# Principal-Agent (Boss and Worker)

Teaching Note | MobLab x Harvard Business Impact

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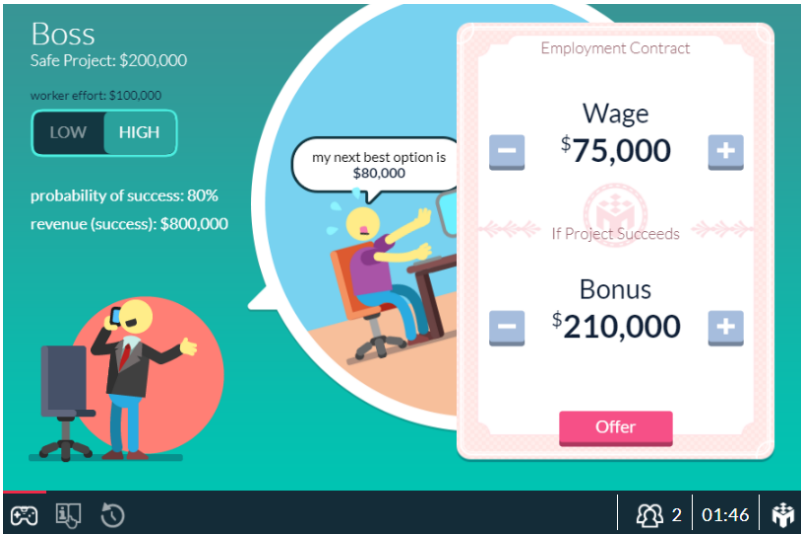
|---|---|
| **Primary Topic:** | Contract Theory, Organizational Economics, Information Economics, Labor Economics |
| **Typical Duration:** | Set-up: 5-10 min | Game play: 10-15 min | Debrief: 15-20 min |
| **Group Size:** | Pairs (Boss and Worker); scales to any class size |
| **Difficulty Level:** | Intermediate / Advanced |
| **Prerequisites:** | Helpful to have covered expected value and the concept of information asymmetry. Works well as the experiential anchor for a unit on contract theory or moral hazard. |

## 1. Simulation Overview

In this simulation, students are divided into boss-worker pairs. Each boss has access to two types of projects: a safe project that pays a known, certain revenue without needing to hire anyone, and a risky project that requires hiring the worker and produces a higher revenue if it succeeds. Workers have an outside offer, and they can decline any contract and take that instead.

The game unfolds in two sequential stages each round. First, the boss proposes a wage-bonus contract to the worker. Second, the worker decides to accept or decline. If the worker declines, the boss falls back to the safe project and the worker takes their outside offer. If the worker accepts, they choose between exerting high or low effort. High effort is more costly but increases the probability the risky project succeeds.



The experiment is most powerful when run under two conditions in sequence: full information (where the boss can observe and contract on effort) and asymmetric information (where the boss can only observe the project outcome, not the effort behind it). The contrast between the two conditions is where the core learning happens. Students directly experience how the inability to monitor effort changes what contracts look like and what welfare outcomes result.

> **Real-World Connection:** The post-COVID shift to hybrid and remote work has made the principal-agent problem more visible than ever. When employers cannot directly observe whether employees are working hard or shirking, they face exactly the information asymmetry modeled in this game. The mechanisms students discover — performance-based bonuses, outcome-contingent pay — are the same tools real organizations use to address moral hazard.

### Learning Objectives

By the end of this simulation, students will be able to:

- **The Role of Information**: Explain how the optimal contract offered by a boss depends on the information environment — specifically, how asymmetric information forces the boss to substitute outcome-based pay for effort-based pay, and why this requires a larger bonus to achieve the same incentive effect.
- **Participation Constraint (PC):** Identify the participation constraint as the requirement that the worker's expected payoff under the contract must exceed their outside option and use it to determine the minimum wage necessary to attract the worker.
- **Incentive Compatibility Constraint (ICC):** Identify the incentive compatibility constraint as the requirement that the worker prefers high effort to low effort under the offered contract, and calculate the minimum bonus required to satisfy it under each information condition.
- **Welfare Consequences of Asymmetric Information**: Explain why asymmetric information reduces economic welfare — some risky projects that would be profitable under full information go unpursued because the required bonus becomes too expensive for the boss to offer.
- **Contract Design**: Design a wage-bonus contract that satisfies both the PC and ICC simultaneously under asymmetric information and explain why the bonus must be larger in this setting than under full information.

## 2. Game Mechanics

### The Two Information Conditions

The game is designed around a contrast between two information environments, ideally run back-to-back:

#### Full Information

The boss can observe the worker's effort and write an enforceable contract specifying a minimum effort requirement. A worker who accepts the contract but fails to meet the minimum effort requirement breaches the contract and receives $0. Because effort is contractible, the boss can offer a guaranteed wage (paid regardless of project outcome, as long as the effort

requirement is met) plus a bonus only if the project succeeds. The contract can be efficient: the boss can offer just enough to satisfy the worker's participation constraint and induce high effort at minimum cost.

**Asymmetric Information (default)**

The boss cannot observe the worker's effort, only the project outcome. Because effort is unobservable and unverifiable, the contract cannot be based on it. The bonus can only be paid if the project succeeds. This creates moral hazard: once the worker has accepted the contract and received the wage, they have an incentive to shirk (choose low effort) and avoid the effort cost while still collecting the wage. To overcome this, the boss must offer a large enough bonus that the worker's expected gain from high effort exceeds the effort cost — even accounting for the risk that the project fails and the bonus is not paid. This requires a larger bonus than under full information, which may make the risky project too expensive to pursue at all.

## Payoff Structure — Default Parameters

The default configuration uses the following values: Successful revenue (RS) = $500K, Unsuccessful revenue (RF) = $250K, Safe project revenue (SP) = $80K, Worker outside offer (NBO) = $80K, Probability of success with high effort (p) = 80%, Cost of high effort (eH) = $100K, Cost of low effort (eL) = $0K.

### Asymmetric Information — Expected Payoffs

| Situation | Payoff Formula |
|---|---|
| Boss (worker chooses high effort) | p x RS + (1-p) x RF - w - p x b |
| Boss (worker chooses low effort) | RF - w |
| Worker (worker chooses high effort) | w + p x b - eH |
| Worker (worker chooses low effort) | w - eL  (= w, since eL = 0) |

### Full Information — Expected Payoffs (worker honors contract)

| Situation | Payoff Formula |
|---|---|
| Boss (project fails) | RF - w |
| Boss (project succeeds) | RS - w - b |
| Worker (project fails) | w - eH |
| Worker (project succeeds) | w + b - eH |
| Worker (breaches contract) | $0 (forfeits all payment) |

**Key Difference:** Under full information, the boss pays a guaranteed wage + bonus only if the project succeeds, tied to effort compliance. Under asymmetric information, the boss still pays wage + bonus-if-successful, but cannot enforce the effort requirement — so the bonus must be large enough to make the worker want to choose high effort voluntarily.

## 3. Classroom Setup

| Configuration | Recommended Setting |
|---|---|
| **Information Condition** | Run Game 1 as Full Information, Game 2 as Asymmetric Information (default). The contrast is the core pedagogical structure. Run both in the same session whenever possible. |
| **Number of Rounds** | 3-5 rounds per game. Multiple rounds give bosses time to learn the constraints and converge toward the optimal contract. Enable Fixed Pairs to keep boss-worker pairs stable across rounds. |
| **Round Duration** | Default: 180 seconds. Sufficient time for bosses to calculate payoffs and workers to evaluate offers. Consider reducing it to 120 seconds once students have played before. |
| **Probability of Success** | Default: 50% (asymmetric) or adjustable. Lowering the probability of success from high effort requires a higher bonus to satisfy the ICC. This is useful for exploring the tradeoff between risk and incentive costs. |
| **Worker Outside Option** | Default: $80K. Increasing the outside option raises the minimum wage required to satisfy the PC, making the risky project more expensive to pursue and welfare losses larger. |
| **Chat** | Optional. Enabling chat allows bosses and workers to negotiate directly, which typically accelerates convergence toward the optimal contract and generates useful discussion material about the role of communication in contracting. |
| **Robot Players** | Agent robot: accepts only contracts where its expected payoff from honoring the contract exceeds the outside offer. Principal robot: always requires high effort and offers a wage + bonus near the PC/ICC intersection with some noise. |
| **Technology Required** | Laptop or tablet with an up-to-date web browser. Direct students to watch video instructions before class to preserve game time. |

## 4. Pedagogical Instructions

### Pre-Game Briefing

The payoff structure is more complex than most MobLab games, invest 5-10 minutes before play to walk through it carefully:

- Introduce the setup: each pair has a boss and a worker. The boss chooses between a safe project (certain revenue, no worker needed) and a risky project (higher upside, requires hiring the worker).
- Walk through the contract components: the boss offers a wage (base pay) and a bonus (additional pay if the project succeeds). Under full information, the contract also specifies a minimum requirement.
- Explain the worker's decision tree: accept or decline the contract. If they accept, choose high or low effort. Under full information, breaching the effort requirement means

receiving $0. Honoring the contract is individually rational only if the expected payoff from doing so exceeds the outside offer.

- For the asymmetric information round, emphasize that the boss cannot see which effort level the worker chose, only whether the project succeeded or failed. The bonus is paid only on success.
- Run through the default payoff equations with numbers: with p = 50%, RS = $500K, RF = $200K, w = $100K, b = $100K, the worker choosing high effort earns $100K + 50% x $100K - $50K = $100K. The same as choosing low effort ($100K - $0 = $100K). Ask students: is this contract incentive compatible?

**Instructor Tip:** Before starting the game, ask students to calculate on paper: what is the minimum bonus required for the worker to prefer high effort under asymmetric information? This calculation primes students to recognize whether the contracts they offer or receive satisfy the incentive compatibility constraint, and makes the debrief much richer.

## The Gameplay Experience

During the full information round, watch for:

- Bosses quickly figure out the minimum wage needed to satisfy the PC and set the effort requirement to High. These are your debrief examples of efficient contracting.
- Workers evaluating the contract by comparing w + b - eH against their outside offer. A few workers may still breach the contract even under full information (accepting the contract then choosing low effort), use these cases to check the contract design: was the wage alone already above the outside offer?

During the asymmetric information round, watch for:

- The shift in boss strategy: many bosses offer higher bonuses in this round as they learn they cannot rely on the effort requirement. Some bosses initially offer the same contract as in the full information round, observe workers choosing low effort, and adjust upward in subsequent rounds.
- Workers exploiting low-bonus contracts by choosing low effort and pocketing the wage — this is moral hazard in action. These pairs typically have lower payoffs for both roles, which is the welfare loss of asymmetric information.
- Some boss-worker pairs not reaching a contract at all in this round — the boss determines that the bonus required to induce high effort makes the risky project unprofitable and opts for the safe project instead. This is the welfare consequence students should see directly.

**Instructor Tip:** Before the debrief, ask students to reflect silently on three questions: (1) As a worker, what determined whether you chose high or low effort? (2) As a boss, how did you decide what bonus to offer? (3) What happened to the number of contracts accepted between the full information and asymmetric information rounds? Written reflection before discussion has been shown to significantly improve the quality of class discussion.

### Facilitator Checklist

1. Configure Game 1 (Full Information) and Game 2 (Asymmetric Information) as separate games in a playlist before class.
2. Direct students to watch the video instructions before class, find the link in the Instructions pop-up at the top right of the game screen.
3. Open the activity and wait for students to join. Assign fixed pairs if you want boss-worker relationships to persist across rounds.
4. Add robot players for any unpaired student — the robot strategies are calibrated to provide realistic counterparties.
5. After Game 1 concludes, note the acceptance rate and effort choices before moving to Game 2. Do not debrief until both games are complete.
6. Before the debrief, navigate to Results and open the Participation and Incentive Compatibility graph. This is the primary visual for the debrief.

## 5. Debriefing & Discussion

Plan for 15-20 minutes. Open with the summary table — show acceptance rates, the percentage choosing high effort, and the percentage of successful projects side by side for both rounds. Then move to the participation and incentive compatibility graph. Let students interpret what they see before introducing the formal theory.

### Suggested Discussion Questions

- As a worker, when did you choose high effort and when did you choose low effort? What was the key factor in that decision — the wage, the bonus, or the probability of success?
- As a boss, how did your contract offer change between the full information and asymmetric information rounds? Why? What constraint were you trying to satisfy?
- In the asymmetric information round, some workers chose low effort even after accepting a contract. From the boss's perspective, why is this individually rational for the worker — and what does it cost both parties?
- Look at the acceptance rate across both rounds. In which round were fewer contracts accepted? Why — and what does a rejected contract mean for total welfare in this game?
- If we define economic welfare as the total payoff for both the boss and the worker, which round produced higher welfare? Why does asymmetric information reduce it?
- The flat-fee wage satisfies the participation constraint — it gets the worker in the door. The bonus satisfies the incentive compatibility constraint — it gets the worker to work hard. Why can't the boss just use a higher wage instead of a bonus to induce effort?
- Where do you see principal-agent problems in the real world? What mechanisms do organizations use to address them — and why do those mechanisms sometimes fail?

### Theoretical Connections

- Moral Hazard: The classic moral hazard problem arises whenever one party to a contract cannot observe the actions of the other. In this game, the worker's effort choice is the hidden action. Once the worker has accepted the contract and secured the wage, the incentive to shirk (choose low effort, avoid the effort cost) is the moral hazard the boss must design around.

- Participation Constraint (PC): For the worker to accept any contract, the expected payoff must exceed the outside offer. Under asymmetric information: w + p x b - eH >= NBO. The flat wage is the primary instrument for satisfying the PC — it raises the worker's expected payoff without affecting the effort incentive.
- Incentive Compatibility Constraint (ICC): For the worker to voluntarily choose high effort under asymmetric information, the expected gain from high effort must exceed the gain from low effort: p x b - eH >= 0 - eL, which simplifies to p x b >= eH (since eL = 0 by default). This establishes the minimum bonus: b >= eH / p. With the default eH = $100K and p = 50%, the minimum bonus is $200K.
- First-Best vs. Second-Best: Under full information, the boss achieves the first-best outcome — contracting directly on effort at minimum cost. Under asymmetric information, the boss is constrained to the second-best outcome. A larger bonus is required, which may make the risky project unprofitable, reducing both employment and welfare relative to the first-best.
- Welfare Loss from Information Asymmetry: The gap between the full information and asymmetric information outcomes is a direct measure of the welfare cost of unobservable effort. Students can calculate this from the results data: compare total payoffs (boss + worker) across both rounds for pairs that reached a contract.
- Applications to Executive Compensation: Stock options and performance bonuses in executive pay are direct real-world implementations of the incentive compatibility constraint. The practice of tying CEO compensation heavily to firm performance (stock price, earnings) reflects the same logic as the bonus structure in this game, aligning the agent's interest with the principal's when effort is unobservable.

## 6. Results & Data Interpretation

### Reading the Results Dashboard

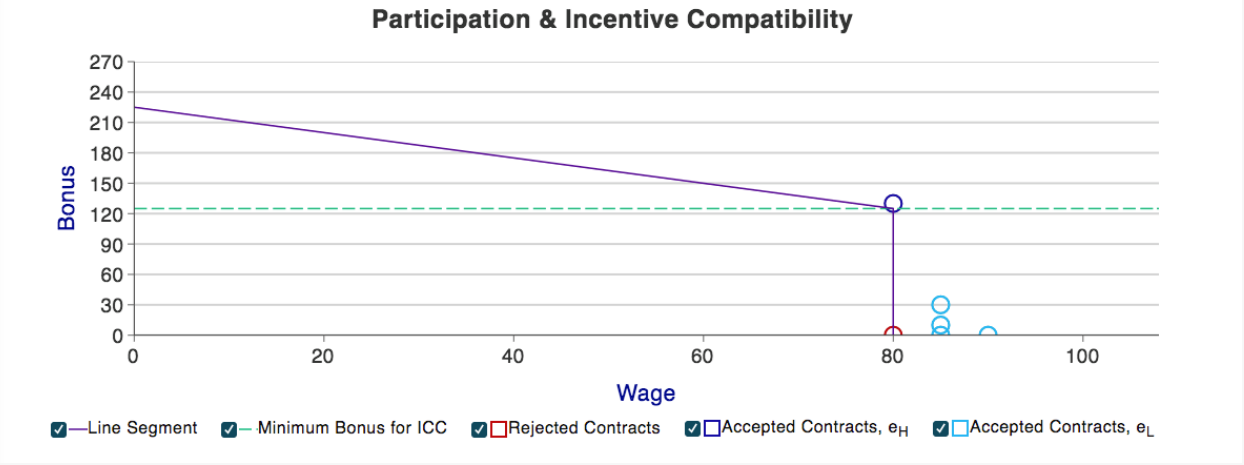
Three views are most useful for this experiment:

- Summary Table: Shows by round the number of participating pairs, percent of contracts accepted (% Accepted), percent that met the participation constraint (% meet PC), percent that chose high effort (% Choose eH), percent that met the incentive compatibility constraint (% E(MB) > MC), and percent of risky projects that succeeded (% Successful). Compare these metrics directly across the full information and asymmetric information rounds — the drop in high-effort rates and successful projects in the asymmetric information round is the welfare story in numbers.

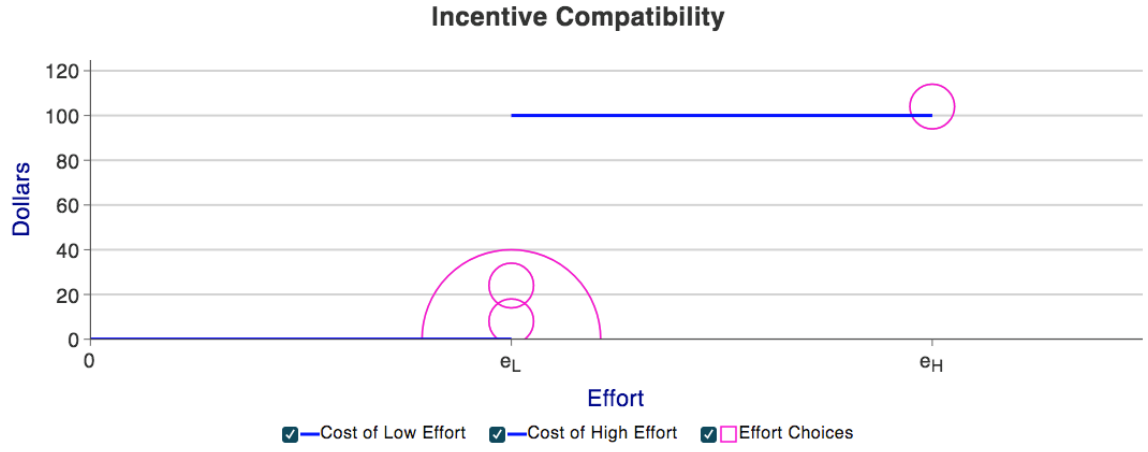
| Round | Pairs | % Accepted | % meet PC | % Choose eH | % E(MB) > MC | % Successful |
|---|---|---|---|---|---|---|
| 1 | 2 | 50.00% | 100.00% | 0.00% | 0.00% | 0.00% |
| 2 | 2 | 100.00% | 100.00% | 50.00% | 50.00% | 50.00% |
| 3 | 2 | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% |

- Participation and Incentive Compatibility Graph: Wage on the x-axis, bonus on the y-axis. The purple frontier separates the acceptance and rejection regions (the participation constraint). The dashed line shows the minimum bonus for incentive compatibility (the ICC). Each contract is plotted as a dot colored by outcome: red = rejected, light blue = accepted but worker chose low effort, dark blue = accepted and

worker chose high effort. The ideal contract sits in the upper-right region — above both lines. Use this graph to show students which contracts fell short of the ICC (low effort followed) and which fell below the PC (rejected).




- Incentive Compatibility Graph: Effort on the x-axis, expected bonus on the y-axis. Each bubble represents a group of contracts with the same expected bonus (p x b), sized by the number of contracts. Bubbles below the cost-of-high-effort line should cluster on the low-effort line; bubbles above it should cluster on the high-effort line. This graph lets students verify whether their effort choices were consistent with the theoretical predictions, and to see which bosses over- or under-paid relative to the ICC.




## Common Outcome Patterns

- Full Information Round — High Acceptance and High Effort: Most contracts are accepted and workers choose high effort, since the effort requirement is enforceable.

The contracts cluster near the PC line — bosses who figured out the math offer the minimum necessary wage and bonus. Bosses who were too generous appear in the upper-right quadrant.

- Asymmetric Information Round — Lower Acceptance and Mixed Effort: Acceptance rates typically fall slightly (some bosses conclude the risky project is not worth the required bonus) and the percentage choosing high effort drops noticeably. Contracts that fell below the ICC line almost always resulted in low effort — a direct, visual confirmation of the theory.
- Learning Across Rounds: In multi-round sessions, bosses typically increase their bonus offers round by round as they observe low effort and adjust. By the final round, many more contracts satisfy the ICC. This learning dynamic is worth discussing: how do real organizations discover the right incentive structure through trial and error?

## 7. Extensions & Variations

### Key Parameter Adjustments

- Vary the Probability of Success: Lower p increases the minimum bonus required for incentive compatibility (b >= eH / p), making it more expensive to induce high effort. This is a clean treatment that shows students how the risk environment affects contract design — higher risk demands higher performance pay.
- Vary the Worker Outside Option: Increasing the NBO raises the minimum wage needed to satisfy the PC. At high enough outside options, the risky project becomes unprofitable even with an efficient contract, demonstrating how labor market conditions affect the principal-agent outcome.
- Enable Chat: Pre-contract negotiation through chat allows bosses and workers to discuss terms directly. This typically increases acceptance rates and effort levels as both parties can more clearly communicate their constraints. It also generates rich chat logs for debrief use.
- Run Multiple Rounds with Fixed Pairs: Repeated interaction allows reputation effects to emerge — bosses who renege on implicit promises and workers who shirk develop reputations that affect future offers. This connects the game to the Folk Theorem and the role of long-term relationships in overcoming moral hazard.

### Cross-Disciplinary Connections

- Human Resources and Executive Compensation: CEO pay structures — heavy in stock options and performance bonuses, lighter in base salary — are a direct application of the ICC. The game gives students an intuitive foundation for understanding why boards structure executive compensation the way they do, and why it is controversial.
- Healthcare Economics — Physician Incentives: Patients (principals) cannot directly observe whether their doctor (agent) recommends the most appropriate treatment or the most profitable one. Fee-for-service vs. capitation payment models are real-world attempts to solve exactly the moral hazard problem students experience in the game.
- Insurance and Adverse Selection: While this game focuses on moral hazard (hidden action), it naturally opens the door to a discussion of adverse selection (hidden information). Both arise from information asymmetry; distinguishing between them is a key conceptual goal for students studying information economics.

- Public Policy — Welfare and Work Requirements: Government transfer programs face a variant of the principal-agent problem: how do you design benefits that support people in need without creating disincentives to work? Work requirements, earnings-linked benefits (EITC), and benefit phase-outs are all attempts to satisfy an incentive compatibility constraint analogous to the one in this game.

## 8. References & Further Reading

The following resources pair well with this experiment:

- Holmstrom, B. (1979). Moral Hazard and Observability. Bell Journal of Economics, 10(1), 74-91. The foundational paper establishing the theory of optimal contracts under hidden action — the direct intellectual parent of this game.
- Laffont, J.J. & Martimort, D. (2002). The Theory of Incentives: The Principal-Agent Model. Princeton University Press. The definitive graduate-level treatment; accessible chapters on the basic model work well as advanced reading.
- Milgrom, P. & Roberts, J. (1992). Economics, Organization, and Management. Prentice Hall. Chapter on incentives and information is an accessible and practically oriented treatment suitable for MBA courses.
- Jensen, M.C. & Meckling, W.H. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. Journal of Financial Economics, 3(4), 305-360. The foundational paper on agency theory in corporate finance — connects the game directly to executive compensation and shareholder-manager conflicts.
- Prendergast, C. (1999). The Provision of Incentives in Firms. Journal of Economic Literature, 37(1), 7-63. A comprehensive survey of empirical evidence on how firms design incentive contracts — useful for connecting the theory to real organizational practice.