



Instructor guide to the principal–agent games

Laboratory implementation, theoretical foundations,
experimental evidence, and variants

Behavioral and Experimental Economics Research Lab
Department of Economics



Revised edition | October 2026

<https://beer-lab.org/>

How to use this guide

This guide supports preparation, implementation, and classroom discussion of the principal–agent game family developed by the Behavioral and Experimental Economics Research Lab (BEER Lab) of the Department of Economics at Tecnológico de Monterrey. It is written for instructors in microeconomics, labor economics, industrial organization, corporate finance, public economics, contract theory, management, and experimental economics. It does not assume prior experience with oTree or incentive design.

The document offers three reading paths. The **quick guide** is sufficient for a first session. The operational chapters describe access, participant screens, and the instructor report. The conceptual chapters develop the model, predictions, experimental evidence, and extensions needed for a careful debrief. Common elements are explained once; each treatment section focuses on what changes relative to the reference game.

The corporate extension adds investment, revenue participation and control rights. The contractual activity separates three decisions that students often conflate. The principal designs a contract, the agent decides whether to participate, and an agent who accepts chooses effort. Project performance is stochastic, so failure does not prove low effort and success does not prove high effort. The sequence makes it possible to teach risk, information, incentives, participation, and surplus distribution within one coherent experience.

Author

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For the instructor

For a first implementation, use the one-interaction basic version and reserve 45–60 minutes. Before revealing the report, ask the class to predict which fixed wage and bonus will induce effort, whether the agent will accept, and who will bear project risk. Keep aggregate outcomes hidden until every pair has finished.

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Quick guide and learning outcomes

1.1 Access through the updated laboratory website

Start at <https://beer-lab.org/en/>. Select **CLASSROOM** in the top navigation menu; it opens <https://teaching.beer-lab.org/en/>. In the **Classroom experiments** catalog, use the search box to locate the activity by name. You can also filter by **Topic** or **JEL code**. Clear any filters left from an earlier search before looking for another game.

Each family's card distinguishes **Español** and **English** access links. The **Show extended version** checkbox selects that edition before following a link. Catalog language and session language are separate choices: verify both. Students use the room specified by the instructor; the instructor prepares and monitors the session through this family's own administrative pages.

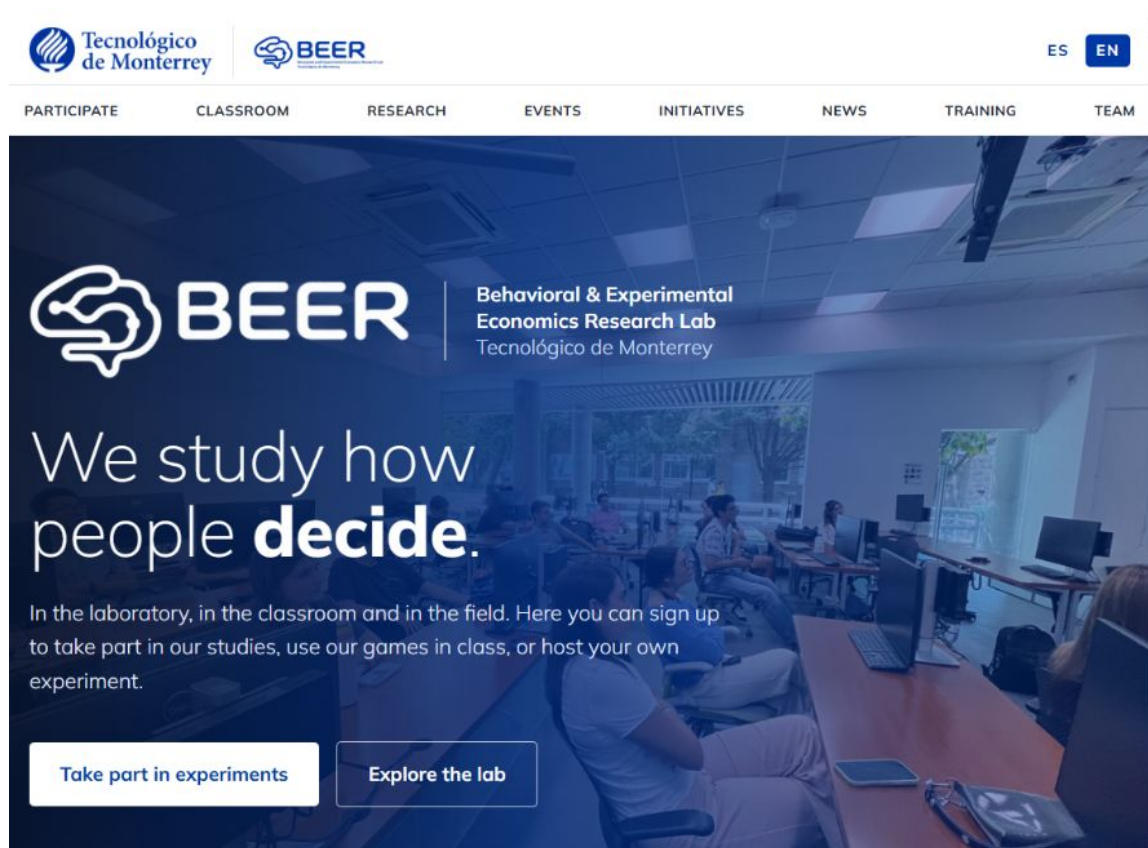


Figure 1.1: Current institutional website. Select CLASSROOM in the top navigation menu to open the teaching experiments. Captured on October 7, 2026.

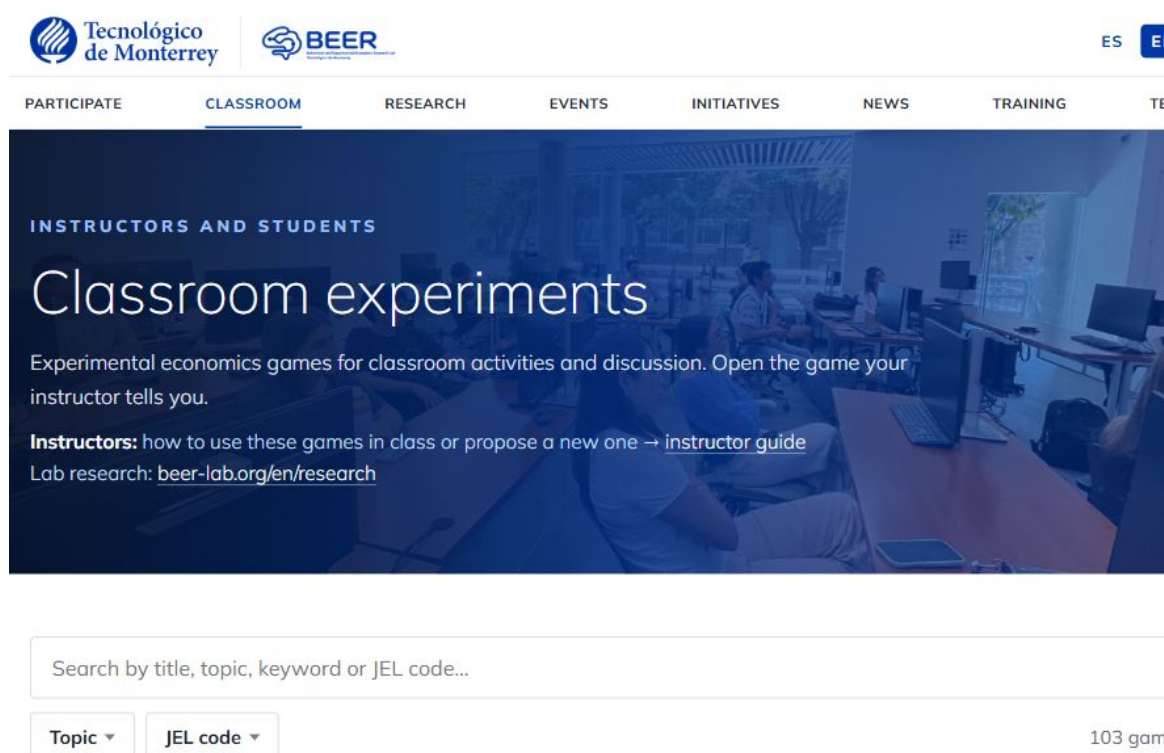


Figure 1.2: Current catalog: search by title, topic, or JEL code. Then locate this family's card and select language and edition. Captured on October 7, 2026.

Checking resources, comprehension, and participant requirements

Before opening the room, check the selected configuration and the number of students present. The session-creation form states the group size and minimum required by that configuration. An individual activity accepts any positive participant count; an interactive activity must satisfy its stated requirement: complete groups when size is fixed, or a minimum participant count when size is flexible. Requirements may change across treatments, for example when adding a third party or changing an institution's size. If you edit a grouping parameter, check the requirement for the edited configuration, rather than relying only on the demo's suggested count.

In the instructions, ensure that students can identify what each role receives, what they can decide, and how the outcome is calculated. An initial account, a distributable budget, and final earnings need not be the same amount. Refer to the resources panel and the example for the selected treatment. Do not carry the basic edition's endowment into a treatment that changes accounts or introduces additional positions.

ECU stands for *Experimental Currency Units*: the activity's unit of account. An outcome of 100 ECU does not automatically equal 100 pesos or 100 dollars. Conversion depends on the session configuration. Before announcing a payment, confirm with the laboratory whether money is paid, the conversion rate, and which decisions count for payment. In hypothetical modules, describe amounts as outcomes in the stated situation.

When a comprehension check is included, an incorrect response receives an explanation beside that question, identifying the submitted answer and the correct answer. Other answers remain in the form. Ask the student to return to the example, locate the relevant rule, and redo the calculation before correcting the response. Avoid revealing answers to the entire class for an individual error, and do not interpret a comprehension mistake as an economic choice in the game.

oTree Demo Sessions Rooms Data Server Check Logout

Demo

[ES] Principal-agente — una interacción
[ES] Principal-agente — 10 rondas, pareja fija
[ES] Principal-agente — 10 rondas, parejas reasignadas
[EN] Principal-Agent — one interaction
[EN] Principal-Agent — 10 rounds, fixed partner
[EN] Principal-Agent — 10 rounds, reassigned partners
[ES] Principal-agente extendido — referencia, una interacción
[ES] Principal-agente extendido — referencia, pareja fija
[ES] Principal-agente extendido — referencia, parejas reasignadas
[ES] Principal-agente extendido — esfuerzo observable y exigible
[ES] Principal-agente extendido — salario fijo
[ES] Principal-agente extendido — resultado poco informativo
[ES] Principal-agente extendido — opción externa alta
[ES] Principal-agente extendido — monitoreo costoso
[ES] Principal-agente extendido — responsabilidad no limitada
[ES] Principal-agente extendido — bono discrecional
[EN] Extended Principal-Agent — baseline, one interaction
[EN] Extended Principal-Agent — baseline, fixed partner
[EN] Extended Principal-Agent — baseline, reassigned partners
[EN] Extended Principal-Agent — observable and enforceable effort
[EN] Extended Principal-Agent — flat wage

Principal-agente / Principal-Agent — BEER Lab

Seleccione una variante de este juego. Select a version of this game.

Figure 1.3: Opening view of the existing family, with the corporate conditions added to its extended menu.

Rooms

Current rooms:

[ES] Principal-agente
[EN] Principal-Agent
[ES] Principal-agente: extendido
[EN] Principal-Agent: extended

Figure 1.4: Rooms contains the four rooms for this family: basic and extended editions in Spanish and English.

Room: [EN] Principal-Agent

Create a new session

Session Config

[EN] Principal-Agent — one interaction

Number of participants

Complete groups of 2 participants. Use a multiple of 2; minimum 2.

Create

[Configure session](#) 

App sequence

principal_agent_game (10 rounds)

Bilingual principal-agent teaching game with contract design, participation, effort, and moral hazard.

0 participants present

Start links

These URLs will stay constant for new sessions, even if the database is recreated.

Room-wide URL

Here is the room-wide URL anyone can use. Don't use this link when testing in multiple tabs on the same browser, because all tabs will be assigned to the same participant, using a cookie.

http://127.0.0.1:8107/room/principal_agent_en

Figure 1.5: Session-creation form for the basic English room. Check the selected configuration and participant requirement before creating the session.

Downloading a session with several rounds

For the instructor

Open **Data** within the relevant session and use that session's CSV or CSV-for-Excel download link. The general export has one row per participant and columns for the different rounds. Ten rounds do not necessarily mean ten rows per person. When the family provides its own long-format export, observations may instead be organized by participant and round or another unit defined by the design.

Save the original file together with the configuration name, session code, and active-round count. Check that columns for the last active round are present and that the data belong to the selected session. Empty cells can represent inactive rounds, a pending decision, or a field that does not apply to a role; do not automatically recode them as zeros. To compare learning, preserve round and group identifiers alongside participant identifiers. Share only anonymous aggregates in class, and record session incidents before constructing derived tables.

Attention

The proposed public route is <https://principalagent.beer-lab.org/>. The local instance verified for this package runs at <http://localhost:8107> with `GAME_FAMILY=principalagent` and a separate database. **Demo** must list 44 configurations and **Rooms** exactly four rooms. If another game family appears, do not begin the session.

Purpose	Understand contracts, participation, effort and corporate investment under different incentives and control rights.
Experimental unit	A pair composed of one principal and one agent. Roles remain fixed throughout a session.
Basic edition	One interaction, ten rounds with a fixed partner, and ten rounds with reassigned partners, in English and Spanish.
Extended edition	Seven contractual variants and nine corporate conditions: investment, equity, control, board, monitoring, enforceable effort, horizon and private benefits.
Decision	Contract, acceptance and effort; corporate conditions add project choice, revenue participation and investment control.
Outcome	Acceptance, effort, success, transfers, role-specific profits, surplus, and compatibility indicators.
Students	https://principalagent.beer-lab.org/room/principal_agent_en .
Instructor	https://principalagent.beer-lab.org/demo .
Local test	http://localhost:8107/demo .
Topics	principal-agent; contracts; moral hazard; incentives; corporate investment; corporate governance.
JEL	C92; D86; G31; G34; J33.
Participants	Multiples of two, minimum two; use four or more for effective reassignment.
Suggested duration	45–60 minutes for the basic game; 75–90 for a corporate comparison.

After the activity, students should be able to distinguish a fixed wage from a contingent payment; compute state-specific and expected payoffs; formulate a participation constraint; find the effort that maximizes the agent's expected net payoff; explain why an imperfect performance signal limits incentives; compare observable and hidden action; and discuss how limited liability, monitoring, reputation, and reciprocity change contract design.

Instructors should be able to interpret a bonus distribution without relying only on its mean, distinguish offered from accepted contracts, separate effort from outcome, compare predictions with behavior, and identify the experimental unit. Repeated rounds from a fixed pair reveal learning and relationship dynamics, but they are not independent observations for statistical inference.

Every participant begins each round with a 200 ECU account balance. The credited balance is 200 plus economic profit. This constant permits the interface to display negative economic profits without producing negative technical balances and does not change any choice because it is added to every alternative. The instructor report displays *economic profit*, excluding the constant.

1.2 Minimum implementation sequence

1. Confirm an even number of participants and select language, edition, rounds, and matching.
2. Open <https://beer-lab.org/>, enter the teaching-games section, and locate the principal-agent family.
3. Sign in at <https://principalagent.beer-lab.org/demo> and open **Rooms**.
4. Select one of the four rooms and activate the intended configuration.
5. Keep **Monitor** and **Report** open in separate tabs. Do not project individual links.
6. Share only the public route for the selected room.
7. Wait until every participant finishes comprehension, contract, acceptance, effort, and outcome.
8. Reveal the aggregate report and follow the debrief sequence in this guide.
9. Export the data if students will complete a follow-up assignment.

Checkpoint

Before allowing entry, verify the visible name, language, treatment, number of rounds, and matching method. For ten random-matching rounds, confirm that reassignment occurs within role, so principals remain principals and agents remain agents.

Platform access and family isolation

The institutional route begins at <https://beer-lab.org/> and continues to <https://teaching.beer-lab.org/>. Once the new card is published, the **English** access should lead to the basic English room. The remaining rooms may be presented as additional instructor options. This family's hostname must run an oTree instance that knows only its 44 configurations and four rooms.

Isolation is more than a visual preference. It prevents a student who enters the principal-agent domain from launching trust, public goods, or another game. It also separates Sessions, Data, and reports by family. Production must start with `GAME_FAMILY=principalagent` and a dedicated database.

2.1 The four rooms

Room	Audience	Content
<code>principal_agente_es</code>	Spanish participants	Three basic configurations: one interaction, fixed partner, and reassigned partners.
<code>principal_agent_en</code>	English participants	The same three basic configurations in English.
<code>principal_agente_extendido</code>	Spanish participants	Three reference configurations and seven extended treatments.
<code>principal_agent_extended</code>	English participants	Three reference configurations and seven extended treatments.

When no session is active, participants may remain on a waiting screen. This is normal. If waiting continues after activation, check that the correct room was opened, that capacity remains, and that the browser is not reusing an obsolete session tab.

2.2 Instructor route

In **Demo**, the instructor can create a practice session and obtain eight participant links. Classroom sessions should use **Rooms** because the public URL is stable. After session creation, oTree displays individual links, Monitor, and Report. Individual links are useful for testing; they should not replace the institutional room route or be projected next to identifiable codes.

oTree
Demo
Sessions
Rooms
Data
Server Check

[EN] Principal-Agent — one interaction: session 'tj643jdw' (demo)

New
Links
Monitor
Data
Payments
Report
Description

Below are temporary links for testing and demonstration. To launch a real study, either create persistent links by setting up a [room](#), or create a session through the [sessions page](#).

Choose one of the following options to play the session:

Combined views

Split-screen view
Not available ⓘ
Grid view
[Launch](#)

Session-wide testing link

Open the below link in up to 8 browser tabs.

<http://127.0.0.1:8042/join/kubeseft>

Single-use links

Open each link in its own browser tab.

P1	http://127.0.0.1:8042/InitializeParticipant/opol1nca
P2	http://127.0.0.1:8042/InitializeParticipant/c0inqznu
P3	http://127.0.0.1:8042/InitializeParticipant/cjkeuhi8
P4	http://127.0.0.1:8042/InitializeParticipant/0rpoe6rx
P5	http://127.0.0.1:8042/InitializeParticipant/bn6xnhtpc
P6	http://127.0.0.1:8042/InitializeParticipant/2qyx9f5n
P7	http://127.0.0.1:8042/InitializeParticipant/mvujq8ep
P8	http://127.0.0.1:8042/InitializeParticipant/n33xla9e

Figure 2.1: Links for a demonstration session. Keep this page private and share only the stable room URL.

Attention

The administrative password, individual links, and Monitor table are operational information. The projector should show only general instructions and, at the end, the aggregate report after the instructor selects **Reveal results**.

Anatomy of the basic game

3.1 Roles, technology, and timing

The principal controls the contract and receives project revenue. The agent controls participation and, under hidden action, effort. Revenue equals 250 ECU after success and 50 ECU after failure. Effort can be 0, 1, 2, 3, 4, or 5. Higher effort raises the success probability and the agent's private effort cost.

Effort e	Success probability $p(e)$	Cost $c(e)$	Expected revenue
0	0.15	0	80
1	0.30	8	110
2	0.45	20	140
3	0.60	38	170
4	0.75	62	200
5	0.90	92	230

The basic contract contains a fixed wage w and a success bonus b . After failure, the agent receives w ; after success, the agent receives $w + b$. An agent who accepts then selects effort without direct observation by the principal. A random draw produces the project state. The outcome contains information about effort but does not identify it exactly.

Timing is essential. The principal moves first; the agent observes the offer and decides whether to participate; the agent chooses effort; nature determines success or failure; the system calculates payoffs. An oral explanation should never imply that the principal can revise terms after observing effort or the outcome.

3.2 Payoffs and the agent's decision

For a risk-neutral agent who accepts and chooses e , expected economic profit is

$$U_A(e \mid w, b) = w + p(e)b - c(e).$$

The principal's expected profit is

$$U_P(e \mid w, b) = p(e)250 + [1 - p(e)]50 - w - p(e)b.$$

The agent rejects when the best expected payoff available under the contract is below the outside option $\bar{u} = 20$. Rejection gives the agent 20 and the principal zero. The participation constraint is

$$\max_e \{w + p(e)b - c(e)\} \geq 20.$$

Incentive compatibility requires the target effort to maximize the agent's payoff. With $w = 4$ and $b = 80$, expected net payoffs for effort 0 through 5 are 16, 20, 20, 14, 2, and -16 . The implementation breaks the tie in favor of the higher effort, so the calculated best response is $e = 2$. Expected utility equals the 20 ECU outside option, and the principal's expected profit is 100.

Theoretical foundation

The fixed wage shifts the agent's payoff at every effort and is mainly used to satisfy participation and distribute surplus. The bonus changes the slope of expected pay with respect to effort, so it is the central instrument for inducing hidden effort.

3.3 Risk and realized outcomes

The equations above describe expected values. Realized profit depends on the state. With $w = 4$, $b = 80$, and $e = 2$, failure produces agent profit $4 - 20 = -16$ and principal profit $50 - 4 = 46$. Success produces agent profit 64 and principal profit 166. The agent receives 20 in expectation but bears substantial outcome risk.

One failure does not prove shirking. Even effort 5 has a 10% failure probability. Likewise, effort 0 succeeds 15% of the time. Instructors should prevent the class from treating performance as a direct measure of conduct. Ten rounds provide more information, but realized frequencies need not equal theoretical probabilities in a small sample.

3.4 Credited balance and economic profit

The result page displays two quantities. **Profit** is the economic result based on revenue, transfers, and effort cost. The **credited balance** adds 200 ECU. A principal profit of 46 yields a 246 ECU balance; an agent profit of -16 yields 184. The constant does not rescue an unfavorable contract or change the best response.

Participant screens

4.1 Welcome and instructions

The opening page presents the BEER Lab, the purpose of controlled activities, and rules concerning silence, independence, and anonymity. Participants must confirm that they have read the rules. This common page establishes laboratory conditions and limits unauthorized communication.

Instructions identify role, treatment, rounds, and matching. They explain the relationship, contract, technology, timing, outside option, numerical example, and round balance. Principals and agents receive the same mechanism description, while the header clearly identifies their fixed role.

What participants will see

Participants should understand that the bonus is tied to the outcome, effort is costly, and rejection is different from project failure. An instructor may clarify vocabulary but should never recommend an offer, an acceptance decision, or an effort level.

4.2 Comprehension

The comprehension check asks who proposes the contract, what rejection pays, the success-state payment in a numerical example, whether effort is observable, and how many rounds are active. Incorrect answers produce a general message and allow another attempt. If many students miss the same item, pause and restate the rule without revealing an optimal decision.

4.3 Contract design, participation, and effort

The principal enters a fixed wage and bonus. The table recalculates the agent's expected net payoff and the principal's expected profit for every effort. It is a reasoning aid rather than an automatic recommendation: the principal must still anticipate which effort the agent will choose and whether the agent will accept.

The agent sees failure and success payments, the outside option, and expected payoff by effort. Acceptance occurs first. An agent who accepts sees a separate effort page. This separation records rejected contracts correctly and prevents instructors from treating nonparticipation as effort zero.



Welcome to the BEER Lab

The **Behavioral and Experimental Economics Research Lab** of the Department of Economics at Tecnológico de Monterrey is a space designed to study economic decisions through controlled activities.

In this activity, you will examine how a principal designs incentives and how an agent responds when effort is costly or difficult to observe.

General laboratory rules

- Work quietly and do not speak with other participants.
- Make every decision independently.
- Do not open other pages or use your phone during the activity.
- If you have a question, raise your hand and wait for the instructor.
- Do not try to identify the person with whom you interact.

☐ I confirm that I have read and will follow the laboratory rules.

Start

Powered by [oTree](#)

Figure 4.1: Institutional welcome page and laboratory rules.



Round 1 / 1 · Your role: Principal

Game instructions

Hidden action with performance contract

Resources and unit of account

Each participant's starting account per round: 200 ECU. The round's profit or loss is added to that account.

ECU stands for Experimental Currency Units. It is the unit of account for this activity.

This session does not convert ECU into real money.

Hidden action with performance contract

The principal cannot observe effort; the bonus depends on the outcome.

The relationship

The principal receives project revenue and proposes a contract. The agent decides whether to accept. If accepted, the agent supplies costly effort that changes the probability of success.

The contract

The fixed wage is always paid. In performance contracts, the bonus is paid when the project succeeds. The agent sees the contract before accepting and choosing effort.

Effort and outcome

Sequence

Figure 4.2: Current basic-edition instructions, with initial resources and experimental units.
Continuation 1/2.

Effort ranges from 0 to 5. Greater effort costs more to the agent and raises the probability of success. The project generates 250 ECU if successful and 50 ECU otherwise.

1. The principal designs a contract.
2. The agent accepts or rejects.
3. If accepted, effort is determined under the treatment rules.
4. The project is realized and payoffs are calculated.

Outside option

If the agent rejects, the agent receives the outside option and the principal receives 0 ECU. The agent's outside option is 20 ECU.

Numerical example

With a 20 ECU fixed wage and a 50 ECU success bonus, the agent receives 70 ECU after success and 20 ECU after failure, before subtracting effort cost. The principal keeps project revenue minus the agent's payment.

Round balance

Each participant starts the round with a 200 ECU balance. The credited balance at the end equals that initial amount plus the round's economic profit. The analysis and instructor report always distinguish profit from the credited balance.

one interaction

one interaction

Your role: Principal

Continue

Con tecnología de [oTree](#)

Figure 4.3: Current basic-edition instructions, with initial resources and experimental units.
Continuation 2/2.



Round 1 / 1 · Your role: Agent

Game instructions

Hidden action with performance contract

Hidden action with performance contract

The principal cannot observe effort; the bonus depends on the outcome.

The relationship

The principal receives project revenue and proposes a contract. The agent decides whether to accept. If accepted, the agent supplies costly effort that changes the probability of success.

The contract

The fixed wage is always paid. In performance contracts, the bonus is paid when the project succeeds. The agent sees the contract before accepting and choosing effort.

Effort and outcome

Effort ranges from 0 to 5. Greater effort costs more to the agent and raises the probability of success. The

Sequence

1. The principal designs a contract.
2. The agent accepts or rejects.

Figure 4.4: Agent instructions. Continuation 1/2.

4.4 Result and completion

The round result reports acceptance, project outcome, effort, probability, revenue, transfer, role-specific profits, and surplus. Both roles see the same pair outcome, with their own profit emphasized. The final screen summarizes rounds, accepted contracts, mean effort, and mean profit, and then asks participants to wait for the instructor.

project generates 250 ECU if successful and 50 ECU otherwise.

3. If accepted, effort is determined under the treatment rules.
4. The project is realized and payoffs are calculated.

Outside option

If the agent rejects, the agent receives the outside option and the principal receives 0 ECU. The agent's outside option is 20 ECU.

Numerical example

With a 20 ECU fixed wage and a 50 ECU success bonus, the agent receives 70 ECU after success and 20 ECU after failure, before subtracting effort cost. The principal keeps project revenue minus the agent's payment.

Round balance

Each participant starts the round with a 200 ECU balance. The credited balance at the end equals that initial amount plus the round's economic profit. The analysis and instructor report always distinguish profit from the credited balance.

one interaction

one interaction

Your role: Agent

Continue

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Figure 4.5: Agent instructions. Continuation 2/2.



Review the marked questions. Each shows your answer and an explanation; your other answers are retained.



Round 1 / 1

Comprehension questions

Answer correctly to continue. You may try again.

Resources and unit of account

ECU stands for Experimental Currency Units. It is the unit of account for this activity.

This session does not convert ECU into real money.

Who proposes the contract?

- ☐ The principal
- ☒ The agent
- ☐ Both simultaneously

Your answer: The agent. The correct answer is The principal. Review the sequence, outside option, success payment, information about effort, and number of rounds.

How many ECU does the agent receive after rejection?

Figure 4.6: Current comprehension check with an incorrect answer, its specific explanation, and retained responses. Continuation 1/2.

20

If the fixed wage is 20 and the success bonus is 50, how much does the agent receive before effort cost when the project succeeds?

70

In this treatment, what happens to effort?

- ☒ It is not directly observed by the principal
- ☐ It is observable and enforceable through the contract
- ☐ It always equals the outcome exactly

How many rounds are in this session?

- ☒ 1
- ☐ 10

Continue

Con tecnología de [oTree](#)

Figure 4.7: Current comprehension check with an incorrect answer, its specific explanation, and retained responses. Continuation 2/2.



Round 1 / 1 · Principal

Design the contract

The agent will see these terms before deciding whether to participate.

Hidden action with performance contract

The principal cannot observe effort; the bonus depends on the outcome.

Fixed wage (ECU)

Bonus if the project succeeds (ECU)

Payment after failure

0 ECU

Payment after success

0 ECU

Expected values by effort

Effort	Success probability	Effort cost	Agent's expected net payoff	Principal's expected profit
0	15%	0	0.0	80.0
1	30%	8	-8.0	110.0
2	45%	20	-20.0	140.0
3	60%	38	-38.0	170.0
4	75%	62	-62.0	200.0
5	90%	92	-92.0	230.0

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Figure 4.8: Contract design and expected-value calculator.



Round 1 / 1 · Agent

Decide whether to accept the contract

Compare the contract with your outside option. If you accept, you will then make the effort decision under this treatment's rules.

Hidden action with performance contract

The principal cannot observe effort; the bonus depends on the outcome.

Offered contract

Payment after failure

4 ECU

Payment after success

84 ECU

Outside option

20 ECU

Effort	Success probability	Effort cost	Agent's expected net payoff
0	15%	0	16,0
1	30%	8	20,0
2	45%	20	20,0
3	60%	38	14,0
4	75%	62	2,0
5	90%	92	-16,0

☐ Accept the contract

☐ Reject and take the outside option

Confirm decision

Figure 4.10: The agent's consecutive decisions. Acceptance or rejection. Continuation 2/2.



Round 1 / 1 · Agent

Choose your effort

Effort is costly and changes the probability of success. The principal does not directly observe this decision unless the treatment rules state otherwise.

Hidden action with performance contract

The principal cannot observe effort; the bonus depends on the outcome.

Effort	Success probability	Effort cost	Agent's expected net payoff
0	15%	0	16,0
1	30%	8	20,0
2	45%	20	20,0
3	60%	38	14,0
4	75%	62	2,0
5	90%	92	-16,0

Effort level

Confirm effort

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Figure 4.11: Private effort choice.





Round 1 / 1 · Your role: Principal

Round result

Hidden action with performance contract

Contract accepted

The project did not succeed

Effort supplied 2	Success probability 45%	Project revenue 50 ECU	Total payment to agent 4 ECU	Principal profit 46,0 ECU
Agent profit -16,0 ECU	Total surplus 30,0 ECU			

Profit **46,0 ECU** Balance credited this round: 246,0 ECU

[View final summary](#)

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Figure 4.12: Symmetric end-of-round information for the pair. Result for the principal.



Round 1 / 1 · Your role: Agent

Round result

Hidden action with performance contract

Contract accepted

The project did not succeed

Effort supplied

2

Success probability

45%

Project revenue

50 ECUTotal payment to
agent**4 ECU**

Principal profit

46,0 ECU

Agent profit

-16,0 ECU

Total surplus

30,0 ECUProfit **-16,0 ECU** Balance credited this round: 184,0 ECU[View final summary](#)Powered by [oTree](#)

Figure 4.13: Result for the agent.



Activity completed

Your decisions have been recorded. Wait for the instructor and do not close the browser until instructed.

Your role Principal	Rounds completed 1	Contracts accepted 1	Mean effort 2	Mean profit per round 46,0 ECU
-------------------------------	------------------------------	--------------------------------	-------------------------	--

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Figure 4.14: Stable completion screen.

Instructor report and interpretation

Before every pair has completed, Report shows progress and keeps aggregate outcomes hidden. Once all pair-rounds finish, **Reveal results** becomes available. This prevents early finishers from influencing participants who are still choosing.

The screenshot shows the oTree web interface. At the top, there's a navigation bar with links: Demo, Sessions, Rooms, Data, and Server Check. Below this, the session title is "[EN] Principal-Agent — one interaction: session 'tj643jd' (demo)". A row of icons for New, Links, Monitor, Data, Payments, Report, and Description is visible. The main area has input fields for "App Name" (principal_agent_game (10 rounds)) and "Round Number" (10), with a "Go" button. Below these, the title "Instructor report: principal-agent" is displayed, followed by a subtitle "Contracts, participation, effort, outcomes, and surplus distribution · Hidden action with performance contract". A progress bar shows four metrics: 8 Participants, 0/8 Completed decisions, 8 Pending, and 0 Completed pair-rounds. A yellow banner states "Aggregate results remain hidden until every pair completes the activity." At the bottom, there is a "Reveal results" button.

Figure 5.1: Instructor report before and after completion. Protected results during the session.

The first block reports acceptance, mean wages and bonuses, incentive-contract frequency, effort, success, profits, surplus, participation compatibility, and best-response consistency. Histograms display bonuses and effort. A round table shows evolution. A final block summarizes monitoring, penalties, and discretionary-bonus fulfillment.

The **acceptance rate** is not self-explanatory. High acceptance may reflect generous fixed pay, effective bonuses, or agents who accept contracts with low expected value. Compare acceptance with the share of offers satisfying the modeled participation constraint. A gap may reflect mistakes, social preferences, risk aversion, or imperfect calculation.

The **best-response indicator** uses risk neutrality and the treatment's monetary rules. It is not a grade. It provides a benchmark for discussion. **Total surplus** separates efficiency from distribution: two contracts can create similar surplus while dividing it differently.

For the instructor

Begin the debrief with facts: bonus distribution, acceptance, and effort distribution. Introduce the prediction only afterward. Starting with equilibrium often causes students to redescribe their choices as though they had followed the model from the outset.

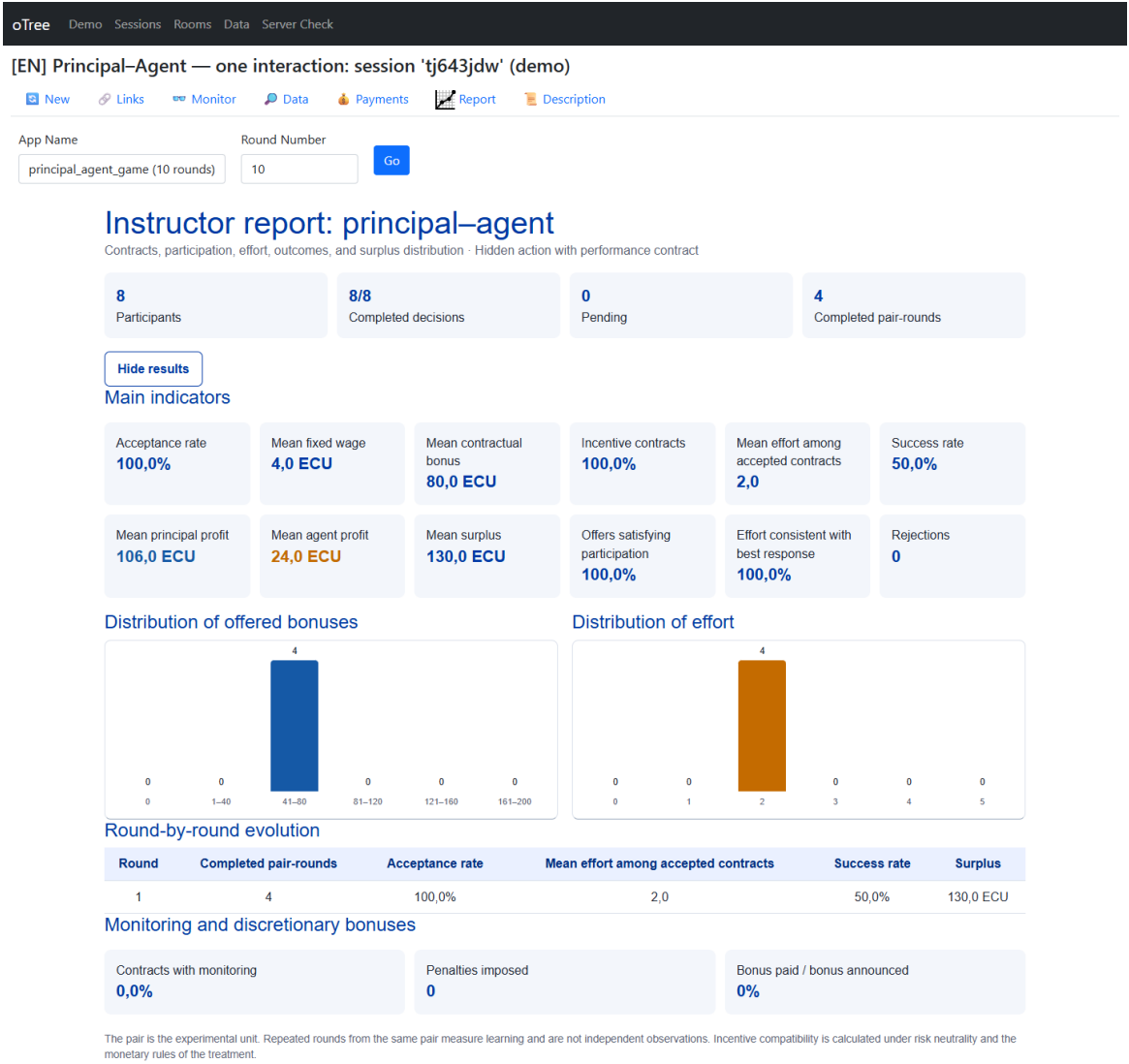


Figure 5.2: Aggregate outcomes after reveal.

Theoretical foundations

6.1 The principal–agent problem

An agency relationship arises when one party delegates an action that affects its welfare and cannot write a complete contract on that action. Employment, lending, insurance, regulation, health care, education, franchising, and corporate governance provide examples. The defining feature is the separation between the party receiving part of the outcome and the party controlling a consequential action.

A careful model distinguishes technology, information, preferences, and contracting restrictions. Technology maps effort into an outcome distribution. Information determines which variables can be verified. Preferences include effort cost, risk, and potentially social motives. Contracting restrictions specify permissible transfers, outside options, and whether promises are enforceable.

The laboratory technology is public and discrete. The outcome is observable and contractible; baseline effort is not. This simplicity allows students to calculate incentives without losing the economic mechanism.

6.2 Complete-information benchmark

If effort were observable and enforceable, the principal could request e and set a wage that leaves the agent exactly the outside option. For a risk-neutral agent, participation requires $w - c(e) \geq 20$. The principal chooses effort to maximize expected revenue minus effort cost and the outside option:

$$\max_e \{50 + 200p(e) - c(e) - 20\}.$$

The calibration reaches its maximum at effort 4 under the lower-effort tie rule. Expected revenue is 200, effort cost is 62, and the outside option is 20; a wage of 82 leaves the agent 20 and gives the principal expected profit 118. This is the first-best benchmark.

Effort 5 produces expected revenue 230 but costs 92. Its net technological surplus ties effort 4, so the maximum effort is not uniquely better. This observation prevents a common pedagogical mistake: treating the highest possible effort as intrinsically efficient.

6.3 Hidden action and incentive compatibility

When effort cannot be enforced, pay must depend on a verifiable signal. A success bonus raises the agent's private marginal benefit from effort. To implement effort 2, a contract must satisfy

$$w + p(2)b - c(2) \geq w + p(j)b - c(j), \quad j = 0, \dots, 5.$$

The fixed wage cancels from effort comparisons. Minimum bonus intensity is determined by cost differences divided by probability differences. Once the bonus is chosen, the fixed wage adjusts participation, subject to limited liability.

Hidden action can reduce surplus because the principal may have to leave rents, impose risk, or accept effort below the efficient benchmark. The loss does not require an assumption that agents are inherently lazy. It follows from noncontractibility and an imperfect signal.

6.4 Risk, insurance, and incentives

With a risk-neutral agent, a sufficiently strong bonus can transfer project variation. With risk aversion, contingent pay is costly: the agent values a lottery below its expected payment. The principal faces an insurance-incentive tradeoff. A fixed wage insures but weakens the effort-pay relationship; a strong bonus motivates but exposes the agent to noise.

The basic activity calculates linear expected payoffs and does not identify a coefficient of risk aversion. A low observed bonus may reflect risk concerns, fairness, confusion, trust, or beliefs about effort. The classroom evidence motivates the tradeoff but does not isolate one explanation.

6.5 The informativeness principle

The informativeness principle states that a feasible signal should enter a contract when it provides incremental information about the action. A noisy signal requires more intense rewards to create a given expected-pay difference. The less-informative treatment compresses success probabilities between 35% and 65%; project outcome responds less to effort, so bonuses lose power.

The principle does not imply that every available metric belongs in compensation. Manipulable, redundant, or noise-dominated measures can add risk without improving inference. This motivates multiple indicators, subjective evaluation, and limits on mechanical performance pay in real organizations.

6.6 Outside option and participation

The outside option represents what the agent receives without the contract: another job, leisure, self-employment, or an institutional alternative. A higher outside option raises the utility that the contract must provide. Under competition and complete information, it often raises compensation without changing efficient effort. Under payment restrictions, it can reduce contracting.

Participation is voluntary. A principal can design an offer that looks profitable but is rejected. Profit maximization without participation is therefore incomplete. Every debrief should ask two questions: what is the agent's best response, and does that response deliver at least the outside option?

6.7 Limited liability

Limited liability prevents sufficiently negative payments in bad states. It can represent law, limited wealth, bankruptcy protection, or ethical constraints. Without it, a risk-neutral principal could charge the agent after failure and pay more after success, shifting risk and extracting rents. The extended treatment permits a fixed payment down to -20 .

Removing the constraint expands the mathematical contract set but does not guarantee acceptance or institutional plausibility. A negative payment may appear unfair, increase rejection, or be impossible outside the laboratory. The extension separates formal optimality, feasibility, and legitimacy.

6.8 Monitoring and sanctions

Monitoring costs 15, produces an audit with probability 0.5, and imposes a 40 ECU penalty when effort is below the target. The expected sanction for noncompliance is therefore 20. Monitoring may raise effort even with a small bonus, but it consumes resources. The penalty is a transfer between roles in this calibration; monitoring cost reduces total surplus.

The principal should compare the behavioral response with the 15 ECU cost. Monitoring that does not change effort destroys surplus. A credible probabilistic audit does not make every action observable. The distinction connects the game to workplace supervision, tax enforcement, and regulation.

6.9 Discretionary contracts and reciprocity

In the discretionary-bonus treatment, the principal announces a maximum and chooses the actual payment after effort and outcome. Backward induction predicts that a purely self-interested principal pays zero in the last stage; an agent who anticipates this should not work for the promise. Experiments nevertheless find positive bonuses, reciprocal effort, and strong performance in settings that allow trust.

The treatment does not turn the announcement into commitment. That absence is the point. Compare announced and paid bonuses, effort, and profit. Their relationship is descriptive because types, expectations, and shared history can affect all of them.

6.10 Fairness and contract design

Fairness preferences can affect acceptance, effort, and discretionary transfers. An agent may reject a profitable but unequal offer; a principal may leave rent to elicit reciprocity; voluntary bonuses may support effort without legal enforcement. The evidence in [Fehr et al. \(2007\)](#) shows that the distribution of participant types affects which contract form performs best.

The standard model remains essential because it organizes constraints and provides a benchmark. Deviations do not automatically refute rationality. Instructors should first check comprehension, beliefs, and risk, and then assess whether reciprocity, inequity, or reputation explains systematic patterns.

6.11 Experimental evidence

[Keser and Willinger \(2000\)](#) study hidden action, binary output, and voluntary participation. Offers reflect distributive principles and cannot be reduced to mechanical rent extraction. In class, their findings motivate a comparison between the risk-neutral optimal contract and observed wage-bonus combinations.

[Anderhub et al. \(2002\)](#) use a simple contracting environment and show that efficiency and fair

play help explain offers and acceptance. [Gächter and Königstein \(2009\)](#) turn a related problem into a classroom experiment in which students design contracts. Asking students to produce an offer makes participation and incentive constraints concrete.

[Fehr et al. \(2007\)](#) compare contract forms and show that voluntary-bonus arrangements can outperform explicit incentives when reciprocal participants are present, while contract choice can sort relationships into suitable arrangements. The implication is conditional: no single contract dominates across information, commitment, and preference environments.

In organizations, [Prendergast \(1999\)](#) and [Gibbons \(1998\)](#) explain how measurement, multitasking, authority, and careers interact with incentives. [Lazear \(2000\)](#) documents a move from hourly pay to piece rates associated with productivity and worker-selection changes. These studies connect the classroom mechanism to firms without treating the game as a literal workplace replica.

Theoretical foundation

The classroom game produces local behavioral evidence under known rules. By itself it does not estimate the causal effect of employment contracts. Its central value is to make constraints, predictions, and mechanisms observable in a way that a verbal lecture cannot.

Implementing the basic game

7.1 Configurations

Each language offers one interaction, ten fixed-partner rounds, and ten reassigned-partner rounds. One interaction introduces the static model and limits direct reputation. Fixed pairs permit shared history, reciprocity, and relational contracting. Reassignment preserves role while reducing continuity with a particular counterpart.

Configuration	Rounds	Matching
<code>principal_agent_en_one_round</code>	1	One pair
<code>principal_agent_en_10_rounds_fixed_partner</code>	10	Fixed pair
<code>principal_agent_en_10_rounds_random_partners</code>	10	Reassignment within role
<code>principal_agente_es_1_ronda</code>	1	One pair
<code>principal_agente_es_10_rondas_pareja_fija</code>	10	Fixed pair
<code>principal_agente_es_10_rondas_parejas_aleatorias</code>	10	Reassignment within role

7.2 Before the session

Confirm that attendance is even. An odd session cannot form complete pairs. Do not improvise an observer inside the same session. Reserve a contingency account controlled by an assistant, or adjust attendance before creation. Decide whether ECU affect a grade or payment, state the rule before play, and do not revise it after seeing outcomes.

Write three questions on the board: what determines acceptance, what determines effort, and why outcome differs from effort. Do not post answers. For ten rounds, decide whether to pause after round five. Avoid language suggesting that high effort is morally correct; the purpose is to analyze choice under incentives.

7.3 During the session

Watch Monitor and respond to raised hands. If a pair is waiting, identify which role has not advanced without announcing the decision. After a disconnection, ask the participant to reopen the same tab; do not create a replacement code. If an agent asks what effort to choose, point to the table and remind the student that the choice is individual. If a principal asks for the best contract, restate the need to anticipate acceptance and effort.

Do not reveal partial aggregates. Fixed partners may remember earlier outcomes but may not communicate. Under reassignment, do not let students use codes to identify counterparts. Automatic matching changes counterpart within role and never changes principal into agent.

7.4 After the session

Verify that Report shows zero pending decisions. Reveal aggregate results, begin with distributions, and ask for interpretations. Export data before closing if a follow-up assignment is planned. Never connect codes to names. For fixed pairs, aggregate at the relationship level or use methods that account for dependence. In a small class, treatment comparisons should remain descriptive.

Extended treatments

The extended versions preserve roles, baseline technology, common screens, and the instructor report. Each section below describes only the treatment-specific change. Extended reference configurations reproduce the basic game for within-room comparisons.

8.1 Observable and enforceable effort

The principal chooses a wage and required effort. The agent accepts or rejects; acceptance implements the specified effort. There is no success bonus. The treatment approximates complete information and provides a first-best benchmark. For a risk-neutral agent, the reference prediction requests effort 4 and pays at least 82, leaving the 20 ECU outside option.

The main comparison concerns surplus and risk. Enforceable effort allows a fixed payment and insures the agent. Hidden action requires contingent pay to induce effort. When an observed offer leaves more or less than 20, ask whether calculation, fairness, or anticipated rejection accounts for the difference.

Use `principal_agent_extended_complete_information`. Ask which constraint disappears, why the wage still matters, whether maximum effort is efficient, and who bears outcome risk.

8.2 Flat wage without a bonus

The contract contains only a fixed wage. Because pay does not change with success, a self-interested risk-neutral agent chooses effort 0 after accepting. The wage can buy participation but not hidden effort. This is the cleanest treatment for showing weak incentives.

It does not establish that salaries always fail. Reputation, reciprocity, professional identity, or intrinsic motivation can sustain positive effort. A deviation from zero therefore opens a discussion of incomplete contracts rather than automatically signaling error.

Use `principal_agent_extended_flat_wage`. Compare high acceptance with low effort and ask whether generous fixed pay elicits reciprocal effort.

8.3 Less informative outcome

Success probabilities are 35, 41, 47, 53, 59, and 65%. Each effort step moves the signal less. The bonus required to induce effort therefore increases, exposing the agent to more risk and reducing the principal's expected profit.



Round 1 / 10 · Principal

Design the contract

The agent will see these terms before deciding whether to participate.

Observable and enforceable effort

Contracted effort is observable and enforceable; the contract uses a fixed payment.

Fixed wage (ECU)

Required effort

Payment after failure

0 ECU

Payment after success

0 ECU

Expected values by effort

Effort	Success probability	Effort cost	Agent's expected net payoff	Principal's expected profit
0	15%	0	0.0	80.0
1	30%	8	-8.0	110.0
2	45%	20	-20.0	140.0
3	60%	38	-38.0	170.0
4	75%	62	-62.0	200.0
5	90%	92	-92.0	230.0

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Figure 8.1: Observable and enforceable effort. Contract with required effort.



Round 1 / 10 • Agent

Decide whether to accept the contract

Compare the contract with your outside option. If you accept, you will then make the effort decision under this treatment's rules.

Observable and enforceable effort

Contracted effort is observable and enforceable; the contract uses a fixed payment.

Offered contract

Payment after failure
82 ECU

Payment after success
82 ECU

Outside option
20 ECU

Required effort: 4

Effort	Success probability	Effort cost	Agent's expected net payoff
4	75%	62	20,0

- ☐ Accept the contract
- ☐ Reject and take the outside option

Confirm decision

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Figure 8.2: The agent evaluates wage and required effort.



Round 1 / 10 · Principal

Design the contract

The agent will see these terms before deciding whether to participate.

Flat wage without bonus

There is no performance payment and effort remains hidden.

Fixed wage (ECU)

Payment after failure

0 ECU

Payment after success

0 ECU

Expected values by effort

Effort	Success probability	Effort cost	Agent's expected net payoff	Principal's expected profit
0	15%	0	0.0	80.0
1	30%	8	-8.0	110.0
2	45%	20	-20.0	140.0
3	60%	38	-38.0	170.0
4	75%	62	-62.0	200.0
5	90%	92	-92.0	230.0

Submit contract

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Figure 8.3: Flat wage under hidden action. The principal sets only a fixed wage.



Round 1 / 10 · Agent

Choose your effort

Effort is costly and changes the probability of success. The principal does not directly observe this decision unless the treatment rules state otherwise.

Flat wage without bonus

There is no performance payment and effort remains hidden.

Effort	Success probability	Effort cost	Agent's expected net payoff
0	15%	0	20,0
1	30%	8	12,0
2	45%	20	0,0
3	60%	38	-18,0
4	75%	62	-42,0
5	90%	92	-72,0

Effort level

Confirm effort

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Figure 8.4: Effort without contingent pay.

This treatment operationalizes informativeness. Compare bonuses, effort, and surplus with the reference. If bonuses do not rise, ask whether principals understood the technology. If bonuses rise without effort, discuss the cost of motivation and possible response errors.



Round 1 / 10 • Principal

Design the contract

The agent will see these terms before deciding whether to participate.

Less informative outcome Success responds less to effort, so the outcome is a weak signal.

Fixed wage (ECU)

Bonus if the project succeeds (ECU)

Payment after failure

0 ECU

Payment after success

0 ECU

Expected values by effort

Effort	Success probability	Effort cost	Agent's expected net payoff	Principal's expected profit
0	35%	0	0.0	120.0
1	41%	8	-8.0	132.0
2	47%	20	-20.0	144.0
3	53%	38	-38.0	156.0
4	59%	62	-62.0	168.0
5	65%	92	-92.0	180.0

Submit contract

Powered by [oTree](#)

Figure 8.5: A less informative performance signal. Calculator with compressed probabilities.

Use `principal_agent_extended_noisy_output`. Avoid describing the environment as pure luck: effort still matters, although less strongly.



Round 1 / 10 · Agent

Choose your effort

Effort is costly and changes the probability of success. The principal does not directly observe this decision unless the treatment rules state otherwise.

Less informative outcome

Success responds less to effort, so the outcome is a weak signal.

Effort	Success probability	Effort cost	Agent's expected net payoff
0	35%	0	49,0
1	41%	8	49,4
2	47%	20	45,8
3	53%	38	36,2
4	59%	62	20,6
5	65%	92	-1,0

Effort level

Confirm effort

 Powered by [oTree](#)

Figure 8.6: Agent choice under weaker informativeness.

8.4 High outside option

Rejection gives the agent 50 ECU rather than 20. Technology is unchanged. Participation becomes more demanding, so the principal must transfer more expected utility or accept more rejections. In an interior solution, the outside option directly raises required fixed pay more than target effort.

Compare fixed wages and acceptance. Increasing the bonus is not necessarily the cheapest way to satisfy participation because it changes effort incentives and risk. Holding bonus and effort constant requires a 30 ECU wage increase.





Round 1 / 10 · Principal

Design the contract

The agent will see these terms before deciding whether to participate.

High outside option
Rejection gives the agent 50 ECU and tightens the participation constraint.

Fixed wage (ECU)

Bonus if the project succeeds (ECU)

Payment after failure

0 ECU

Payment after success

0 ECU

Expected values by effort

Effort	Success probability	Effort cost	Agent's expected net payoff	Principal's expected profit
0	15%	0	0.0	80.0
1	30%	8	-8.0	110.0
2	45%	20	-20.0	140.0
3	60%	38	-38.0	170.0
4	75%	62	-62.0	200.0
5	90%	92	-92.0	230.0

Submit contract

Powered by [oTree](#)

Figure 8.7: A tighter participation constraint. Contract with a high outside option.

Use `principal_agent_extended_high_outside_option`. Connect the mechanism to bargaining




Round 1 / 10 · Agent

Decide whether to accept the contract

Compare the contract with your outside option. If you accept, you will then make the effort decision under this treatment's rules.

High outside option
Rejection gives the agent 50 ECU and tightens the participation constraint.

Offered contract

Payment after failure
34 ECU

Payment after success
114 ECU

Outside option
50 ECU

Effort	Success probability	Effort cost	Agent's expected net payoff
0	15%	0	46,0
1	30%	8	50,0
2	45%	20	50,0
3	60%	38	44,0
4	75%	62	32,0
5	90%	92	14,0

☐ Accept the contract

☐ Reject and take the outside option

Confirm decision

Figure 8.9: The agent compares the offer with 50 ECU. Continuation 2/2.

power and labor-market alternatives without claiming that the calibration represents a particular policy.

8.5 Costly monitoring

The principal can spend 15 ECU on monitoring and choose a target. If effort falls below the target, an audit occurs with probability 0.5 and transfers a 40 ECU penalty. The expected noncompliance sanction is 20. The calculator includes monitoring cost and expected penalty.

Monitoring can substitute for or complement bonuses. It is efficient only if the behavioral response justifies the resource cost. Compare monitoring, target compliance, audits, and surplus. An imposed penalty does not prove that monitoring was optimal; it may indicate a poorly chosen target.





Round 1 / 10 • Principal

Design the contract

The agent will see these terms before deciding whether to participate.

Costly monitoring The principal may pay 15 ECU for monitoring. An audit occurs with 50% probability and imposes a 40 ECU penalty if effort is below the target.

Fixed wage (ECU)

Bonus if the project succeeds (ECU)

Purchase monitoring for 15 ECU?

☐ Yes, monitor

☐ Do not monitor

Minimum effort target

Figure 8.10: Probabilistic, costly monitoring. Monitoring and target choice. Continuation 1/2.

Use `principal_agent_extended_monitoring`. Ask about credibility, undetected shirking, and the distinction between supervision cost and a transferred fine.

8.6 Unlimited liability

The fixed payment may be negative down to -20 . Failure can require the agent to transfer ECU to the principal. This expands the feasible contract set and permits more intense incentives with rent extraction.

Formal predictions should be separated from acceptance and legitimacy. Students may reject a contract with adequate expected value when losses are concentrated in failure. Risk aversion, loss aversion, or fairness may explain the response; the game alone does not identify which motive dominates.



Figure 8.11: Probabilistic, costly monitoring. Monitoring and target choice. Continuation 2/2.

Use `principal_agent_extended_unlimited_liability`. Discuss labor law, bankruptcy, and wealth constraints as reasons liability matters.

8.7 Discretionary bonus

The principal announces a maximum bonus that is not enforceable. The guaranteed payment is the fixed wage; the promise does not enter the agent's standard expected payoff. After effort and outcome, the principal selects an actual bonus between zero and the announced maximum.

The interface distinguishes announcement from automatic success pay. Report compares promised and paid bonuses. Backward induction predicts zero final payment and no effort in response to the promise. Positive payments and effort may reflect reciprocity, fixed-pair reputation, or preferences for promise keeping.

Use `principal_agent_extended_discretionary_bonus`. Ask what makes a promise credible, how fixed and reassigned matching differ, and whether payment responds to effort, outcome, or perceived intention.

8.8 Repeated rounds and matching

One interaction isolates the static problem and limits direct reputation. Ten rounds allow learning and adaptation. With a fixed partner, current actions can change future expectations, creating a relational contract. Reassignment preserves the participant's own history but weakens bilateral reward and punishment.

Do not describe reassignment as perfect anonymity. Participants observe their own history and



Round 1 / 10 · Your role: Agent

Round result

Costly monitoring

Contract accepted

The project did not succeed

Effort supplied

2

Success probability

45%

Project revenue

50 ECUTotal payment to
agent**20 ECU**

Principal profit

15,0 ECU

Agent profit

0,0 ECU

Total surplus

15,0 ECU

Monitoring was purchased, but no audit occurred

Profit **0,0 ECU** Balance credited this round: 200,0 ECU**Next round**Powered by [oTree](#)

Figure 8.12: Outcome, audit, and possible penalty.



Round 1 / 10 · Principal

Design the contract

The agent will see these terms before deciding whether to participate.

Unlimited liability

The failure-state payment can be negative: the agent may pay the principal.

Fixed wage (ECU)

Bonus if the project succeeds (ECU)

Payment after failure

0 ECU

Payment after success

0 ECU

Expected values by effort

Effort	Success probability	Effort cost	Agent's expected net payoff	Principal's expected profit
0	15%	0	0.0	80.0
1	30%	8	-8.0	110.0
2	45%	20	-20.0	140.0
3	60%	38	-38.0	170.0
4	75%	62	-62.0	200.0
5	90%	92	-92.0	230.0

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Figure 8.13: Unlimited liability. Contract with a possible negative payment.




Round 1 / 10 · Agent

Decide whether to accept the contract

Compare the contract with your outside option. If you accept, you will then make the effort decision under this treatment's rules.

Unlimited liability The failure-state payment can be negative: the agent may pay the principal.

Offered contract

Payment after failure
-5 ECU

Payment after success
95 ECU

Outside option
20 ECU

Effort	Success probability	Effort cost	Agent's expected net payoff
0	15%	0	10,0
1	30%	8	17,0
2	45%	20	20,0
3	60%	38	17,0
4	75%	62	8,0
5	90%	92	-7,0

☐ Accept the contract

☐ Reject and take the outside option

Confirm decision

Figure 8.15: The agent sees failure-state exposure. Continuation 2/2.



Round 1 / 10 · Principal

Design the contract

The agent will see these terms before deciding whether to participate.

Discretionary bonus

The promised bonus is not enforceable; the principal later chooses how much to pay.

Fixed wage (ECU)

Announced maximum bonus (ECU)

Fixed wage (ECU)

0 ECU

Announced maximum bonus (ECU)

0 ECU

Expected values by effort

Effort	Success probability	Effort cost	Agent's expected net payoff	Principal's expected profit
0	15%	0	0.0	80.0
1	30%	8	-8.0	110.0
2	45%	20	-20.0	140.0
3	60%	38	-38.0	170.0
4	75%	62	-62.0	200.0
5	90%	92	-92.0	230.0

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Figure 8.16: Discretionary bonus. Nonbinding bonus announcement.



Round 1 / 10 · Principal

Choose the discretionary bonus

Effort and the outcome have been realized. The announced bonus is not enforceable: you may pay any amount from zero to the promised maximum.

Effort supplied	Effort cost	Project revenue	Announced maximum bonus (ECU)
2	20 ECU	250 ECU	40 ECU

Bonus to pay (ECU)

Pay bonus and continue

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Figure 8.17: Payment choice after outcome.

learn from outcomes. Do not attribute every difference to reputation if treatments were run with different classes. A causal comparison requires suitable assignment and sample size.

During the debrief, plot mean bonus and effort by round. Look for convergence, cycles, breakdown after failure, and persistent wages. In fixed pairs, a bonus cut after failure may punish bad luck. Ask whether such learning is rational when effort remains hidden.

Corporate investment and managerial incentives

9.1 An extension of the same family

The extended edition now supports whether to invest, which project to finance and who holds the right to choose. It retains the principal–agent contracting problem: one person offers compensation and another may reject before working. The extension adds capital allocation and corporate governance within the existing four rooms. The earlier contractual configurations remain available under their original rules. This chapter applies exclusively to the nine corporate conditions, identified by descriptive names in the extended menu.

Use the extension when students already distinguish a fixed salary from a success bonus. The additional question is why a firm might undertake an investment that does not maximize its owner’s profit, or forgo an apparently profitable opportunity. The manager controls a costly action and, depending on the condition, project selection. Choices respond to compensation, effort costs and available private benefits. The owner must consider those responses when offering a contract; calculating a project’s maximum possible revenue is insufficient.

This is a teaching adaptation of agency and control problems, not a literal replication of a published experiment. [Jensen and Meckling \(1976\)](#) connects ownership, incentives and agency costs; the hidden-action model in [Holmström \(1979\)](#) supports the effort analysis. The project table, numerical calibration, compensation horizon and veto sequence are design choices of this implementation. Classroom results must not be presented as estimates for a population of firms.

For the instructor

For a finance class, choose a corporate condition in the existing extended room. Begin by comparing delegated investment with owner control, or equity participation with short-horizon compensation. Change one institution per comparison. Keep these accounts separate from the basic contracting game: here each starting account is 240 ECU and the mean account across active rounds is credited once.

9.2 Projects, financing and sequence

Both roles start each round with an account of 240 ECU. The owner uses this account to finance salary, investment and supervision. The manager retains a protective account against effort costs. Accounts reset, earn no interest and do not accumulate to finance later projects. The manager’s outside option provides profit of 20 ECU in addition to the starting account. Following rejection,

owner profit is zero; no salary, capital or supervision cost is paid.

Project	Capital	Success	No success	Early revenue
No investment	0	0	0	0%
Stable	80	220	140	100%
Growth	120	400	40	25%
Expansion	160	300	60	75%

The two middle revenue columns contain total realized revenue, not profit after costs. The final column specifies the proportion received early; the remainder arrives late. Both are settled automatically within the same round. There is no intermediate trading decision, stock quotation, debt or hidden second round. A manager's share is a contractual revenue right, not a tradable security or a promised investment return.

The owner offers salary from 0 to 120 and bonus from 0 to 200 ECU. Where permitted, the owner also sets a share from 0 to 50%, monitoring and an effort target, or enforceable effort. The manager knows the contract and project opportunities before acceptance. Investment is selected next under the assigned control rights. Only then is effort from 0 to 5 chosen, unless it is enforceable or no investment occurs. Success probabilities are 15, 30, 45, 60, 75 and 90%, with respective costs of 0, 8, 20, 38, 62 and 92 ECU.

A project is affordable when salary plus capital plus supervision costs does not exceed 240. Additionally, its success bonus plus the revenue share in the successful state cannot exceed successful revenue. A valid contract must leave at least one project available. Unaffordable projects are identified in the table and excluded from valid choices. The server validates the submitted choice again; inclusion in an informational table does not authorize an unaffordable investment. No investment always remains available under a valid contract.

Salary is paid following acceptance even if no investment is subsequently selected. That outcome entails no effort cost, bonus or share payment. Contracted monitoring costs 15 ECU after acceptance, even without investment; the board costs 5 under the same rule. No investment does not recover those commitments. This distinguishes contract rejection from a later decision to retain capital. The distinction is central: the manager can accept salary and prefer not to develop any project.

9.3 Accounts and a verifiable example

Let K_j denote project capital, R_j realized revenue, w salary, b the bonus and α the share. Let Q_j be the compensation base: total revenue with full-horizon participation, or early revenue only with short-horizon compensation. With supervision cost M , penalty transfer F and external private benefit B_j , profits are

$$\begin{aligned}\pi_O &= R_j - K_j - w - b\mathbf{1}_{\{\text{success}\}} - \alpha Q_j - M + F, \\ \pi_M &= w + b\mathbf{1}_{\{\text{success}\}} + \alpha Q_j - c(e) - F + B_j.\end{aligned}$$

Salary, bonus, share and fine disappear from the sum because they are internal transfers. Surplus excluding external benefits is $R_j - K_j - c(e) - M$. Summed profits additionally include B_j . The report retains both measures so that an externally financed benefit does not appear to be company productivity. Each final account equals 240 plus profit, with no silent truncation of losses. Financing restrictions and cost bounds keep accounts nonnegative.



Round 1 / 1 • Owner

Design the contract

The manager sees these terms before deciding whether to participate.

Equity participation

The share is also paid when the project does not succeed; it depends on realized revenue. It is not a tradable security.

The owner has 240 ECU for salary, capital and supervision costs. Only affordable projects may be selected. The bonus plus the revenue share in the successful state cannot exceed that state's revenue. A contract must leave at least one project affordable.

Fixed wage (ECU)

20

Bonus if the project succeeds (ECU)

80

Manager share of project revenue (%)

20

Investment options

Project	Initial capital	Revenue on success	Revenue without success	Early revenue
No investment	0	0	0	0%
Stable	80	220	140	100%
Growth	120	400	40	25%
Expansion	160	300	60	75%

[Continue](#)

Figure 9.1: Corporate contract: salary, bonus and share within the financing limit.



Round 1 / 1 • Owner

Comprehension questions

Answer correctly to continue. You may try again.

Resources and unit of account

ECU stands for Experimental Currency Units. It is the unit of account for this activity.

This session does not convert ECU into real money.

Short-horizon compensation Here, the share is calculated only on early revenue. The owner also collects all late revenue; the success bonus remains enforceable.

Who selects or proposes investment after acceptance?

- ☐ The owner
- ☒ The manager

How many ECU initially finance salary, capital and supervision?

Your answer: 200. The correct answer is 240. Review the budget, salary with no investment and who controls the project.

If accepted with no investment and salary 20, how much does the manager receive?

[Continue](#)

Figure 9.2: Comprehension: explanation of an incorrect budget with retained answers.

Consider growth with salary 20, bonus 50, share 20% and effort 3. Effort costs 38 and success probability is 60%. On success, total revenue is 400, comprising 100 early and 300 late. With participation in total revenue, the manager receives $20 + 50 + 80 = 150$, earns profit 112 and finishes with 352. The owner earns $400 - 120 - 150 = 130$ and finishes with 370. Joint surplus is 242, equal to $400 - 120 - 38$. The two accounts are not that surplus because they also contain starting balances.

Without success, growth pays total revenue 40: 10 early and 30 late. The bonus is zero and the share payment is 8. The manager receives 28, deducts effort cost 38 and earns profit -10 , finishing with 230. Owner profit is $40 - 120 - 28 = -108$, with an account of 132. A loss is possible and visible; it does not mean capital was charged twice. Total revenue was 40, not 40 plus the early and late receipts.

Under short-horizon compensation, success pays a share of 20 on early revenue rather than 80 on total revenue. Manager profit is 52 and owner profit 190. Without success, the share is 2; respective profits are -16 and -102 . This compensation rule does not change total production, but changes its division and the manager's incentive to select growth or supply effort. The success bonus remains enforceable: short horizon changes the share base, not every contract term.

Checkpoint

Have students reconstruct one state-contingent account before comparing averages. Check capital once, early plus late receipts equal total revenue, bonus only on success, participation on the correct base and effort charged to the manager. Where a private benefit appears, identify the external account financing it.

9.4 Nine conditions and their comparisons

9.4.1 Delegated investment

The manager chooses project and effort; the contract contains salary and a bonus without a revenue share. This is the corporate reference. For given effort, the bonus depends on success rather than revenue size; projects share the same success-probability schedule. A manager maximizing compensation alone may therefore be indifferent between projects with different productivity, or prefer no investment with salary and no bonus. This indifference is a feature that should be made explicit when interpreting decisions. One observation cannot establish a universal project preference.

9.4.2 Equity participation

The owner adds a fraction of total project revenue. The manager now also receives a contingent amount without success. This compensation may change project selection, effort and exposure to risk simultaneously. Compare it with delegation while keeping the same project opportunities, and explain which contractual component changed. A larger share does not guarantee efficiency: it reduces the owner's residual income and may change offered salary or bonus. Participation remains a voluntary decision by the manager.

9.4.3 Owner control

The owner chooses the project directly following acceptance; the manager retains hidden effort. The change concerns a decision right, not observable effort. The owner must anticipate how the

manager will work under the offered contract. An investment with high revenue at maximum effort may perform poorly when its contract induces low effort. Compare projects, acceptance and effort jointly rather than attributing every improvement to the role change. The investment screen identifies the decision maker and current restrictions.

9.4.4 Board veto

The manager proposes a project and the owner can approve it or replace it with no investment. The board costs 5 ECU after acceptance. It cannot redesign the project or renegotiate salary. Veto prevents an investment but leaves salary and board cost payable. The manager knows this possibility before proposing. This sequence distinguishes delegation, direct control and final authorization. A high veto rate does not itself establish good governance; compare intervention costs, avoided projects and the profit that the alternative would have generated.

9.4.5 Managerial monitoring

The owner may pay 15 and specify a target. Conditional on investment, an audit occurs with probability 50%; detected effort below target transfers 40 ECU from manager to owner. An audit without noncompliance produces no fine. The penalty is a transfer, while monitoring cost consumes resources. No investment prevents an audit but does not refund contracted monitoring. Comparison with delegation supports discussion of substitution between incentives and supervision without assuming perfect effort observation.

9.4.6 Enforceable managerial effort

The contract fixes the effort implemented by the system if investment occurs. The manager accepts knowing the effort cost, but retains project choice. This separates control of capital from control of effort. There is no second voluntary effort choice, so do not describe implemented effort as a fresh managerial decision. The participation constraint may require a higher salary. A rejected investment opportunity and an implemented project with mandatory effort are different observations.

9.4.7 Short-horizon compensation

The share applies only to early revenue. The remainder reaches the firm within the same round and does not increase the share payment. Compare against total-revenue participation, which permits the same offered percentage. Growth pays only 25% early, stable pays everything early, and expansion pays 75%. The condition represents a compensation horizon; it does not introduce time discounting or measure individual patience. Do not confuse a project's late receipts with accumulated wealth between rounds.

9.4.8 Private benefits

Expansion gives the manager an additional 40 ECU whatever its outcome. This is explicit external funding, not a deduction from company revenue, an audit-dependent reward or private information about project quality. The owner knows the rule. It supports discussion of how a benefit unavailable to the owner can change capital allocation. Do not call a permitted choice theft, or count this benefit as productive revenue when comparing financial efficiency.

9.4.9 Equity and private benefits

This combines the external benefit with participation in total revenue. Comparison with private benefits asks whether sharing revenue changes selection; comparison with equity participation isolates the external benefit. It introduces neither another family nor a stock-market negotiation game. The focus is the interaction between company-based monetary incentives and a personal benefit outside the company. Avoid comparing total welfare alone: the owner may lose even when external funding raises summed payments.



Round 1 / 1 • Manager

Select investment

Review capital, revenue and financing restrictions. Salary is already agreed. No investment retains capital, pays salary and pays neither bonus nor revenue share.

Short-horizon compensation Here, the share is calculated only on early revenue. The owner also collects all late revenue; the success bonus remains enforceable.

Offered contract

Fixed wage (ECU)

20 ECU

Bonus if the project succeeds (ECU)

80 ECU

Manager share of project revenue (%)

20%

Investment options

Project	Initial capital	Revenue on success	Revenue without success	Early revenue	Affordable
No investment	0	0	0	0%	Affordable
Stable	80	220	140	100%	Affordable
Growth	120	400	40	25%	Affordable
Expansion	160	300	60	75%	Affordable

Project to finance

- ☐ No investment
- ☐ Stable
- ☐ Growth
- ☐ Expansion

Continue

Figure 9.3: The manager selects among affordable projects and no investment.



Round 1 / 1 • Owner

Board decision

You may approve the manager's proposal or replace it with no investment. Salary and board cost are paid either way.

Board veto

The manager proposes a project and the owner, acting as a board, may approve it or replace it with no investment. The board costs 5 ECU after acceptance, even when it vetoes.

Offered contract

Fixed wage (ECU)

20 ECU

Bonus if the project succeeds (ECU)

80 ECU

Manager share of project revenue (%)

0%

Proposed project: Expansion

Investment options

Project	Initial capital	Revenue on success	Revenue without success	Early revenue	Affordable
No investment	0	0	0	0%	Affordable
Stable	80	220	140	100%	Affordable
Growth	120	400	40	25%	Affordable
Expansion	160	300	60	75%	Affordable

Decision on proposal

- ☐ Approve proposal
☐ Veto: no investment

Continue

Figure 9.4: The board may approve or veto a known proposal.



Round 1 / 1 • Owner

Select investment

Review capital, revenue and financing restrictions. Salary is already agreed. No investment retains capital, pays salary and pays neither bonus nor revenue share.

Owner control

After acceptance, the owner chooses the project directly. The manager then chooses effort.

Offered contract

Fixed wage (ECU)
20 ECU

Bonus if the project succeeds (ECU)
80 ECU

Manager share of project revenue (%)
0%

Investment options

Project	Initial capital	Revenue on success	Revenue without success	Early revenue	Affordable
No investment	0	0	0	0%	Affordable
Stable	80	220	140	100%	Affordable
Growth	120	400	40	25%	Affordable
Expansion	160	300	60	75%	Affordable

Project to finance

- ☐ No investment
☐ Stable
☐ Growth
☐ Expansion

Continue

Figure 9.5: The owner exercises the right to choose capital.



Round 1 / 1 • Owner

Design the contract

The manager sees these terms before deciding whether to participate.

Managerial monitoring

The owner may pay 15 ECU after acceptance. If investment occurs, there is a 50% audit probability; detected effort below the target transfers 40 ECU from manager to owner. No investment means no audit.

The owner has 240 ECU for salary, capital and supervision costs. Only affordable projects may be selected. The bonus plus the revenue share in the successful state cannot exceed that state's revenue. A contract must leave at least one project affordable.

Fixed wage (ECU)

Bonus if the project succeeds (ECU)

Purchase monitoring for 15 ECU?

- ☐ Yes, monitor
- ☐ Do not monitor

Minimum effort target

Investment options

Project	Initial capital	Revenue on success	Revenue without success	Early revenue
No investment	0	0	0	0%
Stable	80	220	140	100%
Growth	120	400	40	25%
Expansion	160	300	60	75%

[Continue](#)

Figure 9.6: Supervision: cost, monitoring and target before acceptance.



Round 1 / 1 • Owner

Design the contract

The manager sees these terms before deciding whether to participate.

Enforceable managerial effort

The owner sets contract effort: if investment occurs, the system implements that effort and charges its cost to the manager.

The owner has 240 ECU for salary, capital and supervision costs. Only affordable projects may be selected. The bonus plus the revenue share in the successful state cannot exceed that state's revenue. A contract must leave at least one project affordable.

Fixed wage (ECU)

Bonus if the project succeeds (ECU)

Required effort

Investment options

Project	Initial capital	Revenue on success	Revenue without success	Early revenue
No investment	0	0	0	0%
Stable	80	220	140	100%
Growth	120	400	40	25%
Expansion	160	300	60	75%

[Continue](#)

Figure 9.7: Enforceable effort is specified in the contract.

9.5 Predictions, evidence and limits

For each contract, enumerate effort levels for each project and calculate the manager's expected payoff. Use agreed effort directly in the enforceable condition. Under owner control, choose the project maximizing expected owner profit while anticipating managerial effort. With delegation, the manager chooses its preferred project. With a board, remove proposals the owner would veto relative to no investment and allow the manager to anticipate that rule. Finally compare expected manager payoff with the outside option. This order avoids evaluating participation using a project that had not yet been chosen.

The report calculates this reference under risk neutrality, knowledge of the rules and monetary maximization. Ties are resolved by lower effort and the order no investment, stable, growth and expansion. This is a reproducible computational convention, not a claim that everyone universally prefers that order. Recognize the set of best responses when indifference exists. Choosing another tied project does not establish irrationality. Decision comparisons should also show the expected values generating a tie.

Experimental research indicates that authority, trust and restrictions may affect behavior beyond monetary calculation. [Falk and Kosfeld \(2006\)](#) study behavioral costs of control in another environment; [Fehr et al. \(2013\)](#) examine motivation and the value of authority in a different structure. These studies support discussion questions, not transferable coefficients for this activity. Their findings do not imply that veto always reduces effort or sharing revenue always eliminates conflict. Identification requires comparing institutions, opportunities and participant composition.

Theoretical foundation

Separate three criteria: expected project revenue less capital and effort; owner profit after transfers; and joint payoff including external benefits. They can rank projects differently. Financial efficiency, contractual compliance and voluntary acceptance are also distinct. The activity exposes those differences rather than replacing them with a single performance label.

9.6 Report, data and classroom use

The corporate report has controls to reveal and hide aggregates, including partial data. Its link is private to the instructor. Viewing an individual outcome does not grant a participant report access. Acceptance uses submitted responses as its denominator; investment uses completed accepted contracts. Mean capital and effort use implemented investments. Mean offered participation uses submitted contracts. The project distribution includes no investment among accepted contracts; rejection and pending responses do not become that project. Veto counts are shown over proposals with completed board review.

Download custom and native exports from the session using its session code in the route. The custom export retains all supplied rounds and participants, including pending and inactive rows, and flags their states. Missing decisions remain blank instead of becoming zero effort. It contains proposal, implemented project, board review, offered and paid share, capital, timed revenue, audit, fine, private benefit, surplus and accounts. Native data are wide: one row per participant with rounds in columns. Keep pseudonymous identifiers out of classroom slides.

The nine new conditions initially offer one interaction per language. The architecture accepts multiple active rounds up to ten without changing formulas. A repeated corporate session pays only the mean account across its active rounds on the final round; earlier rounds credit zero to avoid duplicate payment. This differs from the historical contracting regime and must be explained

before play. Historical basic one-round, fixed-partner and reassigned-partner modes retain their original names, rules and payments.

A 75-minute lesson can allocate ten minutes to instructions and comprehension, ten to decisions, fifteen to account reconstruction, twenty to institutional comparison and twenty to discussion and an exercise. Record a written prediction before revealing results. First ask students to explain a choice without judging its decision maker; then compare the contract, control rights and random outcome. Close by asking what would change if the private benefit were deducted from company cash: that would be a different mechanism, not an alternative interpretation of current data.

Feedback script

“What could each person decide when accepting the contract? Which costs were already committed when no investment was selected? Reconstruct a project with and without success. Then compare the manager’s payoff with the owner’s residual revenue. What changes when participation covers early revenue only? Before discussing good or bad management, distinguish the contract, control rights and chance.”



Round 1 / 1 • Manager

Round result

Short-horizon compensation Here, the share is calculated only on early revenue. The owner also collects all late revenue; the success bonus remains enforceable.

Contract accepted

The project succeeded

Implemented project: Growth

Effort supplied: 3 • Monitoring was not purchased

Initial capital 120.00 ECU	Early revenue 100.00 ECU	Late revenue 300.00 ECU	Fixed wage (ECU) 20.00 ECU	Bonus to pay (ECU) 80.00 ECU
Revenue share paid 20.00 ECU	Monitoring and board 0.00 ECU	Penalties imposed 0.00 ECU	External private benefit 0.00 ECU	Principal profit 160.00 ECU
Agent profit 82.00 ECU	Surplus excluding external benefit 242.00 ECU			

Profit **82.00 ECU** This round account: included in mean: 322.00 ECU

Continue

Figure 9.8: Corporate account: timed receipts, capital and transfers shown separately.

Corporate investment

Short-horizon compensation · Completed pairs: 1 / 1

Means and rates use observed decisions only. Rejections count as completed contracts, but do not count as investment. Pending does not mean zero. Private benefits have external funding and are reported separately.

Hide results

[Download data by round](#) · [Download native participant data](#)

Contracts submitted 1	Responses received 1	Completed pairs 1 / 1
Acceptance rate 100.00%	Investments undertaken 1	Investment / accepted contracts 100.00%
Mean capital / investments 120.00	Offered share / submitted contracts 20.00	Mean effort / investments 3.00
Mean owner profit / completed pairs 160.00	Mean manager profit / completed pairs 82.00	External private benefit 0.00
Surplus excluding external benefit 242.00	Vetoes / completed proposals 0 / 0	Offers satisfying participation 100.00%

Investment options (1)

No investment: 0

Stable: 0

Growth: 1

Expansion: 0

Monetary contract prediction

Backward-induction prediction under risk neutrality and known rules, with ties resolved by lower effort and project order. Participation is evaluated before project choice under that prediction. This is a theoretical reference, not an assessment of people.

Figure 9.9: Corporate aggregates with observed denominators and project distribution.



Activity completed

The session is complete. Your ECU payment is the mean account across active rounds, credited once.

Your role Owner	Rounds completed 1	Contracts accepted 1	Mean effort 3	Mean profit per round 160,0 ECU
Final mean credited 400.00 ECU				

Figure 9.10: Explicit completion after the individual outcome.

Attention

The extension is prepared for the existing principal-agent rooms. Corporate screenshots show the validated local implementation; a route printed here does not confirm that the update is published on the public server. Do not reset a database containing sessions to update the schema: preserve its data and coordinate deployment of the added fields.

Debrief scripts

10.1 A fifteen-minute sequence

1. Display the bonus distribution and ask for description before explanation.
2. Reveal acceptance and ask which offers were attractive.
3. Display effort. Ask whether it moves with bonus and whether fixed wage appears related to effort.
4. Compare success with effort to reinforce the role of noise.
5. Calculate one best response and participation condition on the board.
6. Compare principal profit, agent profit, and total surplus.
7. Close with one application: employment, insurance, regulation, or credit.

Feedback script

“The median bonus was X and the modal effort was Y . What have we observed, and what are we inferring? Which effort maximizes expected payoff under the mean contract? Does it provide at least 20? Who bore project risk? Does failure identify low effort? What would change if effort were verifiable?”

10.2 Questions for deeper discussion

Why can a high fixed wage raise acceptance without increasing effort? Can a bonus be too costly for the principal? How do expected and realized profit differ? Why is maximum effort not automatically efficient? How would risk aversion change pay? Which additional signal would help? When is monitoring worthwhile? Why might a nonbinding promise work? Which institutions limit negative payments?

10.3 Common interpretation errors

Do not equate success with effort. Do not call every contract that differs from the risk-neutral benchmark irrational. Do not add the starting balance to economic surplus. Do not treat a pair's repeated rounds as independent observations. Do not compare treatments run in different courses

as though students were randomly assigned. Never reveal an individual's decision to illustrate a theoretical point.

10.4 Class plans

10.5 A 50-minute session

Allocate 5 minutes to rules and purpose, 8 to instructions, 5 to comprehension, 10 to one interaction, 17 to Report, and 5 to closure. Use the one-round basic configuration. The objective is to separate participation and incentives rather than derive every optimal contract.

10.6 A 75-minute session

Run one basic round and one treatment, preferably complete information or flat wage. Reserve 10 minutes for payoff calculations, 15 for each game, and 25 for comparison. Ask for a written prediction before each treatment. The contrast reveals what changes when effort becomes enforceable or contingent pay disappears.

10.7 A 100-minute session

Use ten fixed-pair or reassigned rounds. After round five, pause without revealing aggregates and request predictions about convergence. At the end, analyze evolution, distributions, and relationships. With discretionary bonuses, connect backward induction, reciprocity, and relational contracts.

10.8 Post-session assignment

Provide an anonymous file with pair, round, offer, acceptance, effort, outcome, and profits. Ask students to calculate best response, participation, the observed-predicted effort gap, and round evolution. Require a distinction between observation and experimental unit. The fixed pair is the natural cluster.

Solved exercises for instructors

11.1 Exercise 1: State-contingent payoffs

A contract offers $w = 10$ and $b = 60$. At effort 3, cost is 38. Failure gives agent profit -28 and principal profit 40. Success gives agent profit 32 and principal profit 180. Surplus is 12 or 212. The transfer divides value; effort and project revenue determine total surplus.

11.2 Exercise 2: Best response

For $w = 4$ and $b = 80$, calculate $w + p(e)b - c(e)$. The values are 16, 20, 20, 14, 2, and -16 . Efforts 1 and 2 tie; the implementation chooses the higher effort. The example is useful for discussing tie rules and prediction sensitivity.

11.3 Exercise 3: Participation

With outside option 20, the preceding contract satisfies participation exactly. When the outside option rises to 50, it falls short by 30. Increasing w from 4 to 34 preserves effort incentives and provides 50. Raising the bonus may change the best response and is not a purely distributive adjustment.

11.4 Exercise 4: First best

With enforceable effort, expected revenue minus effort cost equals 80, 102, 120, 132, 138, and 138. Efforts 4 and 5 tie; using the lower-effort rule selects 4 and avoids unnecessary action. After providing the 20 outside option, expected principal profit is 118.

11.5 Exercise 5: A noisy signal

In the reference, moving from effort 1 to 2 raises success by 0.15 and cost by 12, so a bonus of 80 exactly compensates. Under the noisy schedule, probability rises by 0.06, requiring a bonus of 200. Lower informativeness makes incentives expensive.

11.6 Exercise 6: Monitoring

With target 2, effort 1 faces an expected penalty of $0.5 \times 40 = 20$. Monitoring costs the principal 15. If it moves effort from 1 to 2, expected revenue rises by 30. A welfare calculation must also include effort cost and treat the fine as a transfer.

11.7 Exercise 7: Unlimited liability

Consider $w = -5$ and $b = 100$. Failure pay is -5 and success pay 95. A risk-neutral agent may accept if the best expected payoff reaches 20, while a risk-averse agent may demand a larger expected value because losses are concentrated in failure.

11.8 Exercise 8: Discretionary bonus

At the last stage, a self-interested principal pays zero because effort and outcome are sunk. Anticipating this, the agent ignores the announced bonus. Positive observed payments can reflect reciprocity, fairness, reputation, or promise-keeping utility. The label “trust” is not an explanation unless patterns support it.

11.9 Exercise 9: Efficiency and distribution

Two contracts induce the same effort. One leaves expected agent utility 20 and another 35. If behavior and risk are unchanged, expected surplus is equal and only distribution changes. If the second contract changes acceptance or reciprocity, behavior and efficiency may also change.

11.10 Exercise 10: Inference

Twenty fixed pairs play ten rounds, creating 200 pair-round records but only 20 independent relationships. Treating 200 as an independent sample understates uncertainty. Use pair-level summaries or clustered methods when inference is appropriate.

11.11 Exercise 11: The mean contract

Report displays mean wage 18 and mean bonus 65. Nobody may have offered that exact contract, and its best response is not the average of contract-specific best responses. Evaluate incentive compatibility offer by offer and then aggregate the indicator.

11.12 Exercise 12: Selection through acceptance

If only generous contracts are accepted, mean effort among accepted offers says nothing directly about rejected offers. Participation selects the observed effort sample. Compare all offers, accepted offers, and effort conditional on acceptance. Do not code rejection as effort zero unless the research question explicitly calls for it.

Data, ethics, and troubleshooting

12.1 Export and variables

The custom export contains anonymous participant code, round, language, edition, treatment, matching, pair, role, wage, bonus, requested effort, monitoring, target, acceptance, effort, probability, success, revenue, actual bonus, transfer, audit, penalty, economic profit, and credited balance. Keep a data dictionary and never append personal identifiers.

Filter to complete decisions before analysis. A pair is the unit in one round. Fixed-pair rounds remain dependent. Reassignment does not eliminate participant-level dependence. Report treatment-specific sample sizes and do not treat language as an economic treatment unless that comparison was designed deliberately.

12.2 Privacy and research use

Use oTree codes rather than names. Do not publish Monitor or Data screenshots containing codes. Project aggregate results only. If the activity becomes research rather than teaching, follow the relevant consent and ethics-review procedures. Classroom administration alone does not authorize research use.

12.3 Frequent problems

Symptom	Likely cause	Action
“Please wait”	Counterpart is still deciding	Check Monitor and wait; avoid repeated refresh.
Room has no configuration	No active session	Activate the configuration in Rooms.
Other games appear	Wrong family or process	Stop and inspect <code>GAME_FAMILY</code> .
User does not exist	Database reset or obsolete link	Create a new session and use the stable room route.
Report remains hidden	Decisions are pending	Complete or close participants under the lab protocol.
Odd attendance	A counterpart is missing	Adjust before creation; do not force an incomplete group.

Symptom	Likely cause	Action
Wrong language	Wrong room or configuration	Check the EN/ES room and re-enter.
Empty chart	No complete pair	Wait for at least one pair and reload.

12.4 Configuration catalog

The extended room contains three reference configurations and seven treatments in each language. Use one-round reference for a between-group comparison, fixed matching for relationships, and reassignment for learning with weaker bilateral continuity. Specialized treatments use ten fixed-partner rounds so their mechanisms can develop.

English configuration	Central question
<code>principal_agent_extended_baseline_one_round</code>	Which contract appears in one interaction?
<code>principal_agent_extended_baseline_fixed_partner</code>	How does a continuing relationship change conduct?
<code>principal_agent_extended_baseline_random_partners</code>	What persists under reassignment?
<code>principal_agent_extended_complete_information</code>	What does enforceable effort accomplish?
<code>principal_agent_extended_flat_wage</code>	What happens without contingent pay?
<code>principal_agent_extended_noisy_output</code>	How does a weak signal raise incentive cost?
<code>principal_agent_extended_high_outside_option</code>	How does participation change?
<code>principal_agent_extended_monitoring</code>	When is supervision worthwhile?
<code>principal_agent_extended_unlimited_liability</code>	What changes when negative transfers are allowed?
<code>principal_agent_extended_discretionary_bonus</code>	Can a nonbinding promise support effort?

Glossary

Agent: participant who accepts or rejects and controls effort. **Best response:** action maximizing utility given an offer. **Bonus:** success-contingent transfer. **Discretionary contract:** payment chosen after performance without full legal commitment. **Effort:** costly action changing the outcome distribution. **Hidden action:** consequential agent decision that cannot be contracted on directly. **Incentive compatibility:** condition making the desired action optimal. **Limited liability:** restriction on negative transfers. **Monitoring:** costly technology producing information about action. **Moral hazard:** action response to incomplete observability or verification. **Outside option:** value available without contracting. **Participation:** voluntary acceptance when the contract beats the alternative. **Principal:** participant designing the contract and receiving project revenue. **Relational contract:** agreement sustained through future interaction. **Signal:** observable outcome imperfectly related to effort. **Surplus:** sum of economic profits.

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