Costless Coordination through Public Contracting

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February 16, 2026

Abstract

A principal incentivizes a team of agents to work on a joint project. This paper proposes a simple mechanism that implements full effort as the unique outcome under any procedure of Iterative Elimination of Weakly Dominated Strategies. The mechanism asks agents to choose between two public messages, "collaborate" and "monopolize," and the message profile decides their bonuses upon team success. Unlike existing contracts, it achieves the lowest cost while implementing a non-discriminatory, transparent bonus allocation. Thus, efficiency need not come at the cost of fairness or transparency.

JEL: D23 D62 D86

Keywords: team incentives, pay discrimination, pay transparency

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1 Introduction

A central challenge in team incentives is a trilemma between cost-efficiency, fairness, and transparency. To eliminate coordination failure in every equilibrium, existing contracts must give up at least one of the corners: they either pay a high cost and tolerate discrimination among identical workers (e.g., Winter, 2004), or rely on private contracts and sometimes lotteries (e.g., Halac, Lipnowski, and Rappoport, 2021).

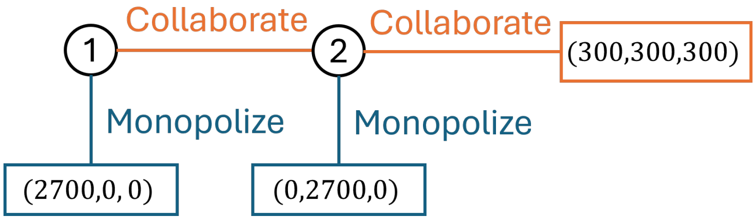
Private contracts, however, are increasingly untenable. Cost-efficient incentive schemes typically rely on interdependent rewards: a worker's pay depends on what others are offered. When those offers are private, a worker may not even be able to verify their own pay terms until the work is done. Moreover, norms are shifting. Salary transparency laws are spreading (Cullen, 2024). Organizations want open pay structures (e.g., Buffer). The demand for contracts that are transparent, fair, and cost-efficient is only growing.

This paper shows that such contracts are not only possible but also simple. I propose a deterministic mechanism with binary public messages that resolves the trilemma under Iterative Elimination of Weakly Dominated Strategies (IEWDS). The mechanism lets workers publicly choose between a collaborative contract and an alternative that grants some "monopoly power." Rejecting the monopoly option then acts as a costly and credible signal of future effort, thereby coordinating team behavior.

Consider a canonical moral-hazard-in-teams environment with effort complementarities. A team of agents collaborates on a joint project. Each agent privately chooses whether to work or shirk. Working is costly but increases the probability of team success, with a larger effect when more agents exert effort. Only the team outcome is contractible. A principal seeks to incentivize the agents to work in every possible outcome that survives IEWDS.

A natural cost-minimizing and non-discriminatory benchmark is to reward each agent just enough so that he works if and *only if* all others work. But there might be a coordination failure: if anyone expects others to shirk, the bonus falls short, and shirking becomes the best response. Following Ma (1988), I call it the second-best benchmark.

My solution, which I call *collaborating*, assigns agents an arbitrary ranking. All but the lowest-ranked agent publicly chooses between *collaborate* and *monopolize*. A unanimous



Note: This graph illustrates how the mechanism maps a profile of agents' contract choices to a vector of success-contingent bonuses for each agent, (b_1, b_2, b_3). If both agent 1 and 2 choose *collaborate*, each agent receives a bonus of 300 upon team success. If either chooses *monopolize*, the highest-ranked one receives 2700 upon success while all others receive nothing.

Figure 1: An example of the contracting procedure for three agents

choice of *collaborate* leads to the second-best bonus profile. Choosing *monopolize* instead grants the agent a large "monopoly" bonus upon team success and zero to others, but only if the agent is the highest-ranked individual to do so. In this sense, agents can exercise a "monopoly right" in a hierarchical manner. Figure 1 illustrates the contracting procedure for a team of three. After observing the choices, all agents privately decide whether to work.

The mechanism implements a unanimous choice of *collaborate* and full effort as a unique outcome under any IEWDS procedure (Theorem 1). The intuition unfolds in two steps. Take the three-agent case (Figure 1) as an example.

- **Step 1: A unanimous choice of *collaborate* coordinates effort.** The monopoly bonus is too large that, if an agent chooses *collaborate* but is planning to shirk, his payoff is always worse than if he had chosen *monopolize* in the first place. As a result, we should expect both agent 1 and 2 to work after a unanimous choice of *collaborate*, which makes it optimal for agent 3 to work as well.

- **Step 2: Coordinated effort makes *collaborate* optimal.** This step proceeds by "upward" induction along the hierarchy. Consider agent 2. By the hierarchy design, his contract choice matters only if agent 1 chooses *collaborate* and thus is expected to work. In that case, if agent 2 also chooses *collaborate*, the resulting unanimous choice of *collaborate* will induce agent 3 to work. The relevant comparison is then simple: agent 2 can either choose *collaborate* while expecting all others to work, or exercise his monopoly right while expecting others to shirk. This means even if agent 2 *monopolize*, the chance of getting that large bonus is small. So he prefers *collaborate*. A similar argument applies to agent 1.

While the result may appear ex post as a natural application of an established equilibrium-selection logic (e.g., Kohlberg and Mertens, 1986), it is far from obvious ex ante. In fact, existing approaches would lead one to expect the opposite: the N-agent procedure in Ben-Porath and Dekel (1992) relies on partially private choices, while Cavounidis and Park (2025) require higher payments to sustain coordination. Thanks to the hierarchy design, my mechanism achieves the second-best benchmark without sacrificing fairness or transparency. Unlike the payment hierarchy in Winter (2004), this "voice" hierarchy has a unique feature: the order—who chooses and who chooses first—does not matter even when agents are asymmetric in effort costs or their contributions to team success.

The result also highlights the power of IEWDS as an equilibrium concept for delivering compelling solutions to real-world problems. Unlike Nash equilibrium, IEWDS places weak demands on players' knowledge and beliefs: it only requires that players avoid weakly dominated strategies, rather than correctly anticipate what others will play. IEWDS also naturally combines forward and backward induction, and these forces jointly eliminate shirking outcomes here. With finite agents, the elimination ends in a bounded number of rounds.

The remainder of the paper illustrates the mechanism in a two-agent example (section 2), characterizes the general N-agent result (section 3 and 4), and discusses implications for real-world incentive provision (section 5), including fee-splitting in legal work and equity contracts in start-up companies.

Related Literature

This paper contributes to the literature on contracting against strategic uncertainty in team production. In the setting of public contracting, in which all bonus offers are publicly known, Winter (2004) provides a benchmark analysis. He studies the optimal independent contract where agents cannot influence their own or others' contracts. The key insight there is that discriminatory bonuses are necessary to ensure full effort in any Nash equilibrium at a minimum cost: a large bonus makes exerting effort a dominant strategy for one agent, so incentivizing the other requires only a small bonus.

Cavounidis and Park (2025) extends this framework by allowing for interdependent contracting, but focuses on a constrained class of mechanisms—subcontracting. The principal sets a bonus budget and delegates bonus allocation to a sequence of agents. The authors incorporate extensive-form rationalizability (Pearce, 1984) in Nash equilibrium to capture forward induction. Subcontracting can sometimes outperform Winter (2004)'s contract, but not always. In both papers, the constraints on the mechanism space or the equilibrium concept push the cost above the second-best level and lead to discrimination. Inspired by Cavounidis and Park (2025), I develop a simple and intuitive mechanism that restores the second-best and eliminates discrimination under IEWDS.[1]

When it comes to private contracting, Halac et al. (2021) finds that the optimal private, independent contract outperforms Winter (2004) and eliminates discrimination by creating mutual assurance among agents. Beyond independent contracting, the principal can approximate the second-best payoff with a mechanism in which agents send private (simultaneous) messages before or after effort decisions (Ma, 1988; Arya et al., 1997; Cavounidis and Ghosh, 2021) or a private incentive scheme where an agent's bonus offer depends on the private offers of others (Halac et al., 2021). In these papers, agents are not informed of others' payments, nor can they verify their own contractual terms before work begins.[2] This lack of transparency in one's own contract is less common in practice. My paper provides a simple mechanism that reaches the second-best without asking agents to work under missing contract terms.

The power of forward induction in selecting equilibria has long been recognized, from

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[1] Iterative (strict) dominance also plays a central role in Winter (2004) and Halac et al. (2021). Wu (2024) compares implementable outcomes under independent contracts across Nash equilibrium, correlated equilibrium, and rationalizability. By contrast, IEWDS and extensive-form rationalizability (EFR) additionally incorporate forward-induction reasoning. The relationship between IEWDS and EFR has been discussed in specific classes of games (Battigalli, 1997; Shimoji, 2002, 2004), but remains unclear in general. Under the mechanism studied in this paper, the unique outcome under IEWDS is also extensive-form rationalizable. A similar observation appears in money-burning games (Shimoji, 2002, 2004).

[2] Various (sequential) mechanisms have also been explored to eliminate undesired equilibria in principal-agent problems with hidden types (Demski and Sappington, 1984; Ma et al., 1988; Mookherjee and Reichelstein, 1990; Glover, 1994) and, more broadly, in contract design problems with externalities (Segal, 2003; Genicot and Ray, 2006; Kapon et al., 2024).

early examples in coordination games (Kohlberg and Mertens, 1986; Van Damme, 1989) to applications in pricing and advertising (Glazer and Weiss, 1990; Bagwell and Ramey, 1994), money-burning (Ben-Porath and Dekel, 1992; Hurkens, 1996; Shimoji, 2002), and cheap-talk games (Antić and Persico, 2023). However, existing multi-agent procedures cannot be directly applied to our design problem. They either rely on stronger solution concepts (Hurkens, 1996) or hide parts of agents' choices (Ben-Porath and Dekel, 1992). Cavounidis and Park (2025) is the first paper that brings forward induction to the team setting. My paper expands the mechanism space and optimally applies the logic to select equilibria under full transparency.

Finally, this paper shows how coordination concerns can generate a new form of hierarchy in organizations. Organizational hierarchies are typically tied to differential pay since monetary incentives play a key role in shaping production and allocation decisions (see e.g., Mookherjee, 2006; Garicano et al., 2013; Winter, 2004; Halac et al., 2021; Cavounidis and Park, 2025). In contrast, the mechanism here features a voice hierarchy: agents choose between contracts in a public, hierarchical way. This structure facilitates multi-agent signaling and supports coordinated effort. While differential pay exists off-path, symmetric agents receive the same pay on-path. The hierarchy lies not really in who earns more, but in who speaks first.

2 A Simple Two-Agent Example

This two-agent example illustrates how we can fine-tune the monopoly bonus to approach the second-best benchmark. Suppose the agents are symmetric with a common effort cost $e = 200$. The team succeeds for sure if all agents work, and with probability p^n if $n \leq 2$ agents shirk. Let $p = \frac{1}{3}$. If agent 1 chooses *collaborate*, each agent receives a collaborating bonus $b^c = 303$ upon team success.[3] The monopoly bonus is set at $b^m = 906$.

This collaborating mechanism yields a unique outcome under any IEWDS procedure: agent 1 chooses *collaborate* and both agents subsequently choose *work*. Since *work* gives a

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[3] The small additions of 3 to the collaborating bonus and 6 to the monopoly bonus are used to break ties; they can be arbitrarily small. So the collaborating bonus b^c can be arbitrarily close to the benchmark 300.

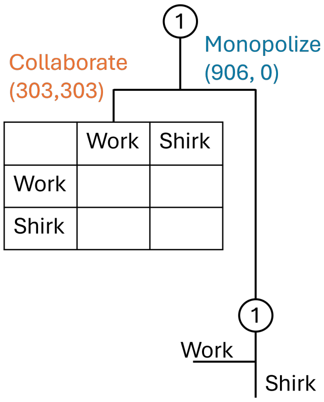

Figure 2: The game tree

		2	
		w, s	s, s
	$collaborate, w$	$103, 103$	$-99, 101$
1	$collaborate, s$	$101, -99$	$34, 34$
	$monopolize, w$	$102, 0$	$102, 0$
	$monopolize, s$	$101, 0$	$101, 0$

Table 1: The purely reduced normal-form game

Note: In the purely reduced normal-form game, agent 1's strategy consists of a message and an effort decision from $\{w(ork), s(hirk)\}$ following the message. Agent 2's strategy consists of an effort decision after *collaborate* and $s(hirk)$ after *monopolize*.

negative payoff for agent 2 following a *monopolize* message, for illustration purposes we omit his action in that branch from the game tree (Figure 2) and its purely reduced normal-form representation (Table 1). Two constraints underpin the main result:

1. Effort Constraint: $\max\{pb^m - e, p^2 b^m\} > pb^c$. This ensures that *monopolize* strictly dominates *collaborate and then shirk* for agent 1.

2. Message Constraint: $\max\{pb^m - e, p^2 b^m\} < b^c - e$. This ensures that *monopolize* is strictly worse than *collaborate and then work* for agent 1 when agent 2 chooses *work* after a *collaborate* message.

The effort constraint guarantees that *collaborate and then shirk* never survives any IEWDS procedure. As a result, agent 2's strategy *shirking after collaborate* will not survive either, and *collaborate* induces coordinated effort. The message constraint then rules out any *monopolize* strategy for agent 1. Hence, we must arrive at the unique outcome mentioned above. Since the collaborating bonus $b^c = 303$ exceeds the second-best level, i.e., $b^c - e = 303 - 200 > pb^c = \frac{1}{3} \times 303$, we can always find a monopoly bonus b^m, such as 906, that satisfies both constraints.

The game admits a bad Subgame Perfect Nash Equilibrium in which agent 1 chooses *monopolize* and plans to shirk after a *collaborate* message. But this strategy profile does not survive IEWDS, because for agent 1, *collaborate and then shirk* is dominated by *monopolize and then work*. It is thus irrational for agent 1 to shirk after *collaborate*, and for agent 2 to expect agent 1 to do so in equilibrium.

3 A General Model of Teamwork

A principal aims to incentivize a group of N agents, $i \in \mathcal{N} := \{1, 2, ..., N\}$, to complete a team project. Each agent privately decides whether to work or shirk, denoted by $a_i \in \{1(work), 0(shirk)\}$. *Work* incurs a personal cost $e_i > 0$. The team outcome — success or failure — depends on the set of agents who choose to work. For any set of agents, $J \subset \mathcal{N}$, let $P(J)$ denote the probability of team success if the agents in J work and others shirk. $P(\cdot)$ satisfies two assumptions: for any $J, J' \in \mathcal{N}$,

1. (monotonicity) if $J \subsetneq J', P(J) < P(J')$;
2. (complementarity) if J, J' are not nested, $P(J \cup J') - P(J) > P(J') - P(J \cap J')$.

The first assumption states that team success becomes more likely as more agents exert effort. The second captures a central source of coordination friction: an agent's marginal contribution is higher when more teammates also choose to work. By contrast, if efforts were strategic substitutes, coordination problems would not arise.

Only the team outcome is contractible. Agents maximize their expected payment net of any effort cost. If the principal promises a bonus $b_i \in [0, \infty)$ upon team success, agent i's payoff will be $P(\{i \in \mathcal{N} : a_i = 1\})b_i - e_i a_i$.

The principal's goal is to induce all N agents to work while minimizing total payment. To avoid distraction, I do not formally define a general mechanism space or the cost-minimization problem because the paper focuses on how a particular mechanism achieves the second-best. Instead, I introduce the concept of unique implementation under IEWDS and characterize the second-best benchmark.

Definition 1 (Unique Implementation under IEWDS). *A mechanism uniquely implements full effort and bonus allocation* $\mathbf{b} := (b_1, b_2, ..., b_N) \in [0, \infty)^N$ *under IEWDS, if in the reduced normal-form representation of the induced game:*

1. *Every IEWDS procedure leads to the same unique outcome; and*

2. *On the equilibrium path of this outcome, each agent i is promised the bonus b_i conditional on team success, and all agents choose to work.*

Definition 2 (Second-Best Benchmark)**.** *The principal's second-best bonus for each agent $i \in \mathcal{N}$ is $\underline{b}_i = \frac{e_i}{P(\mathcal{N})-P(\{\mathcal{N}/\{i\}\})}$. The second-best total bonus is $\sum_{i\in\mathcal{N}} \underline{b}_i$.*

No mechanism can uniquely implement full effort and a bonus allocation with $\sum_i b_i \leq \sum_i \underline{b}_i$. Appendix A provides the formal proof. The intuition is straightforward: If "all agents work" is not a strict Nash equilibrium given the bonus allocation, then some IEWDS procedure will leave a shirking outcome in play.

This second-best benchmark highlights our focus on the coordination issue. If the principal signs a contract with each agent independently and promises each agent (slightly more than) the second-best bonus $\underline{b}_i$ upon team success, miscoordination may happen.[4] No strategy will be weakly dominated because the unique best response is *shirk* when all others shirk. Neither IEWDS nor Nash equilibrium can eliminate the shirking outcome.

4 Collaborating Mechanism

This section starts by describing the *collaborating* mechanism. It can uniquely implement full effort and any bonus allocation that does no better than the *second-best* benchmark ($b_i > \underline{b}_i$ for all $i \in \mathcal{N}$). By carefully designing how agents "speak" through contract choices, the principal can eliminate coordination rents and implement a fair, transparent contract.

4.1 Collaborating Mechanism

The principal selects a target bonus vector and ranks the agents arbitrarily. A collaborating mechanism grants the first $N-1$ agents a binary message space $\{collaborate, monopolize\}$; we refer to them as speakers. If all speakers choose *collaborate*, the mechanism offers each

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[4] Winter (2004) (Proposition 4) shows that offering each agent slightly more than the second-best bonus can induce all agents to work in the unique coalition-proof equilibrium. This equilibrium concept assumes a strong cooperative culture in the workplace.

agent the target bonus conditional on team success. If any speaker chooses *monopolize*, the highest-ranked one will receive a large monopoly bonus upon team success. All others receive nothing.

Let $R : \mathcal{N} \to \mathcal{N}$ be an arbitrary permutation of the agents. The following discussion refers to the agents by their identity $R(i)$, unless specified otherwise.

Definition 3 (Collaborating Mechanism)**.** *A collaborating mechanism, denoted by* $\mathcal{C}(\mathbf{b}^c, \mathbf{b}^m)$*, proceeds as follows:*

1. ***Contracting stage****: Each speaker* $i \in \{1, 2, ..., N-1\}$ *simultaneously sends a public message* $m_i \in M := \{collaborate, monopolize\}$.
    - *If all speakers choose collaborate, each agent receives a success-contingent bonus* b_i^c.
    - *If any speaker chooses monopolize, the highest-ranked speaker among them receives a personalized monopoly bonus* b_i^m *satisfying:*

$$\max\{P(\{i\})b_i^m - e_i,\ P(\phi)b_i^m\} > P(\mathcal{N} \setminus \{i\})b_i^c \tag{EC1}$$

$$\max\{P(\{i,j\})b_i^m - e_i,\ P(\{j\})b_i^m\} > P(\mathcal{N})b_i^c - e_i \quad \forall j \neq i \tag{EC2}$$

$$\max\{P(\{i\})b_i^m - e_i,\ P(\phi)b_i^m\} < P(\mathcal{N})b_i^c - e_i \tag{MC}$$

    All other agents receive zero bonus.

2. ***Working stage****: After observing the full message profile, all agents simultaneously choose whether to work or shirk.*

The constraints mirror those in the two-agent example. Constraint (EC1) ensures that choosing *monopolize* weakly dominates *collaborate and then shirk*. Constraint (MC) ensures that *monopolize* is strictly worse than *collaborate* if an agent expects all others to collaborate and then work. The additional constraint (EC2) rules out bad behaviors off-path: it guarantees that, if another agent works after being monopolized, a speaker strictly prefers to seize the monopoly opportunity rather than collaborate and work.

Such a monopoly bonus vector $\mathbf{b}^m$ exists if $b_i^c > \underline{b}_i$ for all i. When each collaborating bonus exceeds the second-best level, constraints (EC1) and (MC) leave a nonempty set of

b_i^m for us to choose. By strict monotonicity of $P(\cdot)$, we can always raise b_i^m within this set to satisfy (EC2).

Theorem 1. *Given any target bonus vector* $\mathbf{b}$ *with* $b_i > \underline{b}_i$ *for all* $i \in \mathcal{N}$*, the collaborating mechanism* $\mathcal{C}(\mathbf{b}^c, \mathbf{b}^m)$ *with* $\mathbf{b}^c = \mathbf{b}$ *and any* $\mathbf{b}^m$ *satisfying the constraints* (EC1)-(MC) *uniquely implements full effort and bonus allocation* $\mathbf{b}$ *under IEWDS.*

We now formally define strategies in the purely reduced normal-form game induced by the collaborating mechanism. Let $a_i : M^{N-1} \to \{0, 1\}$ be the effort function, mapping the full message profile to the effort decision of agent i . A speaker's strategy $s_i = (m_i, a_i(m_i, \mathbf{m}_{-i}))$ specifies his own message $m_i \in M$ and, given this message, whether to work or shirk after observing all other messages $\mathbf{m}_{-i} \in M^{N-2}$. A nonspeaker's strategy $s_N = a_N(\mathbf{m})$ simply specifies whether to work or shirk after observing all messages.

Let $\mathbf{s}^* := (s_i^*)_{i \in \mathcal{N}}$ denote the outcome that, as will be demonstrated, uniquely survives IEWDS. It consists of the following strategies. All speakers choose *collaborate.* Upon observing a unanimous collaborating message profile, all agents choose *work.* Off the equilibrium path, any message profile that results in agent i being monopolized (i.e., receiving a zero bonus) triggers a *shirk* response from agent i. Conversely, any message profile that allows agent i to monopolize triggers a *work* response from agent i if $P(\{i\})b_i^m - e_i > P(\phi)b_i^m$, and *shirk* otherwise. Compared to Winter (2004)'s contract, we move discriminatory bonuses off the equilibrium path while maintaining a "flat" structure of payments on path.

The proof has three parts. Part 1 (Lemma 1) shows that $\mathbf{s}^*$ survives any IEWDS procedure because it is a strict Nash equilibrium. Part 2 (Lemma 2) proves that no agent works after being monopolized. Part 3 finalizes the proof by showing that no other outcome survives under IEWDS.

Lemma 1. $\mathbf{s}^*$ *survives any IEWDS procedure.*

Proof of Lemma 1. Note first that a strict Nash equilibrium, in which each agent's strategy is the unique best response to the others, cannot be eliminated under any IEWDS procedure. We therefore aim to show that $\mathbf{s}^*$ is a strict Nash equilibrium.

First, suppose agent i chooses *collaborate* but deviates in the working stage by choosing *shirk.* Since all other agents play *work* under $\mathbf{s}^*_{-i}$, and since $b_i^c > \underline{b}_i$, the deviation yields strictly lower payoff. Second, suppose agent i deviates to choose *monopolize.* In this case, all other agents respond by shirking. Whether agent i works or shirks, his expected payoff is strictly below that from playing s_i^* by constraint (MC).

In both cases, s_i^* delivers a strictly higher payoff than any deviation against $\mathbf{s}_{-i}^*$. Hence, it is the unique best response. $\square$

The next part shows that working after being monopolized cannot survive IEWDS. If such a strategy, call it s_i, were to survive, someone else would find it profitable to exploit this *work* response, making s_i strictly worse than a *shirk* alternative. Then s_i must have been eliminated under IEWDS, leading to a contradiction.

Lemma 2. *Any strategy that plays work after being monopolized will not survive IEWDS.*

Proof of Lemma 2. We begin with a useful observation, which follows directly from the definition of IEWDS and will be used repeatedly:

Claim 1. *A strategy s_i will not survive if there exists a surviving strategy profile $\mathbf{s}'$ and an alternative (possibly mixed) strategy $\sigma_i \neq s_i$ such that (1) s_i yields weakly lower payoffs than σ_i against any possibly surviving strategy profiles; and (2) $u_i(s_i, \mathbf{s}'_{-i}) < u_i(\sigma_i, \mathbf{s}'_{-i})$.*[5]

Suppose by contradiction that there exists a surviving strategy s_i which plays *work* after a message profile that allows agent $j \neq i$ to monopolize, i.e., a message profile in which agent j is the highest-ranked monopolizing speaker. When facing the surviving profile $(s_i, \mathbf{s}_{-ij}^*)$, *monopolize* gives agent j a continuation payoff strictly higher than any collaborating payoff because $\max\{P(\{i,j\})b_j^m - c_j, P(\{i\})b_j^m\} > P(\mathbb{N})b_j^c - c_j$ by (EC2). Hence, at least one strategy with $m_j = monopolize$, say s_j, cannot be eliminated and survives to the end.

However, when $m_j = monopolize$ survives, the *work* response from agent i should not survive. Formally, consider an alternative strategy that differs from s_i only in that it plays *shirk* after being monopolized. This strategy weakly dominates s_i and gives a strictly higher

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[5] Even if σ_i, or any strategy in the support of σ_i, is deleted, we can find a surviving strategy for agent i that weakly dominates (each of) them accordingly among the set of possibly surviving strategy profiles. Given $\mathbf{s}'$ survives and $u_i(s_i, \mathbf{s}'_{-i}) < u_i(\sigma_i, \mathbf{s}'_{-i})$, there exists a surviving strategy that weakly dominates s_i. So s_i cannot survive.

payoff when facing this surviving strategy profile $(s_j, \mathbf{s}^*_{-ij})$, in which agent i is monopolized. By Claim 1, s_i will not survive. $\square$

The final step establishes the uniqueness. We begin by showing that the costly signal *collaborate* is credible. The effort constraint (EC1) ensures that *collaborate and then shirk* is weakly dominated by *monopolize.* In particular, it is strictly worse when facing a surviving strategy profile in which all other agents collaborate and then work. Hence, it cannot survive regardless of the elimination order.

Once we rule out *collaborate and then shirk* for all speakers, the nonspeaker will work when all speakers choose *collaborate.* Then, starting from the lowest-ranked speaker, each of them anticipates that (1) all lower-ranked agents will collaborate and then work, and (2) his own message only matters if all higher-ranked speakers choose *collaborate.* As such, each speaker faces a similar trade-off as in the two-agent case and strictly prefers *collaborate and then work* over *monopolize.*

Proof of Theorem 1. Following Lemma 2, we restrict attention to strategies in which agents shirk after being monopolized.

Step 1 (Collaborate and then shirk will not survive). Fix a speaker i. If any higher-ranked speaker chooses *monopolize*, all strategies yield identical payoffs. Now suppose all higher-ranked speakers choose *collaborate*, but at least one lower-ranked speaker chooses *monopolize.* By (EC1), choosing *monopolize* guarantees agent i a strictly positive payoff, while *collaborate* results in zero.

Next, consider the case where all other speakers choose *collaborate* in $\mathbf{s}_{-i}$, but only a subset $K \subseteq \mathcal{N} \setminus \{i\}$ of agents (including the nonspeaker) choose *work* in the second stage. In this case, the expected payoff from playing *collaborate and then shirk* is $P(K)b_i^c$, while *monopolize* yields strictly more than $P(\mathcal{N} \setminus \{i\})b_i^c$ by (EC1). By monotonicity of $P(\cdot)$, we have $P(\mathcal{N} \setminus \{i\}) \geq P(K)$, so at least one strategy with a *monopolize* message weakly dominates *collaborate and then shirk*, and is strictly better against the surviving profile $\mathbf{s}^*_{-i}$, in which all other agents choose *collaborate and then work.*

Therefore, by Claim 1, the strategy *collaborate and then shirk* cannot survive.

Step 2 (Uniqueness of $\mathbf{s}^*$). Once we rule out all strategies that play *collaborate and then shirk*, the strategy s_N^*, in which the nonspeaker chooses *work* following a unanimous *collaborate* message profile, is the unique surviving strategy for the nonspeaker.

We now show that s_i^* is the unique surviving strategy for each speaker $i < N$, using a "backward" induction argument. Assume the induction hypothesis: for every agent $j \in \{i+1, \ldots, N\}$, s_j^* is the unique surviving strategy. We will show that s_i^* will be the unique surviving strategy for agent i.

For each speaker $i < N$, a possibly surviving strategy different from s_i^* must have $m_i =$ *monopolize*. Denote one such strategy by s_i. First, when facing the surviving profile $\mathbf{s}_{-i}^*$, s_i gives strictly lower payoff than s_i^* by constraint (MC). Second, s_i deliver lower payoffs than s_i^* against any possibly surviving opponent strategies:

- If any higher-ranked speaker chooses *monopolize*, then both s_i and s_i^* yield zero payoff;
- Suppose all higher-ranked speakers choose *collaborate*. By the induction hypothesis, all lower-ranked agents must choose *collaborate*. Then, by Step 1, all opponents work after this unanimous *collaborate* message. Hence, we face the same situation as in $\mathbf{s}_{-i}^*$ and s_i gives strictly lower payoff than s_i^*.

By Claim 1, s_i will not survive. It follows that s_i^* is the unique surviving strategy for agent i. We finish the induction argument. $\square$

4.2 Efficient Coordination and Discussion

By Theorem 1, for all $\varepsilon > 0$, the collaborating mechanism can uniquely implement full effort and bonus allocation $\mathbf{b} = (\underline{b}_i + \frac{e_i}{\sum_i e_i}\varepsilon)_{i \in \mathcal{N}}$ under IEWDS. The total bonus $(\sum_i \underline{b}_i) + \varepsilon$ approaches arbitrarily close to the second-best level. The bonus allocation is non-discriminatory: the on-path markup for agent i, $\lim_{\varepsilon \to 0} \frac{b_i - e_i}{e_i} = \frac{1}{P(\mathcal{N}) - P(\mathcal{N} \backslash \{i\})} - 1$, varies nontrivially only with the agent's marginal contribution to team success. We discuss two key properties of this second-best mechanism below.

		s_2	
		w	s
s_1	$collaborate, w$	$b_1^c - c_1, b_2^c - c_2$	$pb_1^c - c_1, pb_2^c$
	$collaborate, s$	$pb_1^c, pb_2^c - c_2$	$p^2 b_1^c, p^2 b_2^c$
	$option$	$z_1, 0$	$z_1, 0$

Note: The table presents the (simplified) reduced normal form game when agent 1 is offered an option that directly pays her $z_i > 0$. Effort decisions are denoted by $w(ork)$ and $s(hirk)$. $((collaborate, w), w)$ is the unique outcome under IEWDS if $pb_1^c < z_1 < b_1^c - c_1$.

Table 2: An abstract outside option in the two-agent example

The Monopoly Option as a Signaling Device

How can speakers credibly promise to work hard in the future? They can do so by making an upfront, public, and costly decision: forgoing the monopoly option. This act of signaling makes it possible to coordinate effort under the approximately second-best bonus allocation.

This intuition echoes earlier work (e.g., Kohlberg and Mertens (1986), Van Damme (1989), Glazer and Weiss (1990), and Ben-Porath and Dekel (1992)) in how forward induction selects equilibria in coordination games. To see this, we return to the two-agent example and consider an outside option that directly assigns some payoff to the speaker. As long as *all agents work* is a strict Nash equilibrium under our target bonus allocation, we can construct an outside option that offers less than the *all agents work* outcome, but more than what an agent would receive from unilaterally deviating to shirk (see Table 2 for a formal representation). The extended normal-form game will then have a unique surviving outcome where all agents choose to work under the target bonus allocation.

The specific structure of this outside option and the subsequent effort decisions can be quite flexible. For instance, a "who-to-team-up" variant of the mechanism also works: if any speaker chooses *monopolize*, the highest-ranked among them proceeds alone and decides whether to work or shirk, while the principal excludes all other agents from the project, instead of allowing them to stay and receive zero bonus. As before, the principal can fine-tune the monopoly bonus to achieve the second-best result.

Voice Hierarchy

Extending the two-agent result to a multi-agent setting is initially far from straightforward. When multiple speakers choose *monopolize*, who should be granted that right? Worse yet, when many agents try to signal their intentions simultaneously, coordination can break down. As Ben-Porath and Dekel (1992) show, simultaneous signaling in their game may lead to an outcome in which players burn money without achieving cooperation. While Hurkens (1996) tackles this issue with a stronger solution concept, I twist the signaling procedure.

Recall that in our mechanism, agents speak simultaneously in the contracting stage. The trouble with everyone talking at once motivates a hierarchical structure of our speaking rules. Once an agent speaks, they concede the monopoly right to the next in line. Such a voice hierarchy turns out to prevent the "voice clash" that arises in simultaneous signaling. The order in which agents speak is quite flexible: unlike Winter (2004); Cavounidis and Park (2025), it does not matter whose voice ranks higher when agents are asymmetric.

A sequential procedure yields the same results if we let agents speak in turn, and all messages are publicly observed. Note that in the voice hierarchy, a *monopolize* message takes effect only if no higher-ranked speaker chooses *monopolize*. This structure lends itself naturally to a sequential mechanism. Figure 3 illustrates the game tree induced by the sequential mechanism.

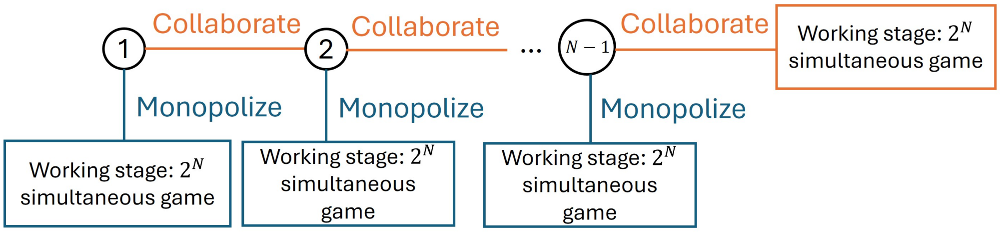

Figure 3: The game tree induced by a sequential *collaborating* mechanism

While Ben-Porath and Dekel (1992) also see the potential of a sequential signaling procedure, their approach does not support pay transparency. They require each agent to observe only prior messages and "leave the scene" after sending their own. My approach differs: everyone sees all messages. In my setting, the principal has more flexibility in designing the off-path subgame when the outside option is chosen. It becomes unnecessary to hide lower-ranked or subsequent messages. As a result, in contrast to other second-best mechanisms (e.g., Halac et al., 2021, Cavounidis and Ghosh, 2021), such transparency lets agents confirm their own contractual terms before deciding whether to work.

5 Examples of Applications

This paper introduces a simple, public mechanism that ensures all agents work under the approximately second-best bonus allocation. The mechanism invites agents to send costly messages to signal their future efforts before the team project starts. Both the messages and the resulting bonus allocation are public information. In this way, contracting with public negotiation procedures serves as a powerful tool to resolve coordination problems in team projects and combat pay discrimination. Several real-life examples and applications are discussed below.

Fee Splitting Among Lawyers

Public bonus-splitting arrangements are common in legal practice, particularly among lawyers from different firms who collaborate on the same case (Grossbaum, 2022). These collaborations often involve contingent fee matters, where payment depends in part on a successful outcome. To avoid disputes, the American Bar Association's Model Rule 1.5(e) requires a written agreement: both the lawyers and the client must consent in advance to the specific share each lawyer will receive. Some jurisdictions go further. For example, Florida Bar rules specify a presumptive 75/25 split between primary and secondary lawyers in contingent fee cases, while allowing equal division by mutual agreement. These legal requirements help institutionalize transparent, pre-work bonus-splitting contracts, which help align expectations and reduce coordination failures in team-based legal work.

Equity Contracts in Startups

Startup companies often offer their employees a choice between higher equity and higher fixed pay. Choosing the high-equity contract can also serve as a credible signal of commitment: "I plan to work hard for the firm." For example, at Buffer, a social media management company, employees can choose between roughly 30% more equity and $10,000 more in fixed salary. The firm also makes compensation fully transparent: it posts an Excel sheet listing everyone's salary and contract choice.[6] As of February 2026, about 75% of their employees have selected the high-equity contract. It would be interesting to explore how the main result of this paper could help improve such incentive schemes.

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[6] See `https://buffer.com/salaries`.

Appendix A Second-Best Benchmark

We prove a slightly more general statement: no mechanism can induce all agents to work with an expected total bonus weakly lower than the *second-best* level in any outcomes that survive IEWDS.

Suppose by contradiction that there exists a mechanism that induces all agents to work with an expected total bonus weakly lower than the *second-best* level in any outcomes that survive IEWDS. For each agent i, let x_i capture the part of her strategy when participating in the mechanism, ϕ_i all the (realized) information from the mechanism, and $a_i(x_i, \phi_i)$ her effort decision rule if she stays. Then we can write the strategy of agent i as $s_i = (x_i, a_i(\cdot))$ in the induced normal-form game.

For each agent i, let S_i^w be the set of strategies that involve working after receiving an expected bonus offer $E(b_i|\phi_i) \leq \underline{b}_i = \frac{e_i}{P(\mathcal{N})-P(\mathcal{N}/\{i\})}$ upon team success on some paths. Formally,

$$S_i^w = \{s_i | a_i(x_i, \phi_i) = 1 \text{ for some } (x_i, \phi_i) \text{ that leads to } E(b_i|\phi_i) \leq \underline{b}_i\}.$$

For each strategy $s_i \in S_i^w$, we can construct an alternative strategy, denoted by $\hat{s}_i$, which replaces *work* by *shirk* on the paths whenever s_i plays *work* after receiving an expected bonus $E(b_i|\phi_i) \leq \underline{b}_i$. More precisely, $\hat{s}_i$ plays the same x_i in the mechanism and exerts the same effort $a_i(x_i, \phi_i)$ whenever $E(b_i|\phi_i) > \underline{b}_i$, but plays *shirk*, $a_i(x_i, \phi_i) = 0$, whenever $E(b_i|\phi_i) \leq \underline{b}_i$. Denote this many-to-one mapping by $h : s_i \mapsto \hat{s}_i$.

Next, we show that s_i is weakly dominated by $\hat{s}_i = h(s_i)$. Fix any strategy profile from opponents, $\mathbf{s}_{-i}$. $\hat{s}_i$ and s_i lead to the same expected bonus $E(b_i|\phi_i)$ because they differ only in effort decisions. If agent i receives an expected bonus $E(b_i|\phi_i) \leq \underline{b}_i$ on path, *shirk* gives a weakly higher payoff than *work*. If instead $E(b_i|\phi_i) > \underline{b}_i$ on path, $\hat{s}_i$ predicts the same effort and thus gives the same payoff as s_i.

Now consider an IEWDS procedure in which we always delete strategies that play *work* after an agent gets an expected bonus less than the second-best level, before we delete those playing *shirk* instead. That is, whenever we can and want to delete a "shirking" strategy $\hat{s}_i \in h(S_i^w)$, we replace it with a "working" strategy s_i in the set $h^{-1}(\hat{s}_i)$. This is feasible because any strategy s_i in $h^{-1}(\hat{s}_i)$ is weakly dominated by $\hat{s}_i$. Since h is many-to-one, for any x_i and ϕ_i that lead to $E(b_i|\phi_i) \leq \underline{b}_i$, we must delete all "working" strategies s_i with $a_i(x_i, \phi_i) = 1$, before deleting "shirking" strategies $\hat{s}_i$ with $\hat{a}_i(x_i, \phi_i) = 0$.

If no outcome survives under the procedure, the mechanism fails, leading to a contradiction. If the surviving set is nonempty, all agents must work on path in any surviving outcome by assumption. Then the way we construct the procedure tells us that all agents must receive an expected bonus strictly higher than $\underline{b}_i$. Otherwise, if some IEWDS procedure induces a surviving outcome in which agent i receives $E(b_i|\phi_i) \leq \underline{b}_i$ and plays *work* on path, we must have deleted the strategy $\hat{s}_i = h(s_i)$ that plays *shirk* on the same path. This contradicts how we construct the IEWDS procedure. However, if all agents receive an expected bonus $E(b_i|\phi_i) > \underline{b}_i$ in any surviving outcome, the expected total cost must exceed the *second-best* level. This leads to a contradiction.

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