optimal deterministic contract exists, it follows that the principal's constraint set for the stochastic contract is non-empty. There exists $p_1 \in [0, 1)$ such that $\tilde{b} \geq \underline{b}$. Consider a relaxed problem without (a_H-PE) constraint. The relaxed problem coincides with the principal's problem of CPE loss aversion and, from Proposition 1, the cost is given by

$$C_r = c + \frac{(\lambda - 1)[q_H + p_1(1 - q_H)][1 - q_H]c}{(q_H - q_L)[1 - (\lambda - 1)(1 - q_H - q_L - p_1(2 - q_H - q_L))]}$$

Following the above analysis analogously, if $q_H + 2q_L \leq 2$, then the principal's cost under the optimal deterministic contract is given by

$$C_d = c + \frac{(\lambda - 1) q_H (1 - q_H) c}{(q_H - q_L)[1 - (\lambda - 1)(1 - q_H - q_L)]}$$

Since $\lambda - 1 > \frac{1 - q_H}{1 - q_L}$, $C_r < C_d$. This completes the proof.

□

Appendix B

Wage-Setting Mechanisms with Reciprocal Workers

B.1 Lemma 1

Lemma 1. Assume that the wage-setting mechanism is exogenous public wage, and workers are self-serving with $\tau = 0$. Then, in equilibrium, the equilibrium wage is set below the surplus, $\overline{w}^* = \frac{v}{2}$, and workers with $\theta_i \leq \frac{v}{2}$ are employed.

Because workers are self-serving, $e_i = 0$ in Stage 2 for any level of public wage $\overline{w}$. Thus, the firm receives zero quality $q_i = 0$ in Stage 2.

In Stage 1, after observing a take-it-or-leave-it offer $\overline{w}$, workers accept $\overline{w}$ if $\theta_i \leq \overline{w}$, and reject otherwise. Thus, the probability of hiring is given by $P(\theta_i \leq \overline{w})$.

At the beginning of the wage bargaining, the firm chooses a public wage $\overline{w}$ to maximize the expected payoff

$$\begin{aligned} &\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})(v - \overline{w}) \\ =& \arg\max_{\overline{w}} \overline{w}(v - \overline{w}) \\ =& \arg\max_{\overline{w}} \overline{w}v - \overline{w}^2 \end{aligned}$$

First-order condition with respect to $\overline{w}$ gives us

$$\begin{aligned} &v - 2\overline{w}^* = 0 \\ \Leftrightarrow& \overline{w}^* = \frac{v}{2} \end{aligned}$$

Workers with $\theta_i \leq \overline{w}^*$, or equivalently $\theta_i \leq \frac{v}{2}$, are employed. □

B.2 Lemma 2

Lemma 2. Assume that the wage-setting mechanism is exogenous private negotiation, and workers are self-serving with $\tau = 0$. Then, in equilibrium, the equilibrium wage is set above worker's outside option, $w_i^*(\theta_i) = \frac{\theta_i}{2} + \frac{1}{2}$, and workers with $\theta_i \leq 2v - 1$ are employed.

Because workers are self-serving, $e_i = 0$ in Stage 2 for any level of initial offers w_i. Thus, the firm receives zero quality $q_i = 0$ in Stage 2.

In Stage 1, workers believe that the firm hires at a given initial offer w_i if the benefit exceeds the cost, i.e. if $v \geq w_i$. Workers choose the initial offer w_i to maximize their wages and the hiring probability. Worker i's objective is given by

$$\begin{aligned} &\arg\max_{w_i} \; P(v \geq w_i)w_i + P(v < w_i)\theta_i \\ =&\arg\max_{w_i} \; (1 - w_i)w_i + w_i\theta_i \\ =&\arg\max_{w_i} \; w_i - w_i^2 + w_i\theta_i \end{aligned}$$

First-order condition with respect to w_i gives us

$$\begin{aligned} &1 - 2w_i^* + \theta_i = 0 \\ \Leftrightarrow &w_i^* = \frac{\theta_i}{2} + \frac{1}{2} \end{aligned}$$

Worker i with an outside option θ_i is employed if

$$\begin{aligned} &v \geq w_i^* \\ \Leftrightarrow &v \geq \frac{\theta_i}{2} + \frac{1}{2} \\ \Leftrightarrow &2v - 1 \geq \theta_i \end{aligned}$$

□

B.3 Lemma 3

Lemma 3. Assume that the wage-setting mechanism is endogenous, and workers are self-serving with $\tau = 0$. There exists a unique pooling equilibrium in which the firm posts a public wage for any realization of the surplus.

Case 1. For the firm with $v < \frac{1}{2}$:

If the firm chooses private negotiation, workers demand $w_i^* = \frac{\theta_i}{2} + \frac{1}{2} \geq \frac{1}{2}$ $\forall \theta_i \in [0, 1]$. Thus, for $v < \frac{1}{2}$, $v < w_i^*$ $\forall \theta_i \in [0, 1]$. The firm cannot hire workers in private negotiation and has an expected payoff of 0.

If the firm chooses public wage, it posts a public wage $\overline{w}^* = \frac{v}{2}$. The firm hires workers with probability $P(\theta_i \leq \overline{w}^*) = \frac{v}{2}$ and, conditional on hiring, earns a profit $\pi_i = v - \overline{w}^* = \frac{v}{2}$. Thus, the firm yields an expected payoff of $\frac{v^2}{4} \geq 0 \; \forall v \in [0, 1]$.

$\Rightarrow$ The firm with $v < \frac{1}{2}$ always prefers public wage. (1)

Case 2. For the firm with $v \geq \frac{1}{2}$:

If the firm chooses private negotiation, workers demand $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$ and the firm hires workers with probability $P(w_i^* \leq v) = P(\theta_i \leq 2v - 1) = 2v - 1$. Conditional on hiring, the firm achieves a profit of $\pi_i = v - E(w_i^* | \theta_i \leq 2v - 1) = \frac{2v-1}{4}$. Thus, the firm yields an expected payoff of $\frac{(2v-1)^2}{4}$ in private negotiation.

If the firm chooses public wage, it yields an expected payoff of $\frac{v^2}{4}$.

The firm prefers public wage over private negotiation if and only if

$$\begin{aligned}
&\frac{v^2}{4} \geq \frac{(2v-1)^2}{4} \\
\Leftrightarrow &v^2 \geq (2v-1)^2 \\
\Leftrightarrow &v \geq 2v - 1 \\
\Leftrightarrow &1 \geq v \quad \text{(Always true)}
\end{aligned}$$

$\Rightarrow$ the firm with $v \geq \frac{1}{2}$ always prefers public wage. (2)

From (1) and (2), there exists a unique pooling equilibrium at public wage. □

B.4 Proposition 1

Proposition 1. Assume that the wage-setting mechanism is exogenous public wage. Suppose that workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ and workers give back the full rent they receive $\tau = 1$. Then, in equilibrium, the equilibrium wage equals to the surplus $\overline{w}^* = v$, and workers with $\theta_i \leq v$ are employed.

Because workers are fully reciprocal, given a public wage $\overline{w}$ and an outside option θ_i, workers exert effort equal to rent $e_i = r_i = \overline{w} - \theta_i$ in Stage 2

In Stage 1, after observing a take-it-or-leave-it offer $\overline{w}$, workers accept $\overline{w}$ if $\theta_i \leq \overline{w}$, and reject otherwise. Thus, the probability of hiring is given by $P(\theta_i \leq \overline{w})$.

At the beginning of the wage bargaining, the firm chooses a public wage $\overline{w}$ to maximize the expected payoff, which is a sum of profit and quality

$$\begin{aligned}
&\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v - \overline{w}) + (\overline{w} - E(\theta_i | \theta_i \leq \overline{w}))] \\
= &\arg\max_{\overline{w}} \overline{w}(v - E(\theta_i | \theta_i \leq \overline{w})) \\
= &\arg\max_{\overline{w}} \overline{w}(v - \frac{\overline{w}}{2})
\end{aligned}$$

First-order condition with respect to $\overline{w}$ gives us

$$\begin{aligned} v - \overline{w}^* &= 0 \\ \Leftrightarrow \overline{w}^* &= v \end{aligned}$$

Workers with $\theta_i \leq \overline{w}^*$, or equivalently $\theta_i \leq v$, are employed. □

B.5 Proposition 2

Proposition 2. Assume that the wage-setting mechanism is exogenous private negotiation and workers employ a linear wage strategy. Suppose that workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ and workers give back the full rent they receive $\tau = 1$. Then, in equilibrium, the equilibrium wage $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$, and workers with $\theta_i \leq v$ are employed.

Because workers are fully reciprocal, the firm expects quality $q_i = w_i - \tilde{\theta}_i(w_i)$, where $\tilde{\theta}_i(w_i) = E(\theta_i|w_i)$ denotes the firm's posterior belief about worker i's outside option θ_i after observing the initial offer w_i.

In Stage 1, the firm hires at an initial offer w_i if the benefit of hiring exceeds the cost of hiring, i.e.

$$\begin{aligned} &\Leftrightarrow v + w_i - \tilde{\theta}_i(w_i) \geq w_i \\ &\Leftrightarrow v \geq \tilde{\theta}_i(w_i) \end{aligned}$$

Thus, workers believe the probability of hiring to be $P(v \geq \tilde{\theta}_i)$. Workers bargain though a take-it-or-leave-it offer w_i. In particular, workers chooses an initial offer w_i to maximize their wages and the hiring probability. Worker i's objective is given by

$$\arg\max_{w_i} P(v \geq \tilde{\theta}_i(w_i))w_i + P(v < \tilde{\theta}_i(w_i))\theta_i$$

I assume that worker i employs a linear wage strategy, that is, $w_i(\theta_i) = \alpha\theta_i + \beta$. In equilibrium, the firm's belief about worker i's strategy coincides with worker i's strategy. Consequently, the firm's posterior belief about the outside option is given by $\tilde{\theta}_i(w_i) = w_i^{-1}(\theta_i) = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$. Given the firm's posterior belief $\tilde{\theta}_i$, I can rewrite worker i's objective as follows

$$\begin{aligned} &\arg\max_{w_i} P(v \geq \frac{w_i}{\alpha} - \frac{\beta}{\alpha})w_i + P(v < \frac{w_i}{\alpha} - \frac{\beta}{\alpha})\theta_i \\ = &\arg\max_{w_i} (1 - \frac{w_i}{\alpha} + \frac{\beta}{\alpha})w_i + (\frac{w_i}{\alpha} - \frac{\beta}{\alpha})\theta_i \\ = &\arg\max_{w_i} w_i - \frac{w_i^2}{\alpha} + \frac{\beta}{\alpha}w_i + \frac{\theta_i}{\alpha}w_i - \frac{\beta}{\alpha}\theta_i \end{aligned}$$

First-order condition with respect to w_i gives us

$$\begin{aligned}
&1-\frac{2}{\alpha}w_i^*+\frac{\beta}{\alpha}+\frac{\theta_i}{\alpha}=0\\
\Leftrightarrow&\frac{2}{\alpha}w_i^*=\frac{\theta_i}{\alpha}+\frac{\alpha+\beta}{\alpha}\\
\Leftrightarrow&w_i^*=\frac{\theta_i}{2}+\frac{\alpha+\beta}{2}
\end{aligned}$$

Furthermore, $w_i^* = \alpha\theta_i + \beta$. Solving both equations simultaneously, I get $\alpha = \frac{1}{2}$ and $\beta = \frac{\alpha+\beta}{2}$. Thus, $\alpha = \beta = \frac{1}{2}$. $\Rightarrow$ Worker i's wage strategy is given by $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$.

In equilibrium, $\tilde{\theta}_i(w_i) = \theta_i$. Hence, workers with $\theta_i \leq v$ are employed.

□

B.6 Proposition 3

Proposition 3. Assume the wage-setting mechanism is endogenous private negotiation and workers employ a linear wage strategy. Suppose that workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ and workers give back the full rent they receive $\tau = 1$. For each $\overline{v} \in [0, 1]$, there exists a separating equilibrium in which the low-surplus firm $v \in [0, \overline{v}]$ self-selects into a public wage offer and the high-surplus firm $v \in [\overline{v}, 1]$ self-selects into private negotiations.

Consider first the firm of a low match surplus $v \in [0, \overline{v}]$. In equilibrium, the firm of a low surplus opts for public wage. The firm chooses a public wage $\overline{w}$ that maximizes the firm's expected payoff.

$$\begin{aligned}
&\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v-\overline{w}) + (\overline{w} - E(\theta_i|\theta_i \leq \overline{w}))]\\
=&\arg\max_{\overline{w}} \overline{w}(v-\frac{\overline{w}}{2})
\end{aligned}$$

First-order condition with respect to $\overline{w}$ gives us: $\overline{w}^* = v$

Given the public wage $\overline{w}^* = v$, the probability of hiring is $P(\theta_i \leq v) = v$. Conditional on hiring, the firm obtains a profit of $v - \overline{w}$ and quality of $\overline{w} - E(\theta_i|\theta_i \leq \overline{w})$. Thus, the firm's equilibrium payoff in public wage is given by

$$\begin{aligned}
&v(v-\overline{w}+\overline{w}-E(\theta_i|\theta_i \leq v))\\
=&v(v-\frac{v}{2}) = \frac{v^2}{2}
\end{aligned}$$

If the firm deviates to private negotiation, workers believe, upon observing private negotiation, that the firm has a high surplus $v \in [\overline{v}, 1]$ and demand at least $\overline{v}$. Assume that for $w_i \geq \overline{v}$, workers employ a linear wage strategy $w_i(\theta_i) = \alpha\theta_i + \beta$. Thus, upon observing the initial offer w_i, the firm believes the outside option is $\tilde{\theta}_i = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$ and hires if $v \geq \tilde{\theta}_i$.

Believing that $v \in [\overline{v}, 1]$, workers choose their initial offer w_i to maximize their wages and the hiring probability.

$$\begin{aligned}
&\arg\max_{w_i \geq \overline{v}} P(v \geq \frac{w_i}{\alpha} - \frac{\beta}{\alpha} \Big| v \in [\overline{v}, 1])w_i + P(v < \frac{w_i}{\alpha} - \frac{\beta}{\alpha} \Big| v \in [\overline{v}, 1])\theta_i \\
=&\arg\max_{w_i \geq \overline{v}} \frac{1 - \frac{w_i}{\alpha} + \frac{\beta}{\alpha}}{1 - \overline{v}} w_i + \frac{\frac{w_i}{\alpha} - \frac{\beta}{\alpha} - \overline{v}}{1 - \overline{v}} \theta_i \\
=&\arg\max_{w_i \geq \overline{v}} (1 - \frac{w_i}{\alpha} + \frac{\beta}{\alpha}) w_i + (\frac{w_i}{\alpha} - \frac{\beta}{\alpha} - \overline{v})\theta_i \\
=&\arg\max_{w_i \geq \overline{v}} w_i - \frac{w_i^2}{\alpha} + \frac{\beta}{\alpha} w_i + \frac{\theta_i}{\alpha} w_i - \frac{\beta}{\alpha}\theta_i - \overline{v}\theta_i
\end{aligned}$$

First-order condition with respect to w_i gives us

$$\begin{aligned}
&1 - \frac{2}{\alpha} w_i^* + \frac{\beta}{\alpha} + \frac{\theta_i}{\alpha} = 0 \\
\Leftrightarrow &\frac{2}{\alpha} w_i^* = \frac{\theta_i}{\alpha} + \frac{\alpha + \beta}{\alpha} \\
\Leftrightarrow &w_i^* = \frac{\theta_i}{2} + \frac{\alpha + \beta}{2}
\end{aligned}$$

Furthermore, $w_i^* = \alpha\theta_i + \beta$. Solving both equations simultaneously, I get $\alpha = \frac{1}{2}$ and $\beta = \frac{\alpha+\beta}{2}$. Thus, $\alpha = \beta = \frac{1}{2}$.

$\Rightarrow$ Worker i's wage strategy is given by $w_i^* = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$, or equivalently

$$w_i^* = \begin{cases} \overline{v} & \text{if } \theta_i < 2\overline{v} - 1 \\ \frac{\theta_i}{2} + \frac{1}{2} & \text{if } \theta_i \geq 2\overline{v} - 1 \end{cases}$$

Case 1. Suppose that $2\overline{v} - 1 > v$ such that the firm prefers to hire only those workers who demand $w_i^* = \overline{v}$. The expected payoff of hiring at $w_i^* = \overline{v}$ is given by

$$\begin{aligned}
&P(\theta_i \leq 2\overline{v} - 1)\Big[(v - \overline{v}) + (\overline{v} - E(\theta_i | \theta_i \leq 2\overline{v} - 1))\Big] \\
=&(2\overline{v} - 1)(v - \overline{v} + \frac{1}{2})
\end{aligned}$$

It is sufficient to check whether the firm of $v = \overline{v}$ has an incentive to deviate. At $v = \overline{v}$, the firm does not deviate if and only if the equilibrium payoff is at least as good as the expected payoff from deviating.

$$\begin{aligned}
&\frac{\overline{v}^2}{2} \geq \overline{v} - \frac{1}{2} \\
\Leftrightarrow &(\overline{v} - 1)^2 \geq 0 \ \text{ (Always true)}
\end{aligned}$$

Case 2. Suppose $\overline{v} \geq v \geq 2\overline{v} - 1$ such that the firm hires all workers with $\theta_i \leq v$, including those who demand $w_i^* = \overline{v}$. The firm yields an expected deviation payoff of

$$\begin{aligned}
&P(\theta_i \leq 2\overline{v} - 1)(v - E(\theta_i|\theta_i \leq 2\overline{v} - 1)) \\
&+ P(2\overline{v} - 1 \leq \theta_i \leq v)(v - E(\theta_i|2\overline{v} - 1 \leq \theta_i \leq v)) \\
=&(2\overline{v} - 1)(v - \frac{2\overline{v} - 1}{2}) + (v - 2\overline{v} + 1)(\frac{v}{2} - \frac{2\overline{v} - 1}{2}) \\
=&(2\overline{v} - 1)v - \frac{(2\overline{v} - 1)^2}{2} + \frac{v^2}{2} - \frac{2\overline{v} - 1}{2}v - \frac{2\overline{v} - 1}{2}v + \frac{(2\overline{v} - 1)^2}{2} \\
=&\frac{v^2}{2}
\end{aligned}$$

$\Rightarrow$ The firm of a low surplus $v \in [0, \overline{v}]$ is indifferent between public wage and private negotiation. In case of indifference, the firm prefers to stay in the equilibrium and chooses public wage.

Consider now the firm of a high match surplus $v \in [\overline{v}, 1]$. In equilibrium, the firm opts for private negotiation. Workers, upon updating their belief that $v \in [\overline{v}, 1]$, set their wage strategy $w_i^* = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$. Thus, the firm's equilibrium payoff in private negotiation is given by

$$\begin{aligned}
&P(\theta_i \leq 2\overline{v} - 1)(v - E(\theta_i|\theta_i \leq 2\overline{v} - 1)) \\
&+ P(2\overline{v} - 1 \leq \theta_i \leq v)(v - E(\theta_i|2\overline{v} - 1 \leq \theta_i \leq v)) \\
=&(2\overline{v} - 1)(v - \frac{2\overline{v} - 1}{2}) + (v - 2\overline{v} + 1)(\frac{v}{2} - \frac{2\overline{v} - 1}{2}) = \frac{v^2}{2}
\end{aligned}$$

If the firm deviates to public wage, it optimally posts a public wage $\overline{w}^* = v$ and yields an expected deviation payoff of $\frac{v^2}{2}$

$\Rightarrow$ The firm of a high surplus $v \in [\overline{v}, 1]$ is indifferent between private negotiation and public wage. In case of indifference, the firm prefers to stay in the equilibrium and chooses private negotiation.

□

B.7 Proposition 4

Proposition 4. Assume that the wage-setting mechanism is exogenous public wage. Suppose that workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ *and workers give back more than the rent they receive* $\tau > 1$. *Then, in equilibrium, the equilibrium wage,* $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$, *exceeds the surplus, and workers with* $\theta_i \leq \frac{v}{2-\tau}$ *are employed.*

Because workers are strongly reciprocal ($\tau \geq 1$), given a public wage $\overline{w}$ and an outside option θ_i, workers exert more effort than the received rent $e_i = \tau r_i = \tau(\overline{w} - \theta_i)$ in Stage 2

In Stage 1, after observing a public wage $\overline{w}$, workers accept $\overline{w}$ if $\theta_i \leq \overline{w}$, and reject otherwise. Thus, the probability of hiring is given by $P(\theta_i \leq \overline{w})$.

At the beginning of the wage bargaining, the firm chooses a public wage $\overline{w}$ to maximize the expected payoff, which is a sum of profit and quality

$$\begin{aligned} &\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v-\overline{w}) + \tau(\overline{w} - E(\theta_i|\theta_i \leq \overline{w}))] \\ =& \arg\max_{\overline{w}\leq 1} \overline{w}(v - \overline{w} + \tau\frac{\overline{w}}{2}) \\ =& \arg\max_{\overline{w}\leq 1} \overline{w}v - \overline{w}^2 + \frac{\tau}{2}\overline{w}^2 \end{aligned}$$

First-order condition with respect to $\overline{w}$ gives us[1]

$$\begin{aligned} &v - 2\overline{w}^* + \tau\overline{w}^* = 0 \\ \Leftrightarrow& \overline{w}^* = \min\{\frac{v}{2-\tau}, 1\} \\ \Leftrightarrow& \overline{w}^* = \begin{cases} \frac{v}{2-\tau} & \text{if } v \leq 2-\tau \\ 1 & \text{if } v \geq 2-\tau \end{cases} \end{aligned}$$

Note that $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\} \geq v$ for all $\tau \geq 1$. Workers with $\theta_i \leq \overline{w}^*$, or equivalently $\theta_i \leq \frac{v}{2-\tau}$, are employed.

Note on comparative statistics with respect to τ:

The equilibrium under exogenous public wage and linear gift exchange with $\tau \geq 1$ is characterized by

1. The hiring probability: $P(\theta_i \leq \frac{v}{2-\tau}) = \frac{v}{2-\tau}$

$$\frac{\partial P}{\partial \tau} = \frac{v}{(2-\tau)^2} \geq 0$$

$\Rightarrow$ As τ increases, the hiring probability increases.

2. The firm's profit: $\pi_i = v - \overline{w}^* = v - \frac{v}{2-\tau} = \frac{1-\tau}{2-\tau}v$

$$\begin{aligned} \frac{\partial \pi_i}{\partial \tau} =& v\Big[\frac{1-\tau}{(2-\tau)^2} + \frac{-1}{2-\tau}\Big] \\ =& v\frac{1-\tau-(2-\tau)}{(2-\tau)^2} \\ =& \frac{-v}{(2-\tau)^2} \leq 0 \end{aligned}$$

$\Rightarrow$ As τ increases, the firm's profit decreases.

[1]Note that if $\overline{w} \geq 1$, the firm's payoff is given by $v - \overline{w} + \frac{\tau}{2}$, which decreases in $\overline{w}$. Thus the firm wants to cap the public wage $\overline{w}$ at 1.

3. The firm's quality: $q_i = \tau(\overline{w}^* - E(\theta_i|\theta_i \leq \overline{w}^*)) = \tau\frac{\overline{w}^*}{2} = \tau\frac{v}{2(2-\tau)}$

$$\begin{aligned}\frac{\partial q_i}{\partial \tau} =& \frac{v}{2}\Big[\frac{\tau}{(2-\tau)^2} + \frac{1}{2-\tau}\Big]\\ =& \frac{v}{2}\frac{\tau + (2-\tau)}{(2-\tau)^2}\\ =& \frac{v}{2}\frac{2}{(2-\tau)^2} = \frac{v}{(2-\tau)^2} \geq 0\end{aligned}$$

$\Rightarrow$ As τ increases, the firm's quality increases.

□

B.8 Proposition 5

Proposition 5. Assume that the wage-setting mechanism is exogenous private negotiation and workers employ a linear wage strategy. Suppose that workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ and workers give back more than the rent they receive $\tau > 1$. Then, in equilibrium, the equilibrium wage $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$ and workers with $\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}$ are employed.

Because workers are strongly reciprocal, the firm expects quality $q_i = \tau(w_i - \tilde{\theta}_i(w_i))$, where $\tilde{\theta}_i(w_i) = E(\theta_i|w_i)$ denotes the firm's posterior belief about worker i's outside option θ_i after observing the initial offer w_i.

In Stage 1, the firm hires at an initial offer w_i if the benefit of hiring exceeds the cost of hiring, i.e.

$$\begin{aligned}\Leftrightarrow & v + \tau(w_i - \tilde{\theta}_i(w_i)) \geq w_i\\ \Leftrightarrow & v \geq (1-\tau)w_i + \tau\tilde{\theta}_i(w_i)\end{aligned}$$

I assume that worker i employs a linear wage strategy, that is, $w_i(\theta_i) = \alpha\theta_i + \beta$. In equilibrium, the firm's belief about worker i's strategy coincides with worker i's strategy. Consequently, the firm's posterior belief about the outside option is given by $\tilde{\theta}_i(w_i) = w_i^{-1}(\theta_i) = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$.

Substituting the firm's posterior belief $\tilde{\theta}_i(w_i)$ into the hiring probability, we have

$$\begin{aligned} & v \geq (1-\tau)w_i + \tau(\frac{w_i}{\alpha} - \frac{\beta}{\alpha})\\ \Leftrightarrow & v \geq (1-\tau+\frac{\tau}{\alpha})w_i - \tau\frac{\beta}{\alpha}\\ \Leftrightarrow & v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}\end{aligned}$$

Thus, workers believe the probability of hiring is $P(v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha})$ at a given w_i.

Workers bargain though a take-it-or-leave-it offer w_i. In particular, workers chooses an initial offer w_i to maximize their wages and the hiring probability. Worker i's objective is given by

$$\begin{aligned}
&\arg\max_{w_i} P(v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha})w_i + P(v < \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha})\theta_i \\
=&\arg\max_{w_i} (1 - \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i + \frac{\tau\beta}{\alpha})w_i + (\frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha})\theta_i \\
=&\arg\max_{w_i} w_i - \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i^2 + \frac{\tau\beta}{\alpha}w_i + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i w_i - \frac{\tau\beta}{\alpha}\theta_i
\end{aligned}$$

First-order condition with respect to w_i gives us

$$\begin{aligned}
&1 - \frac{\alpha+\tau-\tau\alpha}{\alpha}2w_i^* + \frac{\tau\beta}{\alpha} + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i = 0 \\
\Leftrightarrow&\frac{\alpha+\tau-\tau\alpha}{\alpha}2w_i^* = 1 + \frac{\tau\beta}{\alpha} + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i \\
\Leftrightarrow&\frac{\alpha+\tau-\tau\alpha}{\alpha}2w_i^* = \frac{\alpha+\tau\beta}{\alpha} + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i \\
\Leftrightarrow&w_i^* = \frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)} + \frac{1}{2}\theta_i
\end{aligned}$$

Furthermore, $w_i^* = \alpha\theta_i + \beta$. Solving both equations simultaneously, I get $\alpha = \frac{1}{2}$ and $\beta = \frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)}$. Thus, $\alpha = \beta = \frac{1}{2}$.

$\Rightarrow$ Worker i's wage strategy is given by $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$.

In equilibrium, the firm correctly infer workers' outside option $\tilde{\theta}_i(w_i) = \theta_i$. Hence, worker i, with the initial offer $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$, gets employed if and only if

$$\begin{aligned}
&v - w_i + \tau(w_i - \theta_i) \geq 0 \\
\Leftrightarrow&v + (\tau-1)(\frac{\theta_i}{2} + \frac{1}{2}) - \tau\theta_i \geq 0 \\
\Leftrightarrow&v + \frac{\tau-1}{2} \geq \frac{\tau+1}{2}\theta_i \\
\Leftrightarrow&\frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1} \geq \theta_i
\end{aligned}$$

Note on comparative statistics with respect to τ:

The equilibrium under exogenous private negotiation and linear gift exchange with $\tau \geq 1$ is characterized by

1. The hiring probability: $P(\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) = \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}$

$$\begin{aligned}\frac{\partial P}{\partial \tau} =& \frac{-2v}{(\tau+1)^2} + \frac{-(\tau-1)}{(\tau+1)^2} + \frac{1}{\tau+1} \\ =& \frac{-2v - \tau + 1 + \tau + 1}{(\tau+1)^2} \\ =& \frac{2(1-v)}{(\tau+1)^2} \geq 0\end{aligned}$$

$\Rightarrow$ As τ increases, the hiring probability increases.

2. The firm's profit:

$$\begin{aligned}\pi_i =& v - E(w_i^* | \theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) \\ =& v - E(\frac{\theta_i}{2} + \frac{1}{2} | \theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) \\ =& v - \frac{1}{2} - \frac{1}{2} E(\theta_i | \theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) \\ =& v - \frac{1}{2} - \frac{v}{2(\tau+1)} - \frac{\tau-1}{4(\tau+1)} \\ =& \frac{2\tau+1}{2(\tau+1)} v - \frac{3\tau+1}{4(\tau+1)} = \frac{2(2\tau+1)v - (3\tau+1)}{4(\tau+1)}\end{aligned}$$

$$\begin{aligned}\frac{\partial \pi_i}{\partial \tau} =& \frac{1}{4}\Big[\frac{(3\tau+1) - 2(2\tau+1)v}{(\tau+1)^2} + \frac{4v-3}{\tau+1}\Big] \\ =& \frac{1}{4}\Big[\frac{(1-2v) - \tau(4v-3)}{(\tau+1)^2} + \frac{4v-3}{\tau+1}\Big] \\ =& \frac{1}{4}\frac{(1-2v) + (4v-3)}{(\tau+1)^2} = \frac{-(1-v)}{2(\tau+1)^2} \leq 0\end{aligned}$$

$\Rightarrow$ As τ increases, the firm's profit decreases.

3. The firm's quality:

$$\begin{aligned}q_i =& \tau E(-\frac{\theta_i}{2} + \frac{1}{2} | \theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) \\ =& \frac{\tau}{2} - \frac{\tau}{2} E(\theta_i | \theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) \\ =& \frac{\tau}{2}(1 - \frac{2v+\tau-1}{2(\tau+1)}) \\ =& \frac{\tau(\tau+3-2v)}{4(\tau+1)}\end{aligned}$$

$$\frac{\partial q_i}{\partial \tau} = \frac{1}{4}\Big[\frac{-\tau(\tau+3-2v)}{(\tau+1)^2} + \frac{2\tau+3-2v}{\tau+1}\Big]$$
$$= \frac{\tau^2+2\tau+3-2v}{4(\tau+1)^2}$$
$$= \frac{1}{4} + \frac{1-v}{2(\tau+1)^2} \geq 0$$

$\Rightarrow$ As τ increases, the firm's quality increases.

□

B.9 Proposition 6

Proposition 6. Assume the wage-setting mechanism is endogenous private negotiation and workers employ a linear wage strategy. Suppose workers exhibit a linear gift exchange function $e_i^* = \tau r_i$ and workers give back more than the rent they receive $\tau > 1$. Then there exists a unique separating equilibrium in which the low-surplus firm $v \in [0, \overline{v}]$ self-selects into a public wage offer and the high-surplus firm $v \in [\overline{v}, 1]$ self-selects into private negotiations. The cutoff threshold $\overline{v}$ is given by

$$\overline{v} = \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1}$$

Part 1: Existence of the separating equilibrium

Consider first the firm of a low match surplus $v \in [0, \overline{v}]$. In equilibrium, the firm of a low surplus opts for public wage. The firm chooses a public wage $\overline{w}$ that maximizes the firm's expected payoff.

$$\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v - \overline{w}) + \tau(\overline{w} - E(\theta_i | \theta_i \leq \overline{w}))]$$
$$= \arg\max_{\overline{w} \leq 1} \overline{w}(v - \overline{w} + \tau\frac{\overline{w}}{2})$$
$$= \arg\max_{\overline{w} \leq 1} \overline{w}v - \overline{w}^2 + \frac{\tau}{2}\overline{w}^2$$

First-order condition with respect to $\overline{w}$ gives us

$$v - 2\overline{w}^* + \tau\overline{w}^* = 0$$
$$\Leftrightarrow \overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$$

If $v \leq 2-\tau$, then the public wage is $\overline{w}^* = \frac{v}{2-\tau}$, and the probability of hiring is $P(\theta_i \leq \frac{v}{2-\tau}) = \frac{v}{2-\tau}$. Conditional on hiring, the firm obtains a profit of $v - \overline{w} = \frac{1-\tau}{2-\tau}v$ and quality of $\tau(\overline{w} - E(\theta_i|\theta_i \leq \overline{w})) = \tau\frac{v}{2(2-\tau)}$. Thus, the firm's equilibrium payoff in public wage is given by

$$\begin{aligned}&\frac{v}{2-\tau}\Big[\frac{1-\tau}{2-\tau}v + \frac{\tau}{2(2-\tau)}v\Big]\\ =&\frac{v}{2-\tau}\frac{v}{2} = \frac{v^2}{2(2-\tau)}\end{aligned}$$

If $v \geq 2-\tau$, then the public wage is $\overline{w}^* = 1$, and the probability of hiring is $P(\theta_i \leq 1) = 1$. Conditional on hiring, the firm obtains a profit of $v-1$ and quality of $\frac{\tau}{2}$. Thus, the firm's equilibrium payoff in public wage is given by $v - 1 + \frac{\tau}{2}$.

Note that the equilibrium payoff under $\overline{w}^* = \frac{v}{2-\tau}$ is smaller than the equilibrium payoff under $\overline{w}^* = 1$.[2] It is thus sufficient to consider a deviation incentive for the firm with $\overline{w}^* = \frac{v}{2-\tau}$.

If the firm deviates to private negotiation, workers believe, upon observing private negotiation, that the firm has a high surplus $v \in [\overline{v}, 1]$ and demand at least $\overline{v}$. Assume that for $w_i \geq \overline{v}$, workers employ a linear wage strategy $w_i(\theta_i) = \alpha\theta_i + \beta$. Thus, upon observing the initial offer w_i, the firm believes the outside option is $\tilde{\theta}_i = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$ and hires if

$$\begin{aligned}&v - w_i + \tau(w_i - \tilde{\theta}_i) \geq 0\\ \Leftrightarrow& v \geq (1-\tau)w_i + \tau(\frac{w_i}{\alpha} - \frac{\beta}{\alpha})\\ \Leftrightarrow& v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}\end{aligned}$$

Believing that $v \in [\overline{v}, 1]$, workers choose their initial offer w_i to maximize their wages and the hiring probability.

$$\begin{aligned}&\arg\max_{w_i \geq \overline{v}}\ P(v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}\Big|\cdot)w_i + P(v < \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}\Big|\cdot)\theta_i\\ =&\arg\max_{w_i \geq \overline{v}}\ \frac{1 - \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i + \frac{\tau\beta}{\alpha}}{1-\overline{v}}w_i + \frac{\frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha} - \overline{v}}{1-\overline{v}}\theta_i\\ =&\arg\max_{w_i \geq \overline{v}}\ w_i - \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i^2 + \frac{\tau\beta}{\alpha}w_i + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i w_i - \frac{\tau\beta}{\alpha}\theta_i - \overline{v}\theta_i\end{aligned}$$

[2] For $v \leq 2-\tau$, the public wage is $\overline{w}^* = \frac{v}{2-\tau}$ and the firm's payoff is $\frac{v^2}{2(2-\tau)} \leq \frac{2-\tau}{2}$. For $v \geq 2-\tau$, then the public wage is $\overline{w}^* = 1$ and the firm's payoff is $v - 1 + \frac{\tau}{2} \geq \frac{2-\tau}{2}$. If the firm with $\overline{w}^* = \frac{v}{2-\tau}$ does not have an incentive to deviate, it follows that the firm with $\overline{w}^* = 1$ also does not want to deviate.

First-order condition with respect to w_i gives us

$$\begin{aligned}
&1-\frac{\alpha+\tau-\tau\alpha}{\alpha}2w_i^*+\frac{\tau\beta}{\alpha}+\frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i=0\\
\Leftrightarrow&\frac{\alpha+\tau-\tau\alpha}{\alpha}2w_i^*=\frac{\alpha+\tau\beta}{\alpha}+\frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i\\
\Leftrightarrow& w_i^*=\frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)}+\frac{1}{2}\theta_i
\end{aligned}$$

Furthermore, $w_i^*=\alpha\theta_i+\beta$. Solving both equations simultaneously, I get $\alpha=\frac{1}{2}$ and $\beta=\frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)}$. Thus, $\alpha=\beta=\frac{1}{2}$.

$\Rightarrow$ Worker i's wage strategy is given by $w_i^*=\max\{\overline{v},\frac{\theta_i}{2}+\frac{1}{2}\}$, or equivalently

$$w_i^*=\begin{cases}\overline{v} & \text{if } \theta_i<2\overline{v}-1\\ \frac{\theta_i}{2}+\frac{1}{2} & \text{if } \theta_i\geq 2\overline{v}-1\end{cases}$$

Recall that under private negotiation, the firm prefers to hire workers with $\theta_i\leq\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}$

Case 1. Suppose that $2\overline{v}-1>\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}$ such that the firm prefers to hire only those workers who demand $w_i^*=\overline{v}$. The expected payoff of hiring at $w_i^*=\overline{v}$ is given by

$$\begin{aligned}
&P(\theta_i\leq 2\overline{v}-1)\Big[(v-\overline{v})+\tau(\overline{v}-E(\theta_i|\theta_i\leq 2\overline{v}-1))\Big]\\
=&(2\overline{v}-1)(v-\overline{v}+\frac{\tau}{2})
\end{aligned}$$

Because the deviation payoff increases in v, it is sufficient to check whether the firm of $v=\overline{v}$ has an incentive to deviate. At $v=\overline{v}$, the firm does not deviate if and only if the equilibrium payoff is at least as good as the expected payoff from deviating.

$$\begin{aligned}
&\frac{\overline{v}^2}{2(2-\tau)}\geq\overline{v}\tau-\frac{\tau}{2}\\
\Leftrightarrow&\overline{v}^2-2\overline{v}(2-\tau)\tau+(2-\tau)\tau\geq 0\\
\Leftrightarrow&(\overline{v}-(2-\tau)\tau)^2+(2-\tau)\tau(1-(2-\tau)\tau)\geq 0\\
\Leftrightarrow&(\overline{v}-(2-\tau)\tau)^2+(2-\tau)\tau(\tau-1)^2\geq 0\ \ \text{(Always true)}
\end{aligned}$$

Case 2. Suppose $\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}\geq 2\overline{v}-1$ such that the firm hires all workers with $\theta_i\leq\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}$, including those who demand $w_i^*=\overline{v}$. As before, the expected payoff of hiring at $w_i^*=\overline{v}$ is given by $(2\overline{v}-1)(v-\overline{v}+\frac{\tau}{2})$.

In addition, hiring at $w_i^*=\frac{\theta_i}{2}+\frac{1}{2}$ is characterized by the hiring probability $P(\theta_i\in[2\overline{v}-1,\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}])=\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}-(2\overline{v}-1)$, the profit $\pi_i=v-E(\frac{\theta_i}{2}+\frac{1}{2}|\theta_i\in[2\overline{v}-1,\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}])=v-\frac{1}{2}-\frac{1}{2}E(\theta_i|\theta_i\in[2\overline{v}-1,\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}])$, and the quality $q_i=\tau E(-\frac{\theta_i}{2}+\frac{1}{2}|\theta_i\in$

$[2\overline{v}-1, \frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}]) = \frac{\tau}{2} - \frac{\tau}{2}E(\theta_i|\theta_i \in [2\overline{v}-1, \frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}])$. Thus, the expected payoff of hiring at $w_i^* = \frac{\theta_i}{2}+\frac{1}{2}$ is given by

$$
\begin{aligned}
&[\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}-(2\overline{v}-1)][v-\frac{1}{2}+\frac{\tau}{2}-\frac{1}{2}(\tau+1)E(\theta_i|\cdot)] \\
=&[\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}-2\overline{v}+1]\frac{v+\tau-\overline{v}(\tau+1)}{2}
\end{aligned}
$$

The firm yields an expected deviation payoff of

$$(2\overline{v}-1)(v-\overline{v}+\frac{\tau}{2})+[\frac{2v}{\tau+1}+\frac{\tau-1}{\tau+1}-2\overline{v}+1]\frac{v+\tau-\overline{v}(\tau+1)}{2}$$

Because the deviation payoff is increasing in v, it is sufficient to check if the firm with $v=\overline{v}$ has an incentive to deviate. At $v=\overline{v}$, the expected deviation is given by

$$
\begin{aligned}
&(2\overline{v}-1)\frac{\tau}{2}+[\frac{2\overline{v}}{\tau+1}+\frac{\tau-1}{\tau+1}-2\overline{v}+1]\frac{\overline{v}+\tau-\overline{v}(\tau+1)}{2} \\
=&(2\overline{v}-1)\frac{\tau}{2}+\frac{2\overline{v}+\tau-1-(2\overline{v}-1)(\tau+1)}{\tau+1}\frac{\tau(1-\overline{v})}{2} \\
=&(2\overline{v}-1)\frac{\tau}{2}+\frac{2\tau(1-\overline{v})}{\tau+1}\frac{\tau(1-\overline{v})}{2} \\
=&(2\overline{v}-1)\frac{\tau}{2}+\frac{\tau^2(1-\overline{v})^2}{\tau+1}
\end{aligned}
$$

The firm prefers to stay in the equilibrium if the equilibrium payoff exceeds the deviation payoff, i.e.,

$$
\begin{aligned}
&\frac{\overline{v}^2}{2(2-\tau)} \geq (2\overline{v}-1)\frac{\tau}{2}+\frac{\tau^2(1-\overline{v})^2}{\tau+1} \\
\Leftrightarrow&\overline{v}^2(\tau+1) \geq (2\overline{v}-1)\tau(\tau+1)(2-\tau)+2\tau^2(1-\overline{v})^2(2-\tau) \\
\Leftrightarrow&\overline{v}^2(\tau+1) \geq \overline{v}^2(-2\tau^3+4\tau^2)+2\overline{v}(\tau^3-3\tau^2+2\tau)-(\tau^3-3\tau^2+2\tau) \\
\Leftrightarrow&\overline{v}^2(2\tau^3-4\tau^2+\tau+1) \geq 2\overline{v}(\tau^3-3\tau^2+2\tau)-(\tau^3-3\tau^2+2\tau) \\
\Leftrightarrow&\overline{v}^2(\tau-1)(2\tau^2-2\tau-1) \geq 2\overline{v}\tau(\tau-2)(\tau-1)-\tau(\tau-2)(\tau-1) \\
\Leftrightarrow&\overline{v}^2(2\tau^2-2\tau-1) \geq 2\overline{v}\tau(\tau-2)-\tau(\tau-2) \\
\Leftrightarrow&(2\tau^2-2\tau-1)(\overline{v}-\frac{\tau(\tau-2)}{2\tau^2-2\tau-1})^2 \geq \frac{\tau(\tau-2)(1+\tau)(1-\tau)}{2\tau^2-2\tau-1}
\end{aligned}
$$

a. If $2\tau^2+2\tau-1<0$, then by multiplying both sides with $2\tau^2+2\tau-1$ the condition is equivalent to

$$
\begin{aligned}
\Leftrightarrow&|\overline{v}(2\tau^2-2\tau-1)-\tau(\tau-2)| \leq \tau(\tau-2)(1+\tau)(1-\tau) \\
\Leftrightarrow&\overline{v} \geq \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)}-\tau(2-\tau)}{2\tau^2-2\tau-1}
\end{aligned}
$$

b. If $2\tau^2 + 2\tau - 1 \geq 0$, then by multiplying both sides with $2\tau^2 + 2\tau - 1$ the condition is equivalent to

$$\begin{aligned}&\Leftrightarrow |\overline{v}(2\tau^2 - 2\tau - 1) - \tau(\tau - 2)| \geq \tau(\tau - 2)(1 + \tau)(1 - \tau) \\ &\Leftrightarrow \overline{v} \geq \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1}\end{aligned}$$

$\Rightarrow$ The condition such that the firm of a low surplus $v \in [0, \overline{v}]$ prefers public wage is

$$\overline{v} \geq \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1} \tag{$\star$}$$

Consider now the firm of a high match surplus $v \in [\overline{v}, 1]$. In equilibrium, the firm opts for private negotiation. Workers, upon updating their belief that $v \in [\overline{v}, 1]$, set their wage strategy $w_i^* = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$. Thus, the firm's equilibrium payoff in private negotiation is given by

$$(2\overline{v} - 1)(v - \overline{v} + \frac{\tau}{2}) + [\frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1} - 2\overline{v} + 1]\frac{v + \tau - \overline{v}(\tau+1)}{2}$$

If the firm deviates to public wage, it optimally posts a public wage $\overline{w}^* = \frac{v}{2-\tau}$ and yields an expected deviation payoff of $\frac{v^2}{2(2-\tau)}$

At the cutoff $v = \overline{v}$, the firm prefers to stay in the equilibrium if the equilibrium payoff exceeds the deviation payoff, i.e.,

$$\frac{\overline{v}^2}{2(2-\tau)} \leq (2\overline{v} - 1)\frac{\tau}{2} + \frac{\tau^2(1-\overline{v})^2}{\tau+1}$$

Analogous to the above analysis, the condition such that the firm of a high surplus $v \in [\overline{v}, 1]$ prefers private negotiation is

$$\overline{v} \leq \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1} \tag{$\star\star$}$$

From ($\star$) and ($\star\star$), if $\overline{v} = \frac{\sqrt{\tau(2-\tau)(\tau-1)(\tau+1)} - \tau(2-\tau)}{2\tau^2 - 2\tau - 1}$, then there exists a separating equilibrium in which the firm of a low surplus $v \in [0, \overline{v}]$ self-selects into public wage and a high surplus $v \in [\overline{v}, 1]$ self-selects into private negotiation.

Part 2: Uniqueness of the separating equilibrium

Case 1. A pooling equilibrium at public wage

In equilibrium, the firm of any realized v posts a public wage $\overline{w}$ to maximize its expected payoff

$$\begin{aligned}&\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v-\overline{w})+\tau(\overline{w}-E(\theta_i|\theta_i \leq \overline{w}))]\\ =&\arg\max_{\overline{w}} \overline{w}(v-\overline{w}+\tau\frac{\overline{w}}{2})\end{aligned}$$

First-order condition with respect to $\overline{w}$ gives us: $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$. If $\overline{w}^* = \frac{v}{2-\tau}$, the firm's equilibrium payoff in public wage is given by

$$\frac{v}{2-\tau}\Big[\frac{1-\tau}{2-\tau}v+\frac{\tau}{2(2-\tau)}v\Big] = \frac{v^2}{2(2-\tau)}$$

If the firm deviates to private negotiation, workers believe that $v \in [0,1]$ and demand w_i to maximize their expected wage. Assume that workers employ a linear wage strategy $w_i(\theta_i) = \alpha\theta_i + \beta$. Thus, upon observing the initial offer w_i, the firm believes the outside option is $\tilde{\theta}_i = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$ and hires if

$$\begin{aligned}&v - w_i + \tau(w_i - \tilde{\theta}_i) \geq 0\\ \Leftrightarrow& v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}\end{aligned}$$

Workers choose their initial offer w_i to maximize their wages and the hiring probability.

$$\begin{aligned}&\arg\max_{w_i\geq\overline{v}} P(v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha})w_i + P(v < \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha})\theta_i\\ =&\arg\max_{w_i\geq\overline{v}} w_i - \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i^2 + \frac{\tau\beta}{\alpha}w_i + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i w_i - \frac{\tau\beta}{\alpha}\theta_i\end{aligned}$$

First-order condition with respect to w_i gives us

$$\begin{aligned}&1 - \frac{\alpha+\tau-\tau\alpha}{\alpha}2w_i^* + \frac{\tau\beta}{\alpha} + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i = 0\\ \Leftrightarrow& w_i^* = \frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)} + \frac{1}{2}\theta_i\end{aligned}$$

Furthermore, $w_i^* = \alpha\theta_i + \beta$. Solving both equations simultaneously, I get $\alpha = \frac{1}{2}$ and $\beta = \frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)}$. Thus, $\alpha = \beta = \frac{1}{2}$. Worker i's wage strategy is given by $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$.

Given worker i's wage strategy, the firm hires worker i if and only if

$$v - w_i + \tau(w_i - \theta_i) \geq 0 \Leftrightarrow \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1} \geq \theta_i$$

Thus, the firm's expected deviation payoff is given by

$$\begin{aligned}&P(\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1})E(v - (\frac{\theta_i}{2}+\frac{1}{2}) + \tau(-\frac{\theta_i}{2}+\frac{1}{2})|\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1})\\ =&\frac{2v+\tau-1}{\tau+1}(v - \frac{1}{2} + \frac{\tau}{2} - \frac{1}{2}(\tau+1)E(\theta_i|\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}))\\ =&\frac{2v+\tau-1}{\tau+1}(\frac{2v+\tau-1}{2} - \frac{2v+\tau-1}{4}) = \frac{(2v+\tau-1)^2}{4(\tau+1)}\end{aligned}$$

Consider an incentive to deviate for the firm with $v = 0$. At $v = 0$, the firm prefers to deviate if

$$\frac{(\tau-1)^2}{4(\tau+1)} \geq 0 \quad \text{(True)}$$

Thus, a pooling equilibrium at public wage does not exist as the firm of $v = 0$ prefers to deviate to private negotiation.

Case 2. A pooling equilibrium at private negotiation

In equilibrium, the firm of any realized surplus v opts for private negotiation, and workers believe that $v \in [0, 1]$. Assume that workers employ a linear wage strategy $w_i(\theta_i) = \alpha\theta_i + \beta$. Thus, upon observing the initial offer w_i, the firm believes the outside option is $\tilde{\theta}_i = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$ and hires if

$$\begin{aligned}
&v - w_i + \tau(w_i - \tilde{\theta}_i) \geq 0 \\
\Leftrightarrow &v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha} w_i - \frac{\tau\beta}{\alpha}
\end{aligned}$$

Workers choose their initial offer w_i to maximize their wages and the hiring probability.

$$\begin{aligned}
&\arg\max_{w_i \geq \overline{v}} \; P(v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha} w_i - \frac{\tau\beta}{\alpha}) w_i + P(v < \frac{\alpha+\tau-\tau\alpha}{\alpha} w_i - \frac{\tau\beta}{\alpha})\theta_i \\
&= \arg\max_{w_i \geq \overline{v}} \; w_i - \frac{\alpha+\tau-\tau\alpha}{\alpha} w_i^2 + \frac{\tau\beta}{\alpha} w_i + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i w_i - \frac{\tau\beta}{\alpha}\theta_i
\end{aligned}$$

First-order condition with respect to w_i gives us

$$\begin{aligned}
&1 - \frac{\alpha+\tau-\tau\alpha}{\alpha} 2w_i^* + \frac{\tau\beta}{\alpha} + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i = 0 \\
\Leftrightarrow &w_i^* = \frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)} + \frac{1}{2}\theta_i
\end{aligned}$$

Furthermore, $w_i^* = \alpha\theta_i + \beta$. Solving both equations simultaneously, I get $\alpha = \frac{1}{2}$ and $\beta = \frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)}$. Thus, $\alpha = \beta = \frac{1}{2}$. Worker i's wage strategy is given by $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$.

Given worker i's wage strategy, the firm hires worker i if and only if

$$v - w_i + \tau(w_i - \theta_i) \geq 0 \Leftrightarrow \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1} \geq \theta_i$$

Thus, the firm's expected equilibrium payoff is given by

$$\begin{aligned}
&P(\theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) E(v - (\frac{\theta_i}{2} + \frac{1}{2}) + \tau(-\frac{\theta_i}{2} + \frac{1}{2}) | \theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1}) \\
=&\frac{2v+\tau-1}{\tau+1}(v - \frac{1}{2} + \frac{\tau}{2} - \frac{1}{2}(\tau+1)E(\theta_i | \theta_i \leq \frac{2v}{\tau+1} + \frac{\tau-1}{\tau+1})) \\
=&\frac{2v+\tau-1}{\tau+1}(\frac{2v+\tau-1}{2} - \frac{2v+\tau-1}{4}) = \frac{(2v+\tau-1)^2}{4(\tau+1)}
\end{aligned}$$

If the firm deviates to public wage, the firm posts a public wage $\overline{w}$ to maximize its expected payoff

$$\begin{aligned}&\arg\max_{\overline{w}} P(\theta_i \le \overline{w})[(v-\overline{w}) + \tau(\overline{w} - E(\theta_i|\theta_i \le \overline{w}))]\\ =&\arg\max_{\overline{w}} \overline{w}(v-\overline{w}+\tau\frac{\overline{w}}{2})\end{aligned}$$

First-order condition with respect to $\overline{w}$ gives us: $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$.

Consider an incentive to deviate for the firm with $v=1$. At $v=1$, the firm sets $\overline{w}^*=1$ and yields a deviation payoff of $v-1+\frac{\tau}{2}$. Thus, the firm prefers to deviate if

$$\begin{aligned}&\frac{\tau}{2} \ge \frac{(2+\tau-1)^2}{4(\tau+1)}\\ \Leftrightarrow& 2\tau \ge \tau+1\\ \Leftrightarrow& \tau \ge 1 \quad \text{(True)}\end{aligned}$$

Thus, a pooling equilibrium at private negotiation does not exist as the firm of $v=1$ prefers to deviate to public wage.

Case 3. A separating equilibrium – the firm of a low surplus $v \in [0,\tilde{v}]$ opts for private negotiation and a high surplus $v \in [\tilde{v}, 1]$ opts for public wage

Consider the firm of a low surplus $v \in [0,\tilde{v}]$. In equilibrium, the firm opts for private negotiation. Workers, upon observing private negotiation, believe that $v \in [0,\tilde{v}]$. Assume that workers employ a linear wage strategy $w_i(\theta_i) = \alpha\theta_i + \beta$. Thus, upon observing the initial offer w_i, the firm believes the outside option is $\tilde{\theta}_i = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$ and hires if

$$\begin{aligned}&v - w_i + \tau(w_i - \tilde{\theta}_i) \ge 0\\ \Leftrightarrow& v \ge \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}\end{aligned}$$

Believing that $v \in [0,\tilde{v}]$, workers choose their initial offer w_i to maximize their wages and the hiring probability.

$$\begin{aligned}&\arg\max_{w_i}\ P(v \ge \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}\Big|\cdot)w_i + P(v < \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}\Big|\cdot)\theta_i\\ =&\arg\max_{w_i}\ \frac{\tilde{v} - \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i + \frac{\tau\beta}{\alpha}}{\tilde{v}}w_i + \frac{\frac{\alpha+\tau-\tau\alpha}{\alpha}w_i - \frac{\tau\beta}{\alpha}}{\tilde{v}}\theta_i\\ =&\arg\max_{w_i}\ \tilde{v}w_i - \frac{\alpha+\tau-\tau\alpha}{\alpha}w_i^2 + \frac{\tau\beta}{\alpha}w_i + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i w_i - \frac{\tau\beta}{\alpha}\theta_i\end{aligned}$$

First-order condition with respect to w_i gives us

$$\begin{aligned}
&\tilde{v} - \frac{\alpha + \tau - \tau\alpha}{\alpha} 2w_i^* + \frac{\tau\beta}{\alpha} + \frac{\alpha + \tau - \tau\alpha}{\alpha}\theta_i = 0 \\
\Leftrightarrow & \frac{\alpha + \tau - \tau\alpha}{\alpha} 2w_i^* = \frac{\alpha\tilde{v} + \tau\beta}{\alpha} + \frac{\alpha + \tau - \tau\alpha}{\alpha}\theta_i \\
\Leftrightarrow & w_i^* = \frac{\alpha\tilde{v} + \tau\beta}{2(\alpha + \tau - \tau\alpha)} + \frac{1}{2}\theta_i
\end{aligned}$$

Furthermore, $w_i^* = \alpha\theta_i + \beta$. Solving both equations simultaneously, I get $\alpha = \frac{1}{2}$ and $\beta = \frac{\tilde{v}}{2}$. Thus, worker i's wage strategy is $w_i^* = \frac{\theta_i}{2} + \frac{\tilde{v}}{2}$.[3]

Given workers' strategy $w_i^* = \frac{\theta_i}{2} + \frac{\tilde{v}}{2}$, the firm hires if

$$(v - w_i^*) + \tau(w_i^* - \theta_i) \geq 0 \Leftrightarrow \frac{2v}{\tau + 1} + \frac{(\tau - 1)\tilde{v}}{\tau + 1} \geq \theta_i$$

Thus, the firm's expected equilibrium payoff is given by

$$\begin{aligned}
& P(\theta_i \leq \frac{2v}{\tau + 1} + \frac{(\tau - 1)\tilde{v}}{\tau + 1}) E(v - (\frac{\theta_i}{2} + \frac{\tilde{v}}{2}) + \tau(-\frac{\theta_i}{2} + \frac{\tilde{v}}{2}) | \theta_i \leq \frac{2v}{\tau + 1} + \frac{(\tau - 1)\tilde{v}}{\tau + 1}) \\
= & \frac{2v + (\tau - 1)\tilde{v}}{\tau + 1}(v - \frac{\tilde{v}}{2} + \frac{\tau\tilde{v}}{2} - \frac{1}{2}(\tau + 1)E(\theta_i | \theta_i \leq \frac{2v}{\tau + 1} + \frac{(\tau - 1)\tilde{v}}{\tau + 1})) \\
= & \frac{2v + (\tau - 1)\tilde{v}}{\tau + 1}(\frac{2v + (\tau - 1)\tilde{v}}{2} - \frac{2v + (\tau - 1)\tilde{v}}{4}) = \frac{(2v + (\tau - 1)\tilde{v})^2}{4(\tau + 1)}
\end{aligned}$$

If the firm deviates to public wage, it optimally posts $\overline{w}^* = \min\{\frac{v}{2-\tau}, 1\}$ and yields a deviation payoff of at least $\frac{v^2}{2(2-\tau)}$. Consider an incentive to deviate for the firm at $v = \tilde{v}$, the firm wants to deviate if

$$\begin{aligned}
& \frac{\tilde{v}^2}{2(2 - \tau)} \geq \frac{(2\tilde{v} + (\tau - 1)\tilde{v})^2}{4(\tau + 1)} \\
\Leftrightarrow & \frac{\tilde{v}^2}{2 - \tau} \geq \frac{\tilde{v}^2(\tau + 1)}{2} \\
\Leftrightarrow & 2 \geq (\tau + 1)(2 - \tau) \\
\Leftrightarrow & 0 \geq -\tau(\tau - 1) \quad \text{(True)}
\end{aligned}$$

Thus, a separating equilibrium in which the firm of a low surplus opts for private negotiation and a high surplus opts for public wage does not exists, as the firm at the cutoff has an incentive to deviate to public wage. □

[3] Note that $w_i^* \geq \theta_i \Leftrightarrow \tilde{v} \geq \theta_i$. Workers with $\theta_i > \tilde{v}$ are discouraged to apply as they are better off with their outside options.

B.10 Mathematical Note for Discussion

B.10.1 Weak Reciprocity

. Consider weak reciprocity $\tau < 1$.

Note 1: Exogenous Public Wage

At the beginning of the wage bargaining, the firm chooses a public wage $\overline{w}$ to maximize the expected payoff, which is a sum of profit and quality

$$\begin{aligned}
&\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v-\overline{w}) + \tau(\overline{w} - E(\theta_i|\theta_i \leq \overline{w}))] \\
=& \arg\max_{\overline{w}\leq 1} \overline{w}(v - \overline{w} + \tau\frac{\overline{w}}{2}) \\
=& \arg\max_{\overline{w}\leq 1} \overline{w}v - \overline{w}^2 + \frac{\tau}{2}\overline{w}^2
\end{aligned}$$

First-order condition with respect to $\overline{w}$ gives us

$$\begin{aligned}
& v - 2\overline{w}^* + \tau\overline{w}^* = 0 \\
\Leftrightarrow & \overline{w}^* = \frac{v}{2-\tau}
\end{aligned}$$

Note that $\overline{w}^* = \frac{v}{2-\tau} \in [\frac{v}{2}, v]$ for all $\tau < 1$. Workers with $\theta_i \leq \overline{w}^*$, or equivalently $\theta_i \leq \frac{v}{2-\tau}$, are employed.

Note 2: Exogenous Private Negotiation

Assume that worker i employs a linear wage strategy, that is, $w_i(\theta_i) = \alpha\theta_i + \beta$. In equilibrium, the firm's belief about worker i's strategy coincides with worker i's strategy. Consequently, the firm's posterior belief about the outside option is given by $\tilde{\theta}_i(w_i) = w_i^{-1}(\theta_i) = \frac{w_i}{\alpha} - \frac{\beta}{\alpha}$. The firm hires if

$$\begin{aligned}
& v - w_i + \tau(w_i - \tilde{\theta}_i) \geq 0 \\
\Leftrightarrow & v \geq \frac{\alpha + \tau - \tau\alpha}{\alpha} w_i - \frac{\tau\beta}{\alpha}
\end{aligned}$$

Workers bargain though a take-it-or-leave-it offer w_i. In particular, workers chooses an initial offer w_i to maximize their wages and the hiring probability. Worker i's objective is given by

$$\begin{aligned}
&\arg\max_{w_i} P(v \geq \frac{\alpha+\tau-\tau\alpha}{\alpha} w_i - \frac{\tau\beta}{\alpha}) w_i + P(v < \frac{\alpha+\tau-\tau\alpha}{\alpha} w_i - \frac{\tau\beta}{\alpha})\theta_i \\
=& \arg\max_{w_i} w_i - \frac{\alpha+\tau-\tau\alpha}{\alpha} w_i^2 + \frac{\tau\beta}{\alpha} w_i + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i w_i - \frac{\tau\beta}{\alpha}\theta_i
\end{aligned}$$

First-order condition with respect to w_i gives us

$$\begin{aligned}
& 1 - \frac{\alpha+\tau-\tau\alpha}{\alpha} 2w_i^* + \frac{\tau\beta}{\alpha} + \frac{\alpha+\tau-\tau\alpha}{\alpha}\theta_i = 0 \\
\Leftrightarrow & w_i^* = \frac{\alpha+\tau\beta}{2(\alpha+\tau-\tau\alpha)} + \frac{1}{2}\theta_i
\end{aligned}$$

Furthermore, $w_i^* = \alpha\theta_i + \beta$. Solving both equations simultaneously, I get $\alpha = \beta = \frac{1}{2}$. Thus, worker i's wage strategy is given by $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$.

In equilibrium, the firm correctly infer workers' outside option $\tilde{\theta}_i(w_i) = \theta_i$. Hence, worker i, with the initial offer $w_i^* = \frac{\theta_i}{2} + \frac{1}{2}$, gets employed if and only if

$$\begin{aligned} v - w_i + \tau(w_i - \theta_i) \geq 0 \\ \Leftrightarrow \frac{2v}{\tau+1} - \frac{1-\tau}{\tau+1} \geq \theta_i \end{aligned}$$

Comparative statics of the fraction of employed workers with respect to τ:

The hiring probability: $P(\theta_i \leq \frac{2v}{\tau+1} - \frac{1-\tau}{\tau+1}) = \frac{2v}{\tau+1} - \frac{1-\tau}{\tau+1}$

$$\begin{aligned} \frac{\partial P}{\partial \tau} =& \frac{-2v}{(\tau+1)^2} + \frac{-(\tau-1)}{(\tau+1)^2} + \frac{1}{\tau+1} \\ =& \frac{-2v - \tau + 1 + \tau + 1}{(\tau+1)^2} \\ =& \frac{2(1-v)}{(\tau+1)^2} \geq 0 \end{aligned}$$

$\Rightarrow$ As τ decreases, the hiring probability decreases.

Note that for $v < \frac{1-\tau}{2}$, then $\frac{2v}{\tau+1} - \frac{1-\tau}{\tau+1} < 0$. Thus, the probability of hiring is zero for the firm with $v < \frac{1-\tau}{2}$.

Note 3: Separating equilibrium – the firm of a low surplus $v \in [0, \overline{v}]$ chooses public wage and a high surplus $v \in [\overline{v}, 1]$ chooses private negotiation.

Consider the firm of a high surplus $v \in [\overline{v}, 1]$. In equilibrium, upon observing private negotiation, workers believe that $v \in [\overline{v}, 1]$ and demand $w_i^* = \max\{\overline{v}, \frac{\theta_i}{2} + \frac{1}{2}\}$. Thus, the firm yields an expected equilibrium payoff of

$$(2\overline{v} - 1)(v - \overline{v} + \frac{\tau}{2}) + [\frac{2v}{\tau+1} - \frac{1-\tau}{\tau+1} - 2\overline{v} + 1]\frac{v + \tau - \overline{v}(\tau+1)}{2}$$

If the firm deviates to public wage, the firm chooses a public wage $\overline{w}$ that maximizes the firm's expected payoff.

$$\begin{aligned} &\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})[(v - \overline{w}) + \tau(\overline{w} - E(\theta_i|\theta_i \leq \overline{w}))] \\ =& \arg\max_{\overline{w}} \overline{w}v - \overline{w}^2 + \frac{\tau}{2}\overline{w}^2 \end{aligned}$$

First-order condition with respect to $\overline{w}$ gives us

$$v - 2\overline{w}^* + \tau\overline{w}^* = 0 \Leftrightarrow \overline{w}^* = \frac{v}{2-\tau}$$

Given the public wage is $\overline{w}^* = \frac{v}{2-\tau}$, the probability of hiring is $P(\theta_i \leq \frac{v}{2-\tau}) = \frac{v}{2-\tau}$. Conditional on hiring, the firm obtains a profit of $v - \overline{w} = \frac{1-\tau}{2-\tau}v$ and quality of $\tau(\overline{w} - E(\theta_i|\theta_i \leq \overline{w})) = \tau\frac{v}{2(2-\tau)}$. Thus, the firm's deviation payoff is given by

$$\frac{v}{2-\tau}\Big[\frac{1-\tau}{2-\tau}v + \frac{\tau}{2(2-\tau)}v\Big] = \frac{v^2}{2(2-\tau)}$$

Consider an incentive to deviate for the firm with $v = \overline{v}$. At $v = \overline{v}$, the expected equilibrium payoff is given by

$$\begin{aligned}&(2\overline{v}-1)\frac{\tau}{2} + [\frac{2\overline{v}}{\tau+1} - \frac{1-\tau}{\tau+1} - 2\overline{v} + 1]\frac{\overline{v} + \tau - \overline{v}(\tau+1)}{2}\\ =&(2\overline{v}-1)\frac{\tau}{2} + \frac{\tau^2(1-\overline{v})^2}{\tau+1}\end{aligned}$$

The firm prefers to stay in equilibrium if the equilibrium payoff exceeds the deviation payoff, i.e.,

$$\begin{aligned}&(2\overline{v}-1)\frac{\tau}{2} + \frac{\tau^2(1-\overline{v})^2}{\tau+1} \geq \frac{\overline{v}^2}{2(2-\tau)}\\ \Leftrightarrow&(2\overline{v}-1)\tau(\tau+1)(2-\tau) + 2\tau^2(1-\overline{v})^2(2-\tau) \geq \overline{v}^2(\tau+1)\\ \Leftrightarrow&2\overline{v}(\tau^3 - 3\tau^2 + 2\tau) - (\tau^3 - 3\tau^2 + 2\tau) \geq \overline{v}^2(2\tau^3 - 4\tau^2 + \tau + 1)\\ \Leftrightarrow&(2\overline{v}-1)\tau(\tau-2)(\tau-1) \geq \overline{v}^2(\tau-1)(2\tau^2 - 2\tau - 1)\end{aligned}$$

Because $\tau < 1$, then $\tau - 1 < 0$. Dividing both sides with $(\tau - 1)$ we have

$$\begin{aligned}&\overline{v}^2(2\tau^2 - 2\tau - 1) + (2\overline{v}-1)\tau(2-\tau) \geq 0\\ \Leftrightarrow&(2\tau^2 - 2\tau - 1)(\overline{v} + \frac{\tau(2-\tau)}{2\tau^2 - 2\tau - 1})^2 \geq \frac{\tau(2-\tau)(\tau+1)(\tau-1)}{2\tau^2 - 2\tau - 1}\end{aligned}$$

Note that for $\tau < 1$, then $2\tau^2 - 2\tau - 1 = -2\tau(1-\tau) - 1 < 0$. Thus, the LHS of the condition is negative, while the RHS is positive. This implies that the firm at $v = \overline{v}$ prefers to deviate to public wage.

Thus, a separating equilibrium in which the firm of a low surplus chooses public wage and a high surplus chooses private negotiation does not exist. □

B.10.2 Concave Gift Exchange Function

. To examine the implications of the concavity of the gift exchange function on the equilibrium, I assume that the gift exchange function takes the form of $e_i^* = \sqrt{r_i}$

Note 1: Exogenous Public Wage

The firm posts a public wage $\overline{w}$ to maximize its payoff

$$\begin{aligned}&\arg\max_{\overline{w}} P(\theta_i \leq \overline{w})(v - \overline{w} + \sqrt{\overline{w} - E(\theta_i|\theta_i \leq \overline{w})})\\&\arg\max_{\overline{w}} \overline{w}v - \overline{w}^2 + \frac{\overline{w}^{\frac{3}{2}}}{\sqrt{2}}\end{aligned}$$

First order condition with respect to $\overline{w}$ gives us

$$\begin{aligned}&v - 2\overline{w} + \frac{3}{2\sqrt{2}}\overline{w}^{\frac{1}{2}} = 0\\ \Leftrightarrow&\Big(\overline{w}^{\frac{1}{2}} - \frac{3}{8\sqrt{2}}\Big)^2 = \frac{v}{2} + \frac{9}{128}\\ \Leftrightarrow&\overline{w}^* = \left(\frac{\sqrt{64v+9}+3}{8\sqrt{2}}\right)^2 \geq v\end{aligned}$$

Note 2: Exogenous Private Negotiation

In private negotiation, workers set an initial offer w_i. Denote the gift exchange from workers as $e_i(w_i)$. The firm hires worker i if $v - w_i + e_i(w_i) \geq 0$

Worker i sets w_i to maximize the expected payoff

$$\begin{aligned}&P(v \geq w_i - e_i(w_i))w_i + P(v < w_i - e_i(w_i))\theta_i\\ \Leftrightarrow&(1 - w_i + e_i(w_i))w_i + (w_i - e_i(w_i))\theta_i\\ \Leftrightarrow&w_i - w_i^2 + e_i(w_i)w_i + w_i\theta_i - e_i(w_i)\theta_i\end{aligned}$$

First order condition with respect to w_i gives us

$$\begin{aligned}&1 - 2w_i + e(w_i) + w_i e_i'(w_i) + \theta_i - \theta_i e_i'(w_i) = 0\\ \Leftrightarrow&w_i^* = \frac{\theta_i}{2} + \frac{1}{2} + \frac{e(w_i) + (w_i - \theta_i)e_i'(w_i)}{2} \geq \frac{\theta_i}{2} + \frac{1}{2}\end{aligned}$$

□

Appendix C

Work Environment, Mental Health, and The Pandemic

C.1 Additional Tables and Figures

C.1.1 Summary Statistics

C.1.2 Robustness Check: Restricted Sample

C.1.3 Robustness Check: Attrition

C.1.4 Robustness Check: Alternative Leadership Definitions

C.1.5 Robustness Check: Reference Period

C.1.6 Robustness Check: Controls

C.1.7 COVID-19 in India

C.1.8 Parallel Trend

Table C.1: Branch and LO Characteristics (Baseline, December 2019)

	Mean
Branch Characteristics	
No. of LOs per branch	4.43
N (branch)	150
LO Characteristics	
Age	26.22
Male (%)	91.11
Married (%)	52.52
College Degree (%)	83.89
Seniority at company (in months)	32.48
Seniority at branch (in months)	21.74
N (LOs)	596

Notes: Summary statistics on Branch and LO characteristic at baseline, which was collected in December 2019. Our sample covers 150 branches and 596 LOs in total. The variable *Seniority at company* captures the number of months LOs work in the company as of December 2019, and the variable *Seniority at branch* captures the number of months LOs work in the current branch as of December 2019.

Table C.2: Overview of Response Rates

	Total Responses	Sample Responses	Response Rate %
Baseline (Dec 2019)	596	596	91
Additional Survey (May 2020)	545	478	73
Weekly Surveys (Jun-Jul 2020)	534	476	73
Follow-Up Survey (Oct 2020)	327	290	44
Endline (Dec 2020)	509	318	49

Notes: The table shows an overview of responses rates for all surveys. *Total Responses* show the total number of responses, including newly joined LOs in our sample branches, for each survey. *Sample Responses* show the number of responses from our main sample. *Response Rate* captures the fraction of our main sample (655 LOs in total) that responded to each survey.

Table C.3: Development of Mental Heath (June-July 2020)

	(1) SWB	(2) SWB	(3) Stress	(4) Stress
Survey round	0.0359	0.000223	0.0713**	0.0337
	(0.0872)	(0.0660)	(0.0336)	(0.0305)
Constant	12.53***	12.66***	6.502***	6.634***
	(0.371)	(0.273)	(0.145)	(0.124)
Observations	1763	1763	1763	1763
N (LOs)	459	459	459	459
R^2	0.000102	0.687	0.00275	0.480
Individual FE		✓		✓

Notes: This table shows the development of mental health in terms of subjective well-being and perceived stress over 6 survey rounds in June and July 2020. The variable *SWB* is the subjective well-being index elicited through a self-reported questionnaire WHO-5 Well-Being Index, which has 5 items and a range from 0 to 25 The variable *Stress* is the perceived stress index elicited through a self-reported questionnaire Perceived Stress Scale 4 (PSS-4), which has 4 items and a range from 0 to 16. All columns (1)-(4) are weighted with the inverse probability of answering the survey rounds. Column (2) and (4) control for individual fixed effects. Robust standard errors are used in all regressions. $^{*}p < 0.1, ^{**} p < 0.05, ^{***} p < 0.01$.

Table C.4: Performance and Leadership (Oct'19-Feb'20 vs. Mar'20-Jul'20)
Month FE and Controls

	(1) Total Caseload	(2) Monthly Acquisition	(3) Collection Percent	(4) PAR	(5) Loan Portfolio
Panel A. Controlling for month fixed effects					
Leadership	-2.178**	-0.243***	-0.163	-0.0836*	-3606.6
	(1.081)	(0.0931)	(0.101)	(0.0480)	(22253.7)
Leadership*Post	0.444	0.172*	0.0996	-0.0450	8784.5
	(1.566)	(0.102)	(0.108)	(0.0674)	(31899.4)
Observations	5481	5481	5481	5481	5481
N (LOs)	589	589	589	589	589
R^2	0.0232	0.349	0.854	0.113	0.0279
p-value leadership (total)	0.126	0.0987	0.0847	0.00650	0.821
Panel B. Controlling for baseline characteristics					
Leadership	0.180	-0.0727	0.0713	-0.260***	55899.1*
	(1.564)	(0.143)	(0.123)	(0.0711)	(32730.4)
Leadership*Post	-0.771	0.0754	-0.0587	-0.0403	-8460.2
	(2.141)	(0.163)	(0.257)	(0.0976)	(44593.2)
Post	62.41	-21.42***	-71.67***	5.738*	820959.5
	(61.91)	(4.731)	(7.580)	(2.934)	(1294427.8)
Observations	3011	3011	3011	3011	3011
N (LOs)	589	589	589	589	589
R^2	0.0317	0.210	0.623	0.0606	0.0358
p-value leadership (total)	0.686	0.974	0.957	0.0000322	0.119
Panel C. Controlling for month fixed effects and baseline characteristics					
Leadership	0.164	-0.0789	0.0661	-0.258***	55359.6*
	(1.537)	(0.129)	(0.118)	(0.0709)	(31948.6)
Leadership*Post	-0.718	0.0930	-0.0297	-0.0494	-6519.8
	(2.116)	(0.143)	(0.122)	(0.0932)	(43690.7)
Observations	3011	3011	3011	3011	3011
N (LOs)	589	589	589	589	589
R^2	0.0540	0.400	0.929	0.122	0.0751
p-value leadership (total)	0.703	0.831	0.327	0.00000331	0.103

Notes: The table covers the period from October 2019 to July 2020, where pre-lockdown refers to 5 months before the lockdown (from October 2019 to February 2020) and post-lockdown refers to 5 months after the lockdown (from March 2020 to July 2020). *Panel A* controls for month fixed effects, *Panel B* controls for various baseline characteristics, and *Panel C* controls for both month fixed effects and baseline characteristics. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The indicator *Post* is 1 for March 2020 to July 2020. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees) that has yet to be repaid. Baseline characteristics include working styles indices (planning, effort, and work time), preference indices (locus of control, reciprocity), and ability indices (financial literacy, raven, and cognitive reflection test). The scalar *p-value leadership (total)* reports the p-value for the total effect of leadership, i.e., the sum of the coefficients of *Leadership* and *Leadership*Post*. Robust standard errors are used in all regressions. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table C.5: Working Styles and Leadership at Baseline (restricted sample)

	(1) Planning	(2) Effort	(3) Obj. Work Time	(4) Subj. Work Time
Leadership	0.0286**	0.0553***	-0.0103	0.0449***
	(0.0145)	(0.0145)	(0.0145)	(0.0149)
Observations	301	302	305	304
R^2	0.0130	0.0551	0.00167	0.0327

Notes: The table restricts attention to LOs who answered both the baseline and endline surveys. It shows the results of regressing the baseline values of working styles indices on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The *Planning* is a z-score of the planning index that captures how well LOs plan their work (e.g., using reminders and checklists, and following through with their plans). The *Effort* is a z-score of the effort index that captures how much effort LO exerts on main work dimensions (enforcing repayments, marketing, and assessing clients). The variable *Objective Work Time* is a z-score of self-reported working time. The variable *Subjective Work Time* is a z-score of the subjective work time index that captures how much time LOs subjectively perceive they are working (e.g., often working overtime or skipping lunches). Robust standard errors are used in all regressions. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table C.6: Perceptions and Leadership (restricted sample)

	(1) Work Ease	(2) Fair & Support	(3) Job Anxiety
Leadership	0.00661	0.0308*	0.0246
	(0.0208)	(0.0184)	(0.0174)
Observations	184	204	204
R^2	0.000673	0.0173	0.00906

Notes: The table restricts attention to LOs who answered both our October and December surveys. It shows the results of regressing various work perception indices elicited in our October survey on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The variable *Work Ease* is a z-score of the work ease index captures the perceived ease of working in our October survey during the lockdown, i.e. for March-May 2020, and in our December survey after the lockdown, i.e. for June-December 2020. The variable *Fair & Support* is a z-score of the fair and support index captures the perceived fairness and support in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. The variable *Job Anxiety* is a z-score of the job anxiety index captures the perceived job anxiety and demotivation in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. All outcome variables are positively coded, i.e., a higher score indicates a higher perception. Robust standard errors are used in all regressions. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table C.7: Attrition Analysis

	Attrition in June 2020			Attrition in October 2020			Attrition in December 2020		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
main									
Leadership	-0.015			0.023			-0.0087		
	(0.077)			(0.021)			(0.019)		
Planning	0.42			-0.17			-0.069		
	(0.61)			(0.14)			(0.13)		
Effort	-0.63			0.018			0.00035		
	(0.82)			(0.22)			(0.19)		
Obj. Work Time	-0.30			0.17*			0.042		
	(0.30)			(0.090)			(0.081)		
Subj. Work Time	1.11*			-0.0019			-0.13		
	(0.64)			(0.12)			(0.10)		
Locus of Control	0.30			-0.15			-0.094		
	(1.12)			(0.30)			(0.28)		
Negative Reciprocity	-0.29			-0.12			-0.014		
	(0.27)			(0.074)			(0.067)		
Positive Reciprocity	0.14			-0.027			-0.0085		
	(0.40)			(0.086)			(0.079)		
Financial Literacy	0.035			-0.66*			-0.86**		
	(1.35)			(0.39)			(0.36)		
Raven Score	-2.37			0.44			0.76**		
	(1.63)			(0.34)			(0.32)		
CRT score	-1.19			0.24			0.45		
	(2.25)			(0.47)			(0.43)		
Total Caseload		-0.00011	0.00058		0.0011	0.0013		0.0017*	0.00090
		(0.0012)	(0.00096)		(0.00097)	(0.00081)		(0.00094)	(0.00079)
Monthly Acquisition		0.0067	0.00082		0.0075	0.0016		0.0026	0.0038
		(0.0068)	(0.0031)		(0.0060)	(0.0026)		(0.0059)	(0.0025)
Collection Percent		-0.0071*	-0.0053*		-0.0068**	-0.0076***		-0.0074**	-0.0073***
		(0.0036)	(0.0029)		(0.0033)	(0.0028)		(0.0033)	(0.0028)
PAR		-0.0081	-0.018***		-0.0055	-0.0090*		-0.010*	-0.012**
		(0.0069)	(0.0067)		(0.0056)	(0.0051)		(0.0054)	(0.0049)
Loan Portfolio		-4.5e-10	-0.000000060		-0.000000040	-0.000000072*		-0.000000063	-0.000000050
		(0.000000056)	(0.000000045)		(0.000000047)	(0.000000038)		(0.000000046)	(0.000000037)
Constant	-1.21	-0.28	0.034	0.064	0.032	0.45**	0.51	0.43**	0.75***
	(5.02)	(0.21)	(0.20)	(1.25)	(0.20)	(0.21)	(1.12)	(0.21)	(0.22)
Observations	305	562	590	305	562	590	305	562	590
November 2019			✓			✓			✓

Notes: The table analyzes whether baseline characteristics predict LO's attrition in different surveys, using Probit regressions. The outcome *Attrition in June 2020* indicates whether LOs left and did not participate in our June 2020 survey onwards. The outcome *Attrition in October 2020* indicates whether LOs left and did not participate in our October survey onwards. The outcome *Attrition in December 2020* indicates whether LOs left and did not participate in the endline survey in December 2020.
Column (1), (4), and (7) use the survey data and examine whether baseline characteristics such as leadership, planning, effort, and work time predict LO's attrition. Column (2), (5), and (8) use the admin data and examine whether the average performance from December 2018 to October 2019 predicts LO's attrition. Column (3), (6), and (9) use the admin data and examine whether the performance in November 2019 predicts LO's attrition. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table C.8: Performance and Objective Leadership (Oct'19-Feb'20 vs. Mar'20-Jul'20)

	(1) Total Caseload	(2) Total Caseload	(3) Monthly Acquisition	(4) Monthly Acquisition	(5) Collection Percent	(6) Collection Percent	(7) PAR	(8) PAR	(9) Loan Portfolio	(10) Loan Portfolio
Objective Leadership	-11.83	-11.63	-1.805**	-1.738**	0.663	0.664	0.715	0.712	-83773.4	-78632.1
	(9.126)	(9.052)	(0.897)	(0.815)	(0.859)	(0.859)	(0.447)	(0.446)	(190971.8)	(188592.3)
Objective Leadership*Post	1.865	1.827	1.250	1.239	-0.933	-0.992	-0.659	-0.697	64646.2	67075.8
	(13.31)	(13.25)	(1.008)	(0.900)	(1.686)	(0.936)	(0.653)	(0.629)	(271920.8)	(269342.4)
Post	51.59***		-18.70***		-70.08***		5.551***		808824.0***	
	(9.562)		(0.747)		(1.244)		(0.494)		(196033.1)	
Observations	5481	5481	5481	5481	5481	5481	5481	5481	5481	5481
N (LOs)	589	589	589	589	589	589	589	589	589	589
R^2	0.0118	0.0225	0.183	0.349	0.573	0.854	0.0454	0.112	0.00700	0.0279
p-value leadership (total)	0.304	0.311	0.229	0.189	0.852	0.377	0.908	0.973	0.921	0.952
Month FE		✓		✓		✓		✓		✓

Notes: The table covers the period from October 2019 to July 2020, where pre-lockdown refers to 5 months before the lockdown (from October 2019 to February 2020) and post-lockdown refers to 5 months after the lockdown (from March 2020 to July 2020). Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Objective Leadership* takes a value of 1 if my manager's leadership rating from all LOs within my branch is higher than the average leadership rating of all managers across all branches. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees) that has yet to be repaid. The scalar *p-value leadership (total)* reports the p-value for the total effect of leadership, i.e., the sum of the coefficients of *Objective Leadership* and *Objective Leadership*Post*. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table C.9: Working Styles and Objective Leadership

	Planning		Effort		Objective Work Time		Subjective Work Time	
	(1) Baseline	(2) Endline	(3) Baseline	(4) Endline	(5) Baseline	(6) Endline	(7) Baseline	(8) Endline
Objective Leadership	0.199**	0.136	0.377***	0.103	-0.0760	0.286**	0.290***	0.0997
	(0.0834)	(0.119)	(0.0842)	(0.117)	(0.0824)	(0.115)	(0.0841)	(0.114)
Observations	581	275	581	268	588	299	590	285
R^2	0.00983	0.0502	0.0354	0.0717	0.00147	0.0296	0.0209	0.0750
Baseline Index		✓		✓		✓		✓

Notes: The table shows the results of regressing various working styles indices on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Objective Leadership* takes a value of 1 if my manager's leadership rating from all LOs within my branch is higher than the average leadership rating of all managers across all branches. The *Planning* is a z-score of the planning index that captures how well LOs plan their work (e.g., using reminders and checklists, and following through with their plans). The *Effort* is a z-score of the effort index that captures how much effort LO exerts on main work dimensions (enforcing repayments, marketing, and assessing clients). The variable *Objective Work Time* is a z-score of self-reported working time. The variable *Subjective Work Time* is a z-score of the subjective work time index that captures how much time LOs subjectively perceive they are working (e.g., often working overtime or skipping lunches). Odd columns (1), (3), (5), and (7) show the results for the baseline value of the outcomes. Even columns (2), (4), (6), and (8) show the results for the endline value of the outcomes, controlling for the baseline value of the outcomes. The z-scores at the endline are created using the mean and standard deviation of the endline indices. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table C.10: Perceptions and Objective Leadership (earlier and later months, 2020)

	Work Ease		Fair & Support		Job Anxiety	
	(1) Mar–May	(2) Jun–Dec	(3) Mar–Oct	(4) Nov–Dec	(5) Mar–Oct	(6) Nov–Dec
Objective Leadership	0.0118	-0.181	0.224*	0.247**	0.261**	0.0201
	(0.130)	(0.120)	(0.116)	(0.124)	(0.121)	(0.124)
Observations	246	267	278	268	278	267
R^2	0.0000339	0.00819	0.0133	0.0152	0.0166	0.000100

Notes: The table shows the results of regressing various work perception indices on leadership at the earlier and later stages of the pandemic. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Objective Leadership* takes a value of 1 if my manager's leadership rating from all LOs within my branch is higher than the average leadership rating of all managers across all branches. The variable *Work Ease* is a z-score of the work ease index captures the perceived ease of working in our October survey during the lockdown, i.e. for March-May 2020, and in our December survey after the lockdown, i.e. for June-December 2020. The variable *Fair & Support* is a z-score of the fair and support index captures the perceived fairness and support in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. The variable *Job Anxiety* is a z-score of the job anxiety index captures the perceived job anxiety and demotivation in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. All outcome variables are positively coded, i.e., a higher score indicates a higher perception. The z-scores for the later months (in even columns 2, 4, and 6) are created using the mean and standard deviation of the indices from our December survey. Robust standard errors are used in all regressions. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table C.11: Mental Health and Objective Leadership

	Subjective Well-Being				Perceived Stress			
	(1) z-score (Jun)	(2) Increase (0-1)	(3) Decrease (0-1)	(4) z-score (Dec)	(5) z-score (Jun)	(6) Increase (0-1)	(7) Decrease (0-1)	(8) z-score (Dec)
Objective Leadership	0.190***	0.0538*	-0.0294	0.221*	-0.0602	0.00243	0.0450*	-0.0666
	(0.0497)	(0.0278)	(0.0283)	(0.117)	(0.0490)	(0.0268)	(0.0270)	(0.119)
Observations	1751	414	414	305	1751	414	414	305
N (LOs)	456	414	414	305	456	414	414	305
R^2	0.0106	0.00898	0.00262	0.0116	0.00578	0.0000198	0.00667	0.00104
Wave FE	✓				✓			

Notes: The table shows the results of regressing the subjective well-being and perceived stress indicators on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Objective Leadership* takes a value of 1 if my manager's leadership rating from all LOs within my branch is higher than the average leadership rating of all managers across all branches. Subjective well-being and perceived stress are elicited through self-reported questionnaire WHO-5 Well-Being Index and Perceived Stress Scale 4 (PSS-4), respectively. Column (1) and (5) look at the z-scores elicited in our June 2020 survey, controlling for wave fixed effects and weighted with the inverse probability of answering the weekly surveys. Column (2) and (6) examine the fraction of increases, where *Increase (0-1)* captures the fraction of increases among all fluctuations during the survey period. Column (3) and (7) examine the fraction of decreases, where *Decrease (0-1)* captures the fraction of decreases among all fluctuations during the survey period. Column (4) and (8) look at the one-time z-score elicited in our December 2020 survey. Robust standard errors are used in all regressions. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table C.12: Performance and Leadership (Oct'19-Feb'20 vs. Mar'20-Jul'20), exclude own rating

	(1) Total Caseload	(2) Total Caseload	(3) Monthly Acquisition	(4) Monthly Acquisition	(5) Collection Percent	(6) Collection Percent	(7) PAR	(8) PAR	(9) Loan Portfolio	(10) Loan Portfolio
Leadership	-2.391**	-2.385**	-0.221**	-0.217**	-0.145	-0.145	-0.0731*	-0.0731*	-20879.7	-20741.4
	(0.978)	(0.971)	(0.0927)	(0.0852)	(0.0930)	(0.0930)	(0.0429)	(0.0429)	(20300.0)	(20068.9)
Leadership*Post	0.675	0.684	0.149	0.151	0.103	0.101	-0.0163	-0.0202	14982.0	15560.6
	(1.390)	(1.384)	(0.104)	(0.0937)	(0.176)	(0.0985)	(0.0631)	(0.0602)	(28537.0)	(28256.9)
Post	32.47		-22.38***		-73.59***		5.691***		394110.1	
	(40.79)		(3.131)		(5.251)		(1.917)		(838618.4)	
Observations	5461	5461	5461	5461	5461	5461	5461	5461	5461	5461
N (LOs)	587	587	587	587	587	587	587	587	587	587
R^2	0.0128	0.0234	0.184	0.348	0.573	0.854	0.0462	0.112	0.00703	0.0277
p-value leadership (total)	0.0824	0.0847	0.133	0.0894	0.780	0.180	0.0532	0.0273	0.769	0.795
Month FE		✓		✓		✓		✓		✓

Notes: The table covers the period from October 2019 to July 2020, where pre-lockdown refers to 5 months before the lockdown (from October 2019 to February 2020) and post-lockdown refers to 5 months after the lockdown (from March 2020 to July 2020). The indicator *Post* is 1 for March 2020 to July 2020. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all other LOs (excluding own rating) within the branch. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees) that has yet to be repaid. The scalar *p-value leadership (total)* reports the p-value for the total effect of leadership, i.e., the sum of the coefficients of *Leadership* and *Leadership**Post*. Robust standard errors are used in all regressions. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table C.13: Working Styles and Leadership (exclude own rating)

	Planning		Effort		Objective Work Time		Subjective Work Time	
	(1) Baseline	(2) Endline	(3) Baseline	(4) Endline	(5) Baseline	(6) Endline	(7) Baseline	(8) Endline
Leadership	0.0107	0.00522	0.0303***	-0.0138	-0.00890	0.0271**	0.0286***	-0.00634
	(0.00838)	(0.0133)	(0.00909)	(0.0123)	(0.00823)	(0.0111)	(0.00922)	(0.0123)
Observations	579	274	579	267	586	297	588	284
R^2	0.00264	0.0466	0.0213	0.0727	0.00187	0.0290	0.0188	0.0734
Baseline Index		✓		✓		✓		✓

Notes: The table shows the results of regressing various working styles indices on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all other LOs (excluding own rating) within the branch. The *Planning* is a z-score of the planning index that captures how well LOs plan their work (e.g., using reminders and checklists, and following through with their plans). The *Effort* is a z-score of the effort index that captures how much effort LO exerts on main work dimensions (enforcing repayments, marketing, and assessing clients). The variable *Objective Work Time* is a z-score of self-reported working time. The variable *Subjective Work Time* is a z-score of the subjective work time index that captures how much time LOs subjectively perceive they are working (e.g., often working overtime or skipping lunches). Odd columns (1), (3), (5), and (7) show the results for the baseline value of the outcomes. Even columns (2), (4), (6), and (8) show the results for the endline value of the outcomes, controlling for the baseline value of the outcomes. The z-scores at the endline are created using the mean and standard deviation of the endline indices. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table C.14: Perceptions and Leadership (excluding own rating)

	Work Ease		Fair & Support		Job Anxiety	
	(1) Mar–May	(2) Jun–Dec	(3) Mar–Oct	(4) Nov–Dec	(5) Mar–Oct	(6) Nov–Dec
Leadership	0.00567	-0.0141	0.00121	0.0120	0.0200*	-0.0000445
	(0.0144)	(0.0137)	(0.0130)	(0.0145)	(0.0116)	(0.0142)
Observations	244	266	276	267	276	266
R^2	0.000703	0.00379	0.0000361	0.00268	0.00929	3.70e-08

Notes: The table shows the results of regressing various work perception indices on leadership at the earlier and later stages of the pandemic. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all other LOs (excluding own rating) within the branch. The variable *Work Ease* is a z-score of the work ease index captures the perceived ease of working in our October survey during the lockdown, i.e. for March-May 2020, and in our December survey after the lockdown, i.e. for June-December 2020. The variable *Fair & Support* is a z-score of the fair and support index captures the perceived fairness and support in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. The variable *Job Anxiety* is a z-score of the job anxiety index captures the perceived job anxiety and demotivation in our October survey since the lockdown, i.e. for March-October 2020, and in our December survey for November-December 2020. All outcome variables are positively coded, i.e., a higher score indicates a higher perception. The z-scores for the later months (in even columns 2, 4, and 6) are created using the mean and standard deviation of the indices from our December survey. Robust standard errors are used in all regressions. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table C.15: Mental Health and Leadership (excluding own rating)

	Subjective Well-Being				Perceived Stress			
	(1) z-score (Jun)	(2) Increase (0-1)	(3) Decrease (0-1)	(4) z-score (Dec)	(5) z-score (Jun)	(6) Increase (0-1)	(7) Decrease (0-1)	(8) z-score (Dec)
Leadership	0.0107**	0.00639**	-0.00540*	0.00773	-0.00492	0.00207	0.00780***	0.00314
	(0.00538)	(0.00294)	(0.00307)	(0.0145)	(0.00531)	(0.00286)	(0.00278)	(0.0141)
Observations	1742	412	412	303	1742	412	412	303
N (LOs)	454	412	412	303	454	412	412	303
R^2	0.00412	0.0107	0.00745	0.00119	0.00564	0.00121	0.0169	0.000193
Wave FE	✓				✓			

Notes: The table shows the results of regressing the subjective well-being and perceived stress indicators on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all other LOs (excluding own rating) within the branch. Subjective well-being and perceived stress are elicited through self-reported questionnaire WHO-5 Well-Being Index and Perceived Stress Scale 4 (PSS-4), respectively. Column (1) and (5) look at the z-scores elicited in our June 2020 survey, controlling for wave fixed effects and weighted with the inverse probability of answering the weekly surveys. Column (2) and (6) examine the fraction of increases, where *Increase (0-1)* captures the fraction of increases among all fluctuations during the survey period. Column (3) and (7) examine the fraction of decreases, where *Decrease (0-1)* captures the fraction of decreases among all fluctuations during the survey period. Column (4) and (8) look at the one-time z-score elicited in our December 2020 survey. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$

Table C.16: Performance and Leadership (Mar'19-Jul'19 vs. Mar'20-Jul'20)

	(1) Total Caseload	(2) Total Caseload	(3) Monthly Acquisition	(4) Monthly Acquisition	(5) Collection Percent	(6) Collection Percent	(7) PAR	(8) PAR	(9) Loan Portfolio	(10) Loan Portfolio
Leadership	2.569**	2.556**	0.144**	0.141**	0.0564	0.0637	-0.137**	-0.132**	99596.8***	99006.7***
	(1.020)	(1.020)	(0.0714)	(0.0716)	(0.0907)	(0.135)	(0.0597)	(0.0561)	(20539.6)	(20614.0)
Leadership*Post	-4.320***	-4.298***	-0.221**	-0.214**	-0.115	-0.125	0.0125	0.00388	-95242.6***	-94229.7***
	(1.526)	(1.526)	(0.0885)	(0.0841)	(0.188)	(0.158)	(0.0789)	(0.0741)	(30860.6)	(30846.0)
Post	216.7***	215.9***	-1.332	-1.821	-66.70***	-67.22***	5.907**	6.368***	4998809.8***	4953468.3***
	(45.17)	(45.14)	(2.650)	(2.523)	(5.623)	(4.694)	(2.385)	(2.246)	(912978.2)	(912176.4)
Observations	4832	4832	4832	4832	4832	4832	4832	4832	4832	4832
N (LOs)	572	572	572	572	572	572	572	572	572	572
R^2	0.0365	0.0371	0.0720	0.171	0.570	0.745	0.0617	0.152	0.0539	0.0565
p-value leadership (total)	0.123	0.125	0.144	0.0972	0.721	0.457	0.0158	0.00823	0.850	0.835
Month FE		✓		✓		✓		✓		✓

Notes: The table covers the period from March-July 2019 and March-July 2020, where pre-lockdown refers to the period from March 2019 to July 2019 and post-lockdown refers to the period from March 2020 to July 2020. The indicator *Post* is 1 for March 2020 to July 2020. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees) that has yet to be repaid. The scalar *p-value leadership (total)* reports the *p*-value for the total effect of leadership, i.e., the sum of the coefficients of *Leadership* and *Leadership*Post*. Robust standard errors are used in all regressions. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table C.17: Performance and Leadership (Dec'18-Feb'20 vs. Mar'20-Jul'20)

	(1) Total Caseload	(2) Total Caseload	(3) Monthly Acquisition	(4) Monthly Acquisition	(5) Collection Percent	(6) Collection Percent	(7) PAR	(8) PAR	(9) Loan Portfolio	(10) Loan Portfolio
Leadership	-0.0864	-0.0854	0.000717	0.00261	-0.0565	-0.0539	-0.113***	-0.112***	41413.7***	41283.2***
	(0.636)	(0.634)	(0.0550)	(0.0506)	(0.0609)	(0.0678)	(0.0321)	(0.0315)	(13135.5)	(13074.3)
Leadership*Post	-1.664	-1.657	-0.0773	-0.0758	-0.00240	-0.00689	-0.0116	-0.0162	-37059.4	-36504.2
	(1.301)	(1.300)	(0.0760)	(0.0671)	(0.176)	(0.106)	(0.0607)	(0.0577)	(26510.7)	(26411.3)
Post	131.1***	138.2***	-10.55***	-5.880***	-69.57***	-70.68***	5.520***	6.958***	2893234.3***	3255074.7***
	(38.32)	(38.57)	(2.264)	(2.017)	(5.238)	(3.201)	(1.838)	(1.768)	(781699.6)	(783880.2)
Observations	9929	9929	9931	9931	9931	9931	9931	9931	9931	9931
N (LOs)	589	589	589	589	589	589	589	589	589	589
R^2	0.0234	0.0263	0.0814	0.238	0.565	0.674	0.0338	0.0813	0.0271	0.0344
p-value leadership (total)	0.123	0.125	0.144	0.0972	0.721	0.457	0.0157	0.00821	0.850	0.835
Month FE		✓		✓		✓		✓		✓

Notes: The table covers the period from December 2018 to July 2020, where pre-lockdown refers to the period from December 2018 to February 2020 and post-lockdown refers to the period from March 2020 to July 2020. The indicator *Post* is 1 for March 2020 to July 2020. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees) that has yet to be repaid. The scalar *p-value leadership (total)* reports the p-value for the total effect of leadership, i.e., the sum of the coefficients of *Leadership* and *Leadership*Post*. Robust standard errors are used in all regressions. $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$.

Table C.18: Performance and Leadership (Oct'19-Mar'20 vs. Apr'20-Jul'20)

	(1) Total Caseload	(2) Total Caseload	(3) Monthly Acquisition	(4) Monthly Acquisition	(5) Collection Percent	(6) Collection Percent	(7) PAR	(8) PAR	(9) Loan Portfolio	(10) Loan Portfolio
Leadership	-2.398**	-2.350**	-0.258***	-0.253***	-0.216**	-0.216**	-0.0925**	-0.0929**	-8935.2	-7847.4
	(1.018)	(1.004)	(0.0907)	(0.0829)	(0.0886)	(0.0887)	(0.0433)	(0.0433)	(21043.8)	(20655.7)
Leadership*Post	1.033	1.008	0.241**	0.244***	0.264***	0.263***	-0.0272	-0.0325	22123.6	22110.8
	(1.610)	(1.600)	(0.0984)	(0.0883)	(0.0912)	(0.0912)	(0.0718)	(0.0691)	(32798.9)	(32435.7)
Post	5.953		-26.60***		-96.47***		7.624***		-211302.1	
	(47.25)		(2.931)		(2.660)		(2.177)		(963085.7)	
Observations	5481	5481	5481	5481	5481	5481	5481	5481	5481	5481
N (LOs)	589	589	589	589	589	589	589	589	589	589
R^2	0.00642	0.0233	0.203	0.349	0.854	0.854	0.0746	0.113	0.00187	0.0279
p-value leadership (total)	0.274	0.281	0.644	0.762	0.0250	0.0273	0.0368	0.0200	0.600	0.568
Month FE		✓		✓		✓		✓		✓

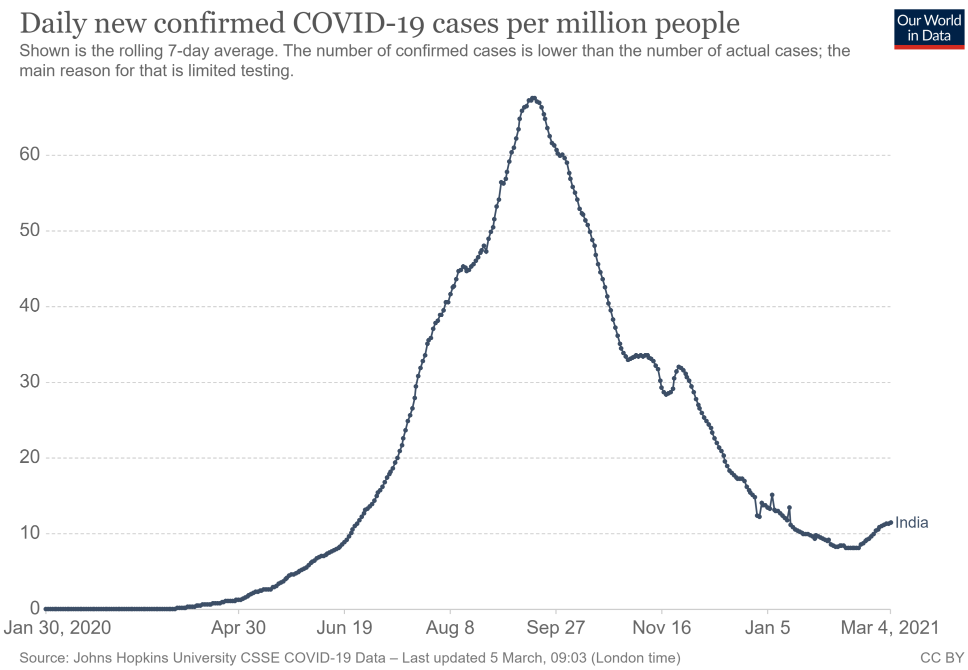
Notes: The table covers the period from October 2019 to July 2020, where pre-lockdown refers to the period from October 2019 to March 2020 and post-lockdown refers to the period from April 2020 to July 2020. The indicator *Post* is 1 for April 2020 to July 2020. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees) that has yet to be repaid. The scalar *p-value leadership (total)* reports the p-value for the total effect of leadership, i.e., the sum of the coefficients of *Leadership* and *Leadership*Post*. Robust standard errors are used in all regressions. $^{*}p < 0.1, ^{**} p < 0.05, ^{***} p < 0.01$.

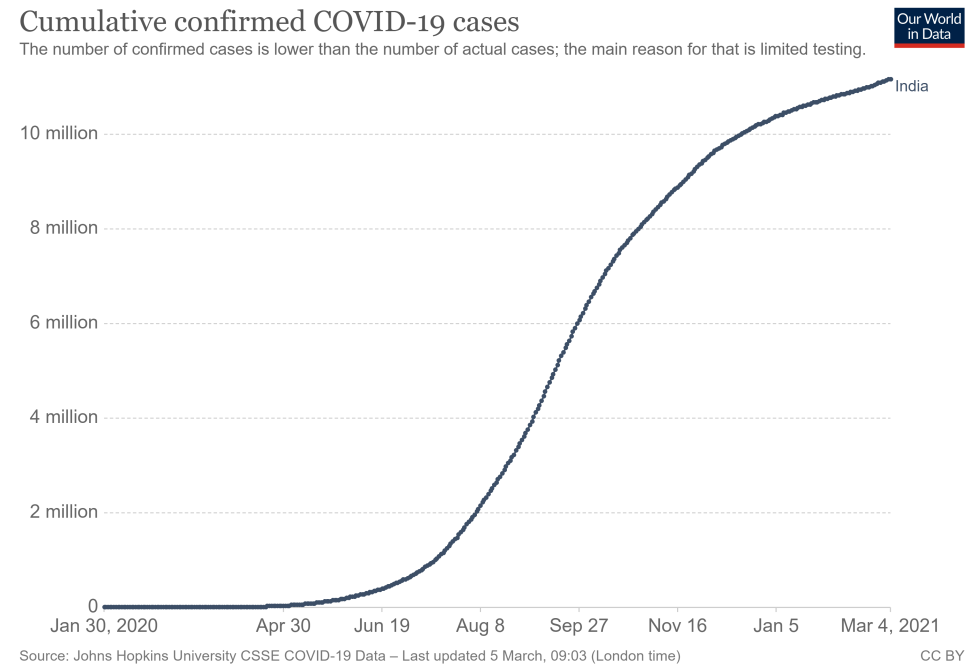
Table C.19: Mental Health and Leadership, with controls

	Subjective Well-Being				Perceived Stress			
	(1) z-score (Jun)	(2) Increase (0-1)	(3) Decrease (0-1)	(4) z-score (Dec)	(5) z-score (Jun)	(6) Increase (0-1)	(7) Decrease (0-1)	(8) z-score (Dec)
Leadership	0.0242***	0.00772**	-0.00160	0.0273	-0.00750	0.00246	0.00788**	-0.00271
	(0.00707)	(0.00390)	(0.00413)	(0.0207)	(0.00745)	(0.00379)	(0.00352)	(0.0215)
Observations	1252	281	281	199	1252	281	281	199
N (LOs)	331	281	281	199	456	281	281	199
R^2	0.0521	0.0451	0.0552	0.129	0.0482	0.0334	0.0576	0.0510
Wave FE	✓				✓			
Controls	✓	✓	✓	✓	✓	✓	✓	✓

Notes: The table shows the results of regressing the subjective well-being and perceived stress indicators on leadership. Leadership is elicited through a self-reported questionnaire Global Transformational Leadership (GTL), which consists of 8 items and has a range from 8 to 40. The independent variable *Leadership* captures the manager's average leadership rating from all LOs within the branch. Subjective well-being and perceived stress are elicited through self-reported questionnaire WHO-5 Well-Being Index and Perceived Stress Scale 4 (PSS-4), respectively. Column (1) and (5) look at the z-scores elicited in our June 2020 survey, controlling for wave fixed effects and weighted with the inverse probability of answering the weekly surveys. Column (2) and (6) examine the fraction of increases, where *Increase (0-1)* captures the fraction of increases among all fluctuations during the survey period. Column (3) and (7) examine the fraction of decreases, where *Decrease (0-1)* captures the fraction of decreases among all fluctuations during the survey period. Column (4) and (8) look at the one-time z-score elicited in our December 2020 survey. *Controls* include working styles indices (planning, effort, and work time), preference indices (locus of control, reciprocity), and ability indices (financial literacy, raven, and cognitive reflection test). Robust standard errors are used in all regressions. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

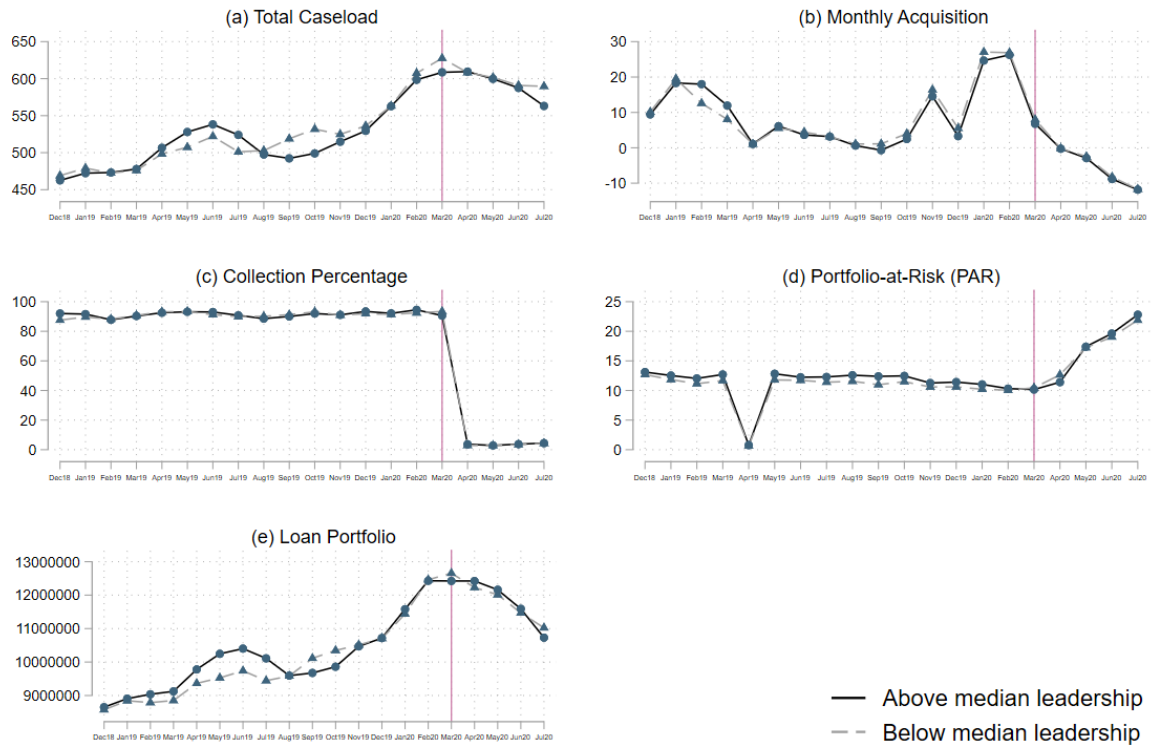
Figure C.1: Development of Covid cases in India (January 2020 - March 2021)





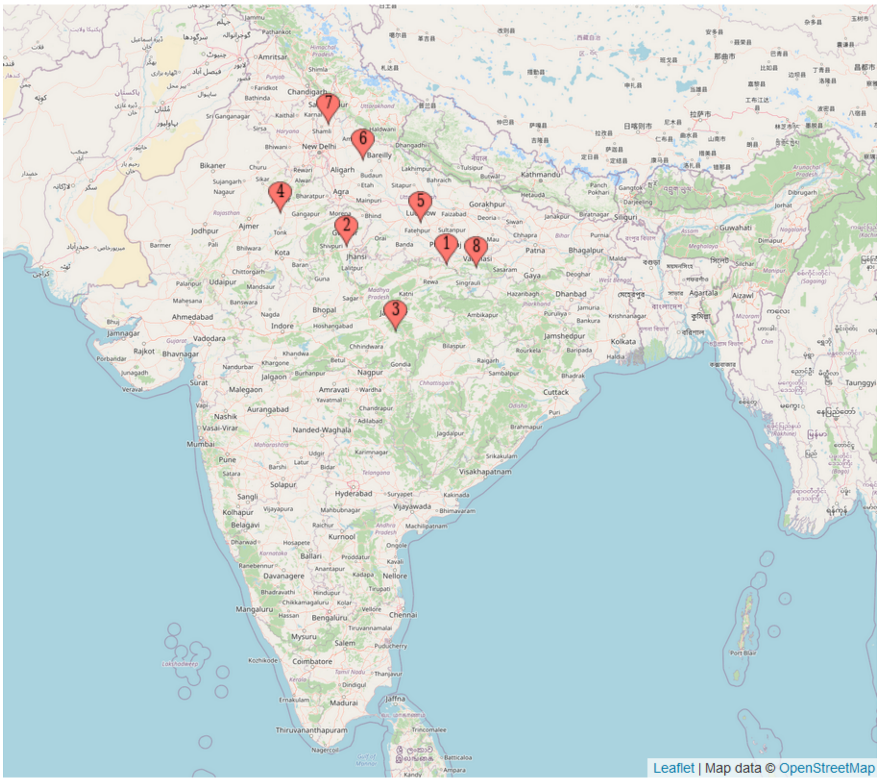
Source: Our World in Data (`https://ourworldindata.org/coronavirus/country/india?country=~IND`)

Figure C.2: Parallel Trend of Performance Indicators (December 2018 - July 2020)



Notes: The figures show the trend of main performance indicators, namely total caseload, monthly acquisition, collection percentage, PAR, and loan portfolio, over the period from December 2018 to July 2020, separately for above and below median leadership. The red vertical line indicates the onset of covid in March 2020. The indicator *Total Caseload* represents the total number of clients that LOs handle. The variable *Monthly Acquisition* shows the number of clients being acquired each month, net of settled clients. The variable *PAR* is the percentage of gross loan portfolio that is overdue by more than 30 days. The variable *Loan Portfolio* is the accumulated outstanding loan (in Indian Rupees.) that has yet to be repaid.

Figure C.3: Study Locations



1. Allahabd, 2. Gwalior, 3. Jabalpur, 4. Jaipur, 5. Lucknow, 6. Moradabad, 7. Saharanpur, 8. Varanasi.

C.2 Description of Variables and their Sources

C.2.1 Mental Health

Subjective Well-Being Measured weekly for six week in June and July 2020 and once in December 2020. The WHO-5 index is a self-reported measure of current subjective well-being, first introduced in 1998 as part of the DEPCARE project on well-being measures in primary health care. It has been found to have adequate validity in screening for depression and in measuring well-being (Topp et al., 2015). The index consists of five statements, which respondents rate according to the 0-5 scale. The total score thus ranges from 0 to 25, with 0 representing the worst possible well-being and 25 representing the best possible well-being. The wording is as follows:

"Over the last two weeks,

a. I have felt cheerful and in good spirits

b. I have felt calm and relaxed

c. I have felt active and vigorous

d. I woke up feeling fresh and rested

e. My daily life has been filled with things that interest me"

Responses are measured on a five-point scale (at no time [0], some of the time [1], less than half of the time [2], more than half of the time [3], most of the time [4], all of the time [5]).

Perceived Stress Measured weekly for six week in June and July 2020 and once in December 2020. The Perceived Stress Scale (PSS), developed by Cohen, Kamarck and Mermelstein (1983), is a self-reported measure. The short version, PSS-4, is a simple psychological instrument to measure the degree to which one perceives current events in the last week as stressful. Four items are designed to detect how unpredictable, uncontrollable, and overloaded respondents find the situations in their lives. The total score ranges from 0 to 16, with the higher score indicating the more perceived stress. The wording is as follows:

"In the last week, how often have you felt

- ... that you were unable to control the important things in your life?
- ... confident about your ability to handle your personal problems?
- ... that things were going your way?
- ... difficulties were piling up so high that you could not overcome them?"

Responses are measured on a five-point scale (never [0], almost never [1], sometimes [2], fairly often [3], very often [4]).

C.2.2 Leadership

Leadership Measured at the baseline survey in December 2019 and at the endline survey in December 2020. The Global Transformational Leadership scale (GTL) is a short and practical self-reported instrument to measure the seven behaviours of transformational leadership. It has been developed as a single construct of transformation leadership and is validated to have satisfactory reliability by Carless, Wearing and Mann (2000). The index consists of seven statements (one item for each behaviour), which respondents evaluate the frequency of transformational leadership behaviours exhibited by their leader, according to a 1-5 scale. The total score thus ranges from 5 to 35, with a higher score indicating more engagement of leaders in transformational behaviours. The wording is as follows:

"How often/frequently does your Manager engage in the following activities?

i. communicates a clear and positive vision of the future
ii. treats BROs as individuals, supports and encourages their development
iii. gives encouragement and recognition to BROs
iv. fosters trust, involvement and cooperation among BROs in the branch
v. encourages thinking about problems in new ways and questions assumptions
vi. is clear about his/her values and practices which he/she preaches
vii. instills pride and respect in others and inspires me by being highly competent"

Responses are measured on a five-point scale (rarely or never [1], once in a while [2], sometimes [3], fairly often [4], very frequently, if not always [5]).

C.2.3 Working Styles

Planning Measured at the baseline survey in December 2019 and at the endline survey in December 2020. The planning index captures the extent LOs plan their work and consists of 5 items.

The wording is as follows:

"Would you agree or disagree to the following statements?

1. I plan my everyday work life.
2. I use checklists to organize my everyday work load.
3. I use reminders to manage my everyday work load.
4. It is difficult to stick to my work plan.
5. It is difficult for me to follow-through to reach the specific performance level I aimed at. "

Responses are measured on a five-point scale (Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]). Item 4 and 5 are recoded in inverse order before adding up.

Effort Measured at the baseline survey in December 2019 and at the endline survey in December 2020. The effort index captures the extent LOs exert effort in three main work dimensions (repayment, marketing, and client assessment) and consists in total of 23 items.

The wording is as follows:

"Would you agree or disagree to the following statements?

Repayment

1. I actively try to gain information about members' business activities.
2. I actively try to gain information about members' loan usage/ on how a borrrower has used the loan amount.
3. I encourage loan repayments by closely following over-due clients in their everyday life to build up pressure.
4. I encourage loan repayments loan repayments by cautioning that no further loans will be available for borrower if repayment is not made.
5. I ask group leaders for help in reminding defaulting members about repayment.
6. I ask other members for help in reminding defaulting members about repayment.
7. When a reason for non-repayment is genuine, I allow other group members to contribute and submit a repayment for a defaulting borrower
8. I allow defaulters to repay their installment from the meeting directly at the branch in the evening.

Marketing

9. I regularly provide your clients information about loan products available
10. I think about different ways how to best provide information on different loan products to all clients
11. I advertise utilities that MFI sells
12. I advertise other loan products, like home improvement loans or sanitation loans to all clients.
13. I advertise other loan products, like home improvement loans or sanitation loans to all clients.

14. I identify clients who may be good candidates for other loan products available aside from the standard loan, like home improvement loans, sanitation loans, or utility products.

15. I only advertise other loan products, like home improvement loans or sanitation loans to clients who may be good candidates for these.

16. I identify potential villages to expand services to.

17. I market MFI in new and existing areas.

18. I ask clients to encourage others to join MFI

    Client Assessment

19. I inquire about client's housing situation to see whether they may be interested in a home improvement or sanitation loan.

20. I only assess client eligibility and do all necessary background checks, once a client requests to switch from JL to IL.

21. I only assess client eligibility and do all necessary background checks, once a client requests an additional loan product.

22. I go through the list of joint liability borrowers and mark who would be a good candidate for an upgrade to an individual loan.

23. I actively approach aligible JL clients to switch to IL loans."

Responses are measured on a five-point scale (Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]). Item 20 and 21 are recoded in inverse order before adding up.

Subjective Work Time Measured at the baseline survey in December 2019 and at the endline survey in December 2020. The subjective work time index captures how LOs perceive their working time and consists of 4 items.

The wording is as follows:
"Would you agree or disagree to the following statements?

1. To improve my performance, I often work-after hours.

2. I often skip lunch breaks to get my work load done.

3. I try to work while I am traveling back and forth from clients.

4. I often work after regular working hours for LOs to get my workload done."

Responses are measured on a five-point scale (Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]).

C.2.4 Perceptions

Work Ease Measured once in October 2020 and once at the endline survey in December 2020. The work ease index captures how easy LOs work during Covid. The work ease index in our October 2020 survey asks how easy LOs work *during the lockdown*, i.e., between March and May. The work ease index in our December 2020 surveys asks how easy LOs work *after the lockdown* is lifted, i.e., between June and December 2020.

The wording is as follows:

"On a scale of 1-5, with 1 being completely disagree and 5 being completely agree, please state your level of agreement with the following statements.

1. I had a lot of new tasks for my work
2. As compared to before, I had less workload
3. As compared to before, my work was easier
4. I had a hard time concentrating on work
5. As compared to before, my work was more stressful
6. The interaction with clients has become easier
7. I faced technological difficulties completing my work as I lacked prop-er equipment (like smartphones/laptops/printers etc)"

Responses are measured on a five-point scale (Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]). Item 1, 4, 5, and 7 are recoded in inverse order before adding up.

Fair & Support Measured once in October 2020 and once at the endline survey in December 2020. The fair & support index captures the extent LOs perceive they are treated fairly and receive support. The fair & support index in our October 2020 survey asks for LOs' perception *since the lockdown*, i.e., between March and October 2020. The fair & support index in our December 2020 surveys asks for LOs' perception *in the last two months*, i.e., between November and December 2020.

The wording is as follows:

"On a scale of 1-5, with 1 being completely disagree and 5 being completely agree, please state your level of agreement with the following statements.

1. In these difficult times, the new tools/processes that MFI implemented are very supportive.
2. My manager is very supportive.
3. Other LOs from my branch are very supportive.

4. My performance assessment is fair during this period
5. It is fair that BROs will get paid 100% of their salary if they work.
6. It is fair that BROs will get paid lower salaries if they do not work.
7. It is fair that BROs might receive their salary payments quicker if they come to the branch."

Responses are measured on a five-point scale (Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]).

Job Anxiety Measured once in October 2020 and once at the endline survey in December 2020. The job anxiety index captures the extent LOs feel anxious about the job prospect. The job anxiety index in our October 2020 survey asks for LOs' perception *since the lockdown*, i.e., between March and October 2020. The job anxiety index in our December 2020 surveys asks for LOs' perception *in the last two months*, i.e., between November and December 2020.

The wording is as follows:

"On a scale of 1-5, with 1 being completely disagree and 5 being completely agree, please state your level of agreement with the following statements.

1. I face technological difficulties completing my work, because clients lack proper equipment (like mobile phones)
2. I can help support clients in these difficult times
3. I feel demotivated during this period
4. I fear that Sonata might close its business
5. After the crisis, there will be more jobs than before for BROs"

Responses are measured on a five-point scale (Strongly agree [1], Agree [2], Neutral [3], Disagree [4], Strongly disagree [5]). Item 2 and 5 are recoded in inverse order before adding up.

C.2.5 Preferences and Abilities

Locus of Control Measured once at the baseline survey in December 2019. The Locus of Control questionnaire is a self-reported instrument developed by Richter et al. (2013) and frequently used in the German Socio-Economic Panel (SOEP). The instrument measures LOs' locus of control and consists of 10 items, each item based on a four-point Likert scale ranging from 1 "Strongly agree" to 4 "Strongly disagree". The total score thus ranges from 10 to 40, with a higher score indicating more internal locus of control. The wording is as follows:

"The following statements apply to different attitudes towards life and the future. To what degree to you personally agree with the following statements?

1. How my life takes course depends on me
2. Compared to other people, I have not achieved what I deserve
3. What a person achieves in life is a question of fate or luck
4. If a person is socially or politically active, he/she can have an effect on social conditions
5. I often experience that others have a controlling influence over my life
6. One has to work hard in order to succeed
7. When I encounter difficulties in my life, I often doubt my own abilities
8. The opportunities that I have in life are determined by the social conditions
9. Innate abilities are more important than any efforts one can make
10. I have little control over the things that happen in my life "

Responses are measured on a four-point scale (Strongly agree [1], Agree [2], Disagree [3], Strongly disagree [4]). Item 1, 4, 6, and 9 are recoded in inverse order before adding up.

Financial Literacy Measured once in May 2020. The Financial Literacy index is based on the OECD Financial Literacy questionnaire (INFE, 2011), which consists of 6 items and is adjusted to the Indian context. The instrument measures LOs' financial literacy, each correct item counts as one point. The total score thus ranges from 0 to 6, with a higher score indicating higher financial literacy. The wording is as follows:

1. Imagine that five brothers are given a gift of 10,000 Rs. If the brothers have to divide the money equally, how much does each one get?
2. Now, imagine that the five brothers have to wait for one year to get the 10,000 Rs and inflation amounts to 10%. In one year's time will they be able to buy:
   - More than they could today
   - The same amount
   - Less than they could today
3. You lend 2,500 Rs to a friend one evening and he gives you 2,500 Rs back the next day. How much interest has he paid on this loan?

4. Suppose you put 1,000 Rs into a savings account with a guaranteed interest rate of 2% per year and no fees. You don't make any further payments into this account and you don't withdraw any money. How much would be in the account at the end of the first year, after the interest payment is made?

5. And how much would be in the account at the end of five years [there are no fees]? Would it be:

   - more than 1100 Rs
   - exactly 1100 Rs
   - less than 1100 Rs
   - or is it impossible to tell from the information given

6. Let's assume that you saw a TV-set of the same model on sales in two different shops. The initial retail price of it was 10,000 Rs. One shop offered a discount of 1500 Rs, while the other one offered a 10% discount. Which one is a better bargain, a discount of 1500 Rs or 10%?

   - A discount of 1500 Rs
   - They are the same
   - A 10% discount

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