



Instructor guide: patents and licensing

Laboratory implementation, theoretical foundations,
experimental evidence, and variants

Behavioral and Experimental Economics Research Lab
Department of Economics



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

How to use this guide

This guide supports preparation, implementation and classroom discussion of the BEER Lab Patents and Licensing family. It is written for instructors with different levels of experience in experimental economics, industrial organization and innovation economics.

The operational route explains access and preparation. The theoretical chapter develops formulas and worked examples. The treatment and report chapters support selection of a comparison and a debrief without assuming specialist knowledge.

Both language editions cover the same basic game and sixteen extensions. Common screens are explained once; each treatment identifies its changes and limits of interpretation.

Author

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For the instructor

This guide follows the English-language interface. Spanish configurations use the same logic. Never project individual codes or connect outcomes to names, student identification numbers, or seats in the room.

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Preparing a session

1.1 What students will learn

Patents and Licensing places students in charge of access to a technology. The central question is how separately chosen licensing charges interact when someone needs several technologies to make one product. Each student controls a decision that looks profitable in isolation, while the combined decisions determine whether production is attractive. The basic activity therefore connects individual incentives with the price of a package, output, and the distribution of surplus. It does not ask students to invent a product, invest in research, apply for a patent, or assess whether a legal claim is valid. Those are different decisions, covered by other activities or by subsequent classroom discussion.

The family also contains a second environment in which the technology owners themselves manufacture competing products. This allows the instructor to distinguish cooperation over access from competition over output. A reciprocal royalty is both a payment made on one's own production and income received on the rival's production. Equal royalties can cancel in the accounts when quantities happen to match, yet still change the incentive to expand output. Students should finish the session able to explain why an accounting cancellation does not imply that a contract has no strategic effect.

Use the basic activity to introduce complementary technologies, independent pricing, and royalty stacking. Use negotiated package licenses to discuss coordination, the division of receipts, and agreement costs. Introduce substitute technologies before drawing a general conclusion about cooperation: joining complementary rights and joining competing alternatives can have different consequences for consumers. The production block is appropriate after students understand a simple quantity-setting duopoly. These are alternative teaching routes within one family. An instructor can activate a single treatment without running all the other options, and the common instructions need not be repeated in a lecture.

The following learning outcomes are observable in a discussion or short written assessment. Students should be able to calculate a firm's response to announced charges; distinguish a per-unit royalty from a fixed access payment; identify whose receipts and costs change under a license; explain the difference between a transfer and a real resource cost; interpret quantity, price and surplus separately; and state which assumptions make a theoretical reference relevant. A successful session need not reproduce every equilibrium. A class that observes failed agreement or shutdown can still learn the mechanism if the instructor reconstructs the incentives accurately.

For the instructor

For a first class, prepare one basic session and one complementary package-license session. For a course on competition policy, compare the complementary and substitute cases. For industrial organization, add the cross-licensing production block. These routes guide lesson planning; they do not restrict which of the sixteen extensions can be activated.

1.2 Family at a glance

Purpose	Each participant controls a technology and chooses a charge for its use. An automated firm needs complementary licenses and adjusts output to their combined cost. Extensions compare negotiated package licensing, substitutes, fixed fees, charge limits, three owners, demand, production costs, limited duration and cross-licensing between producing firms. The report separates decisions, transfers, output, prices and surplus.
Experimental unit	A market of two participants; three participants in the three-owner treatment.
Participants	At least two, in multiples of two; the three-owner treatment requires at least three, in multiples of three.
Basic edition	One interaction; ten rounds with fixed partners; ten rounds with random reassignment.
Extended edition	The three basic modes plus sixteen distinct teaching treatments.
Decision	Per-unit charges, fixed access payments, proposals and acceptance; production quantities in the cross-licensing block.
Payoff	A renewed individual account of 100 ECU each round, plus net profit. Scores from active rounds are added.
Suggested duration	50–75 minutes with discussion; an instructional estimate, not a pilot-validated duration.
Topics	Intellectual property; technology licensing; royalty stacking; complementary and substitute patents; cross-licensing; competition policy.
JEL	A22; C92; D43; L24; L41; O34.

The application is a single bilingual family. It contains 44 configurations: three basic and nineteen extended configurations in each language. The nineteen extended options comprise the three baseline modes and sixteen additional treatments. Translations are not separate economic games. The four rooms distinguish language and edition, while the configuration selected inside a room determines the mechanism. This distinction matters when the instructor prepares a comparison: selecting the extended room does not automatically combine several treatments into one session, and completing a basic session does not automatically move students to an extension.

1.3 From the laboratory website to the correct room

Begin at <https://beer-lab.org/>. Open the classroom area, labelled *CLASSROOM* on the current English navigation, and continue to <https://teaching.beer-lab.org/en/>. The directory

lets instructors search by title, topic and JEL classification. Locate Patents and Licensing and read its card before selecting a route. A student room is an entry point for participants; the instructor's Demo page is a place to select and create a session. Neither address is itself an individual decision link. Screenshots in this guide show the current navigation and a local instance containing fictitious sessions.

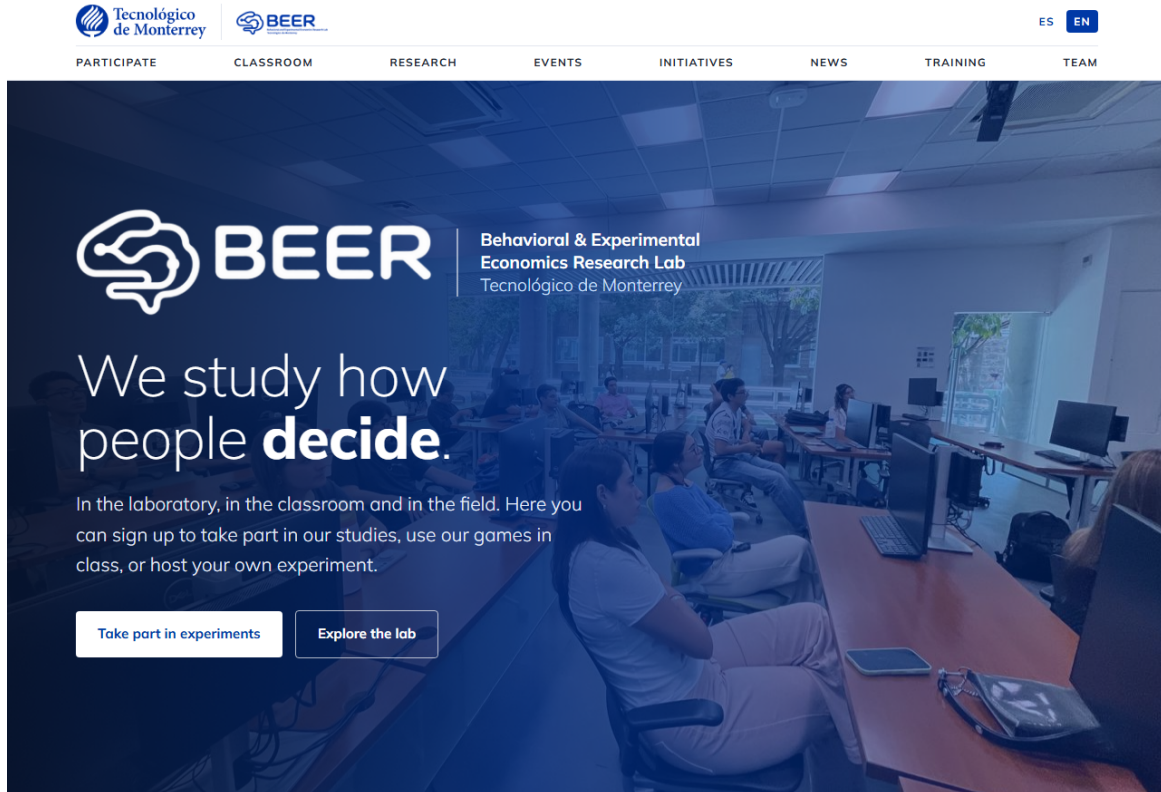


Figure 1.1: Open the classroom area from the laboratory website.

The instructor route is <https://patents.beer-lab.org/demo>. The English basic room is https://patents.beer-lab.org/room/patents_en; the English extended room is https://patents.beer-lab.org/room/patents_extended. The Spanish routes are https://patents.beer-lab.org/room/patentes_es and https://patents.beer-lab.org/room/patentes_extendido. These are the product's canonical routes. The delivery record distinguishes a locally verified implementation from a public domain that still requires laboratory deployment. For a local demonstration on the production computer, open <http://localhost:8186/demo>. A localhost address does not give another computer access to that computer's server.

Each domain must display only this family. Demo should contain 44 configurations; Rooms should contain exactly four rooms. The basic English room offers three English baseline configurations and selects a basic option first. The extended English room offers nineteen English extended configurations. The corresponding Spanish counts are identical. If another game appears, stop before creating a class session and ask the laboratory coordinator to check the selected family and instance. A display filter inside a room is useful, but a separate family database is what also keeps Sessions and Data from mixing unrelated games.

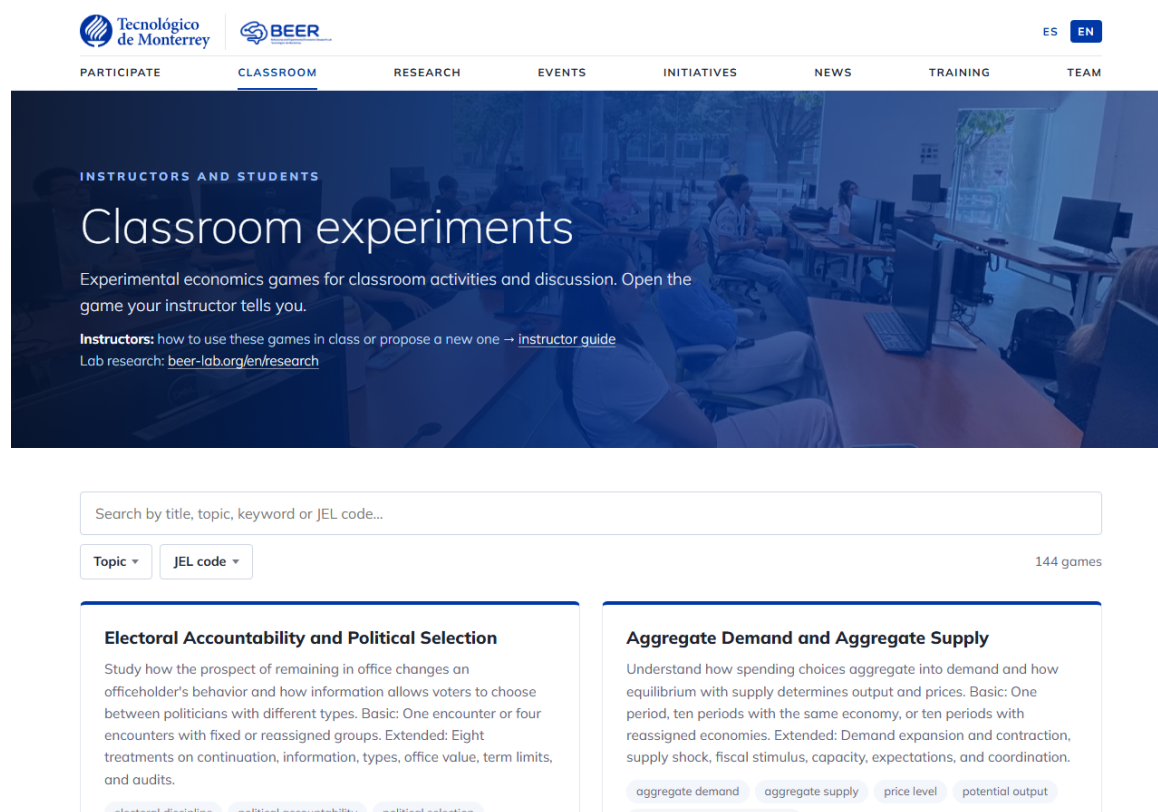


Figure 1.2: Use the teaching directory to select the game family.

1.4 Preparation before students arrive

Choose the economic comparison first, then decide the number of participants. Ordinary treatments require a minimum of two and a multiple of two. The three-owner treatment requires a minimum of three and a multiple of three. Four participants give two independent pairs, while six give either three pairs or two three-person markets. A larger class increases the number of markets rather than the number of people in each market. Do not change attendance merely to match the demonstration default. Enter the actual supported number, and keep an alternative plan for an absent student. The form checks incompatible counts; overriding that check is not an appropriate way to form a market.

In Demo or the administrative creation form, select language, edition and the descriptive treatment name. Confirm active rounds and matching before creating the session. Basic options are one interaction, ten rounds with the same people, and ten rounds with random reassignment. In the latter, a pairing may recur and positions can change; the application does not promise that every person meets every possible partner exactly once. Extensions normally use ten rounds with fixed market membership. In negotiation treatments, the proposing position alternates between A and B. Changing the proposer does not change who belongs to the market.

After creation, the start-links page provides individual participant links and the administrative report link. Distribute only individual links or the participant room address specified for the laboratory session. Keep the instructor's credentials and administrative report private. A participant link belongs to one person in one existing session; it should not be reused as a general invitation for a later class. If the database has been replaced, the old link may report that the user no longer exists. The correct response is to create a new session in the current database and distribute its links, rather than asking students to keep refreshing an obsolete address.

Demo

[ES] Patentes y licencias — Básico — Una interacción
[ES] Patentes y licencias — Básico — Mismas personas en cada ronda
[ES] Patentes y licencias — Básico — Reasignación aleatoria en cada ronda; puede repetirse una pareja
[ES] Patentes y licencias — Extendido — Una interacción
[ES] Patentes y licencias — Extendido — Mismas personas en cada ronda
[ES] Patentes y licencias — Extendido — Reasignación aleatoria en cada ronda; puede repetirse una pareja
[ES] Patentes y licencias — Extendido — Licencia conjunta de complementos
[ES] Patentes y licencias — Extendido — Licencia conjunta con costo de acuerdo
[ES] Patentes y licencias — Extendido — Licencia conjunta con reparto desigual
[ES] Patentes y licencias — Extendido — Tecnologías sustitutas
[ES] Patentes y licencias — Extendido — Licencia conjunta de sustitutos
[ES] Patentes y licencias — Extendido — Pagos fijos por acceso
[ES] Patentes y licencias — Extendido — Límite de cargos por unidad
[ES] Patentes y licencias — Extendido — Tres tecnologías complementarias
[ES] Patentes y licencias — Extendido — Mayor demanda del producto
[ES] Patentes y licencias — Extendido — Costo de producción positivo

Figure 1.3: Check the family and select a descriptive session configuration.

Rooms

Current rooms:

Patentes y licencias · ES · Básico
Patentes y licencias · ES · Extendido
Patents and Licensing · EN · Basic
Patents and Licensing · EN · Extended

Figure 1.4: The isolated instance contains four language and edition rooms.

Room: Patents and Licensing · EN · Basic

Create a new session

Session Config

[EN] Patents and Licensing — Basic — One interaction

Number of participants

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

Create

[Configure session](#) 

App sequence

patents_licensing_game (10 rounds)

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://127.0.0.1:8186/room/patents_en

Figure 1.5: The basic English room starts with a basic English option.

oTree
Demo
Sessions
Rooms
Data
Server Check
Logout

[EN] Patents and Licensing — Basic — One interaction: session 'g914c82x'

Edit
Links
Monitor
Data
Payments
Report
Description

You can either use the session-wide link, persistent links, or single-use links.

Session-wide link

If it's not practical for you to use a Room, you can distribute the following link to participants.

<http://127.0.0.1:8186/join/bilutido>

Persistent links

For a real session, you should use a [room](#).

Single-use links

Below are single-use links.

P1	http://127.0.0.1:8186/InitializeParticipant/qaudmsma
P2	http://127.0.0.1:8186/InitializeParticipant/uiu435xg
P3	http://127.0.0.1:8186/InitializeParticipant/su9lx1qo
P4	http://127.0.0.1:8186/InitializeParticipant/ulfsflt7

Figure 1.6: Distribute individual participant links; keep the report private.

Run a short rehearsal before admitting the class. Open two participant windows, check that instructions and buttons use the intended language, intentionally answer one comprehension item incorrectly, and verify that the correction appears beside that item. Submit the participants' decisions and inspect the result and terminal closing screen. Open the report while the session is still incomplete to confirm that revelation is disabled. Confirm the browser can download a session CSV. This rehearsal tests the actual class route and network conditions; it does not require running every treatment again or deleting existing sessions.

Checkpoint

Before admitting students, verify the family, four rooms, language, edition, treatment, active rounds, participant multiple, matching rule, renewed 100 ECU account, private report and working session download. Prepare the theoretical comparison on paper, and keep the report hidden while students decide.

Economic foundations

2.1 A license is a decision about access

In this activity, a patent is a stylized right to control use of one technology. A license grants access under an announced payment rule. The application takes the technologies and the rights as given. It does not model how an innovation was discovered or the costs and uncertainty of obtaining protection. This restriction lets a class focus on what happens after rights are distributed. The owner chooses a charge, while the party using the technology responds to the total cost of access. An economically valuable right can earn no receipts if its price prevents anyone from using it.

Technologies are complementary when the product requires all of them. They are substitutes when either technology can perform the required function. These descriptions concern the technological rule in the exercise, not whether two patent documents contain similar language. With complements, each owner can block production by making the package too expensive. With substitutes, an owner can lose demand to the alternative. A package license combines rights under one charge. Whether that combination eliminates an obstacle or suppresses an alternative depends on which of these relationships applies.

[Haugen and Juranek \(2023\)](#) provide two classroom experiments on technology licensing, linking royalty stacking with cross-licensing and patent pools. This family follows those instructional questions and develops its own numerical implementation, integer decisions, automated downstream response, negotiation sequence, accounting and report. It is not a literal reproduction of their protocol. In particular, the downstream firm in the licensing block is explicitly a profit-maximizing monopolist with an announced response formula. This choice makes downstream profit and consumer surplus measurable in the same accounting system.

2.2 Complementary technologies and independent royalties

Let final demand be $P = A - Q$, where P is the product price in ECU per unit, Q is total output, and A is the demand intercept. The basic value is $A = 12$. The automated downstream firm has constant production cost c , equal to zero in the basic game. There are n technology owners, each charging r_i for each unit using their technology. Because all technologies are essential, the firm pays the sum $R = \sum_i r_i$ on each unit. It chooses output to maximize $(A - Q - c - R)Q$, so its response is $Q = \max\{0, (A - c - R)/2\}$ and the resulting price is $P = A - Q$.

Owner i receives $\pi_i = r_i Q$. Increasing a charge has two effects: more income on each unit still produced and fewer units on which to collect it. It also reduces other owners' receipts, because they sell fewer licenses, but the person raising the charge does not bear those other losses. This external effect explains royalty stacking. It is not enough to say that each owner wants a high charge. A charge so high that production stops also eliminates that owner's own receipts, and the

best response depends on what the other owners choose.

For an interior continuous-choice solution, the owner's best response is $r_i = (A - c - \sum_{j \neq i} r_j)/2$. In a symmetric equilibrium, all owners choose $r = (A - c)/(n + 1)$. With two owners, $A = 12$ and $c = 0$, this gives $r_1 = r_2 = 4$. Total royalties are 8, output is 2, and the final price is 10. Each owner receives 8 ECU; the downstream firm earns $(10 - 8)2 = 4$ ECU. Consumer surplus is $Q^2/2 = 2$ ECU. Adding these amounts gives 22 ECU of total surplus, before the separate classroom accounts.

Theoretical foundation

The implemented choices are integers. In the basic game each charge is between 0 and 6. The pure equilibria on that grid are (3, 5), (4, 4) and (5, 3). All produce total royalties of 8 and output of 2. The symmetric continuous solution is a useful reference, but the program does not incorrectly label the two asymmetric grid equilibria as mistakes.

The upper bound on independent charges is the integer part of $(A - c)/n$, unless a treatment announces a tighter bound. It keeps the action range understandable and is part of the implemented game. It must be included when checking incentives: the unconstrained derivative is not sufficient if its solution lies outside the allowed range. With positive production cost or a different demand intercept, both the response and the bound change. The instructor should use the parameter table displayed to participants and the report's enumerated grid equilibria, rather than copying the basic numbers to every extension.

2.3 Joint licensing and the difference between revenue and welfare

A package license replaces separately chosen charges with one per-unit charge R . If owners maximize their combined receipts, they maximize $R(A - c - R)/2$. The interior revenue-maximizing package charge is $R^J = (A - c)/2$. Under basic demand and cost, it is 6. Output rises from 2 to 3, price falls from 10 to 9, and licensing receipts rise from 16 to 18. With equal shares, each owner receives 9. The downstream firm earns 9 and consumers obtain 4.5. Total surplus is therefore 31.5. Cooperation can improve every party's payoff relative to independent complementary pricing without eliminating all market power.

The package charge of 6 is not the efficient quantity or a universal welfare optimum. If access is free, the same downstream monopolist produces 6 units, sells at 6, earns 36 and leaves consumer surplus of 18. Total surplus is 54. If output could instead be chosen to maximize total gains with zero real production cost, the first-best quantity would be 12 and surplus 72. The exercise deliberately retains downstream monopoly, so these two benchmarks must not be collapsed. Moving from independent royalties to a package helps relative to the initial institution; it does not establish that every remaining restriction has disappeared.

In the application a package is a proposed contract, not an automatic coordinated solution. One owner proposes the total charge, the other accepts or rejects, and rejection returns both to independent pricing in that round. Equal sharing makes the revenue calculation symmetric, but it does not guarantee acceptance. Unequal sharing and agreement costs can change willingness to agree even when a package raises gross receipts. The joint-revenue benchmark describes what a coordinated pricing objective would select; it does not solve the entire proposal-and-response game or infer the proposer's beliefs.

[Lerner and Tirole \(2004\)](#) analyze patent pools under more general technological and contractual conditions, including the distinction between complements and substitutes. Their theoretical work supports treating the relationship among rights as central to the welfare question. The classroom implementation simplifies those environments and does not test every condition in their model. Instructors should describe a classroom comparison as evidence about decisions under the

announced rules, then use the article to broaden the institutional discussion. An observed increase in licensing income alone is not a complete measure of whether a pool benefits society.

2.4 Substitutes and fixed access payments

With substitute technologies, the downstream firm requires only one right. Without a package agreement, it uses the technology with the lower per-unit charge. Ties divide licensed units equally. A pair charging 2 and 2 therefore does not impose a total royalty of 4: the relevant charge is 2, output is 5, and each owner licenses 2.5 units and receives 5 ECU. If one lowers the charge to 1 while the other remains at 2, output is 5.5 and the cheaper owner receives all 5.5 units of licensing demand. The higher-charge owner receives zero. Summing substitute charges would implement a different game and would destroy this comparison.

Under continuous prices, identical costless substitutes create the familiar incentive to undercut toward zero. The integer grid matters again. Both $(0, 0)$ and $(1, 1)$ are pure equilibria in the implemented baseline substitute game: cutting a charge of 1 to zero sacrifices all receipts, while increasing it loses the customer. A joint package can choose a positive charge and remove that independent competition. This is why the direction of the consumer effect can differ from the complementary case. The classroom result should be compared with the feasible independent reference, and the discrete pricing rule should remain explicit in the discussion.

A fixed access payment changes a different margin. The downstream firm's operating profit before fixed fees is $(A - c)^2/4$. If total requested access fees do not exceed this amount, the automated firm operates and pays them; equality is resolved in favor of operation. Output is $(A - c)/2$, independent of fee size conditional on operation. With $A = 12$ and $c = 0$, two fees of 18 extract the 36 ECU operating profit while leaving output at 6. Fees of 18 and 19 instead prevent operation and generate no licensing receipts. Fixed fees remove the per-unit distortion conditional on entry, but do not make participation or coordination irrelevant.

2.5 Cross-licensing between producing firms

In the production block, two participants choose integer outputs q_1 and q_2 . Total output is $Q = q_1 + q_2$ and price is $P = A - Q$. Each firm needs the other's technology, pays a common royalty f on its own units, and receives that royalty on the other's units. With production cost c_i , its profit is $\pi_i = (P - c_i - f)q_i + fq_j$. The other firm's output and the licensing receipts on it are fixed when taking a unilateral best response. The interior response is therefore $q_i = (A - c_i - f - q_j)/2$. The received royalty does not offset the marginal cost of increasing one's own output.

Under zero production cost and no royalty, the symmetric continuous outcome is $q_1 = q_2 = 4$, $Q = 8$ and $P = 4$. Each firm earns 16 and consumer surplus is 32. Total surplus is 64. With a reciprocal royalty of 2, the symmetric continuous reference becomes $q_i = 10/3$. The implemented integer game has equilibria $(3, 3)$, $(3, 4)$ and $(4, 3)$. At $(3, 3)$, price is 6 and each firm earns 18: sales are 18, the outgoing royalty is 6 and the incoming royalty is 6. Consumer surplus is 18 and total surplus 54. Producer profit has risen while consumers and total surplus have fallen.

The integer zero-royalty game also admits $(3, 5)$ and $(5, 3)$ alongside $(4, 4)$. Unequal outputs therefore need not indicate error or fairness. Reciprocal fixed payments of 6 ECU cancel at every profile, preserving zero-royalty incentives. The exercises reconstruct the distinction between a fixed transfer and a per-unit marginal cost.

The participant experience

3.1 Welcome, resources and instructions

The first participant screen identifies the laboratory and explains the educational purpose. It asks participants to keep silence, make private decisions, follow the screen instructions, avoid closing or refreshing the page, and request help privately. Acceptance of these rules permits the participant to continue. This screen is not a consent form for an unannounced research project, a demographic questionnaire, or an opportunity for the instructor to explain which outcome is expected. Administrative preparation should already be complete before students reach it. Use neutral verbal guidance so that the first decision is not turned into a test of obedience to a predicted equilibrium.

The instructions explain the role, number of people in a market, demand formula, costs, allowed decision and matching rule. The renewed 100 ECU account is displayed in the body, together with the definition of ECU as Experimental Currency Units. The account is individual, not a joint fund to divide and not a stock of physical product. Each round adds net profit to that account; the final score adds all active rounds. There is no announced conversion into real money. A license charge is a contract condition, not money taken from the owner's initial account simply because the owner types the number.

The worked example follows the selected mechanism. Complementary technologies add charges, substitutes select the lower charge and split ties, and fixed fees are assessed against the downstream operating profit. In cross-licensing, the example shows sales, incoming and outgoing licensing payments, costs and net profit for the participant's own position. These distinctions are essential: an example valid for complementary royalties would be misleading if copied unchanged into the substitute or fixed-fee treatment. If parameters are changed by the laboratory team, the instructions and comprehension calculation use the effective values rather than an unrelated baseline.

What participants will see

Participants see their role, effective parameters and a specific decision. Aggregate results and theoretical predictions belong to the instructor's debrief and are not shown before choices.

3.2 Comprehension without strategic coaching

The comprehension page checks three points: the initial individual account, output in the displayed example, and the meaning of the participant's decision. It is intended to detect confusion about units and rules before interaction begins. It does not ask students to announce the equilibrium,



Welcome to the laboratory

The Behavioral and Experimental Economics Research Lab in the Department of Economics at Tecnológico de Monterrey is a space for learning about economic decision-making through controlled activities.

You will make individual, private decisions. At the end, the instructor will use aggregate results for classroom discussion.

General laboratory rules

- Remain silent throughout the activity.
- Do not talk or communicate with other participants.
- Make decisions individually and privately.
- Follow the instructions on screen.
- Do not close, refresh or leave the page.
- If you need help, raise your hand and ask for private assistance.

☐ I have read and agree to follow these rules.

Start

Figure 3.1: Participants read the laboratory rules and accept before starting.

Licensing decisions: instructions

Resources and unit of account

Each participant receives 100 ECU at the start of every round; this account is renewed. The round score is 100 plus your net profit. The final score adds all active rounds.

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

This session does not convert ECU into real money.

Starting account each round
100 ECU

Your role in this round
Owner B

Round
1 / 1

One interaction

Each of the 2 people controls a different technology. An automated firm needs every technology to produce. Owners simultaneously choose an integer charge per unit. R is the sum of charges. The firm produces Q = the greater of 0 and $(A - c - R)/2$, sells at $P = A - Q$, and pays each owner their charge times Q . No other participant controls this firm.

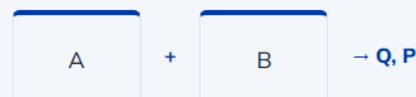


Figure 3.2: Identify the renewed account, roles and technological relationship.

Product demand	$P = 12 - Q$
Cost per unit produced	0 ECU
Maximum decision	6
People in your market	2

The table shows your actual conditions. In licensing to the automated firm, c is that firm's cost. When two participants produce, c is your own cost. Quantities may be fractional only when calculated by the automated firm.

Example for understanding the rules

Example with separate charges: $A = 12$, $c = 0$ and 2 charges of 2 ECU per unit. $R = 4$, $Q = (A - c - R)/2 = 4$ and $P = 8$. Each owner receives 8 ECU. This calculation neither recommends a choice nor assumes an agreement.

Continue

Figure 3.3: Read the effective parameters and the worked example before deciding.

calculate their best strategy against a rival, or commit to cooperation. A wrong answer has no payment penalty. The page identifies the submitted answer, the correct answer and the rule explaining the correction. Correct answers remain entered while a participant revises an incorrect field. The instructor should therefore address the particular misconception rather than restarting everyone's explanation.

How many ECU does each person receive at the start of every round?

Your answer: 0. The correct answer is 100. The 100 ECU account belongs to each person and is renewed; it is neither licensing income nor product quantity.

How many units Q are produced in the separate calculation example above?

What does the individual decision in your mode represent, after any negotiation?

☒ A charge for every unit using your technology
☐ A fixed access payment, independent of quantity
☐ The quantity your firm will produce

Figure 3.4: An incorrect item receives a specific explanation; other answers remain entered.

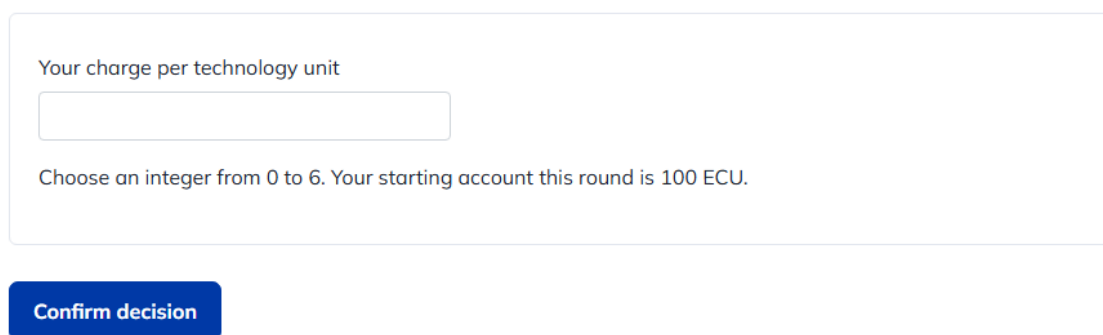
For example, if someone answers zero for the starting account but correctly calculates output, the feedback explains that the person receives 100 ECU at the start of every round. It does not erase the output calculation or mark every item as wrong. In the substitute treatment, check that students understand why two equal charges of 2 yield an effective charge of 2 rather than 4. In the fixed-fee treatment, distinguish whether production takes place from how much is produced conditional on operation. If several participants struggle with the same item, pause briefly and restate the rule without recommending a charge.

3.3 Decisions and genuine waits

In ordinary licensing, each owner chooses one integer charge within the displayed range and confirms it privately. Nobody sees the other owner's current choice before submitting. In the basic two-person market the range is 0 to 6. A different treatment may announce a tighter cap, a third owner, a fixed fee or another demand level. The server checks the effective range, including attempts to submit an out-of-range number. The displayed 100 ECU account remains visible in the decision guidance. It should not be interpreted as permission to enter any number up to 100: the contract's choice range is a separate restriction.

A wait page appears when another decision in the same market is still required. In negotiation, one wait collects a proposal and another collects its response. The output calculation then waits for all required independent charges or production quantities. Waiting does not signal rejection, a high charge, a poor result, or a technical failure. The participant should leave the page open and ask for private assistance if the delay is unusual. The instructor can inspect progress to locate an unfinished decision, but should not replace it with a fabricated response just to accelerate the class.

In repeated play, Results is followed by the next active round. Fixed markets preserve membership; reassigned markets create a new random grouping. Negotiation alternates the proposing



Your charge per technology unit

Choose an integer from 0 to 6. Your starting account this round is 100 ECU.

Confirm decision

Figure 3.5: Confirm an individual charge within the announced integer range.

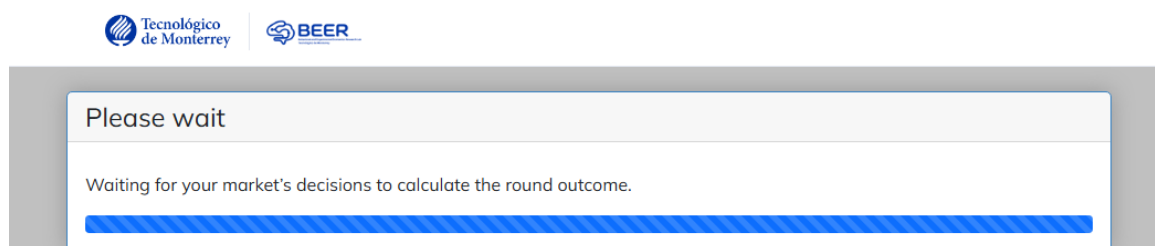


Figure 3.6: Leave the page open while the remaining market decisions arrive.

position each round. In the duration treatment, independent royalty choices occur only before the announced charge-free phase. During the latter, no charge is requested and the program calculates access without royalties. Participants still receive a result for each active round. The instructor should announce the intended horizon before starting rather than unexpectedly changing it while participants are deciding.

3.4 Private results and explicit completion

The individual result distinguishes licensing receipts, payments, net profit and the round score. The market panel shows total output, final price and the applicable per-unit charge. A participant in cross-licensing additionally sees product sales revenue and production costs, so that the net-profit calculation can be reconstructed. Units covered by a license can differ from total output when substitute technologies split demand. A substitute package covers its output with both rights without claiming that both technologies are physically used. Fixed access payments are not displayed as if they were per-unit royalties. A zero receipt can be a genuine observation when production stops or an alternative technology is selected.

After the last result, a final page states that the activity is complete, asks the participant to wait for the instructor and displays the accumulated score and round history. It is terminal: participants do not press another Next button to reach an empty page or the oTree message that no pages remain. This closure is useful during a class because the teacher can see that the decision phase has ended before opening the aggregate discussion. Students should not close their windows until the instructor has confirmed that downloads and the debrief are ready.

Round result

Round 1

Licensing receipts 8 ECU	Licensing and agreement payments 0 ECU	Net profit 8 ECU	Round score 108 ECU
Total quantity Q 4	Price P (ECU per unit) 8	Applied per-unit charge 4	

Units covered by your license: 4

The next round again starts with 100 ECU; previous profit does not change that account.

[View final summary](#)

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

Figure 3.7: Read the personal payoff and distinguish it from market output and price.



Activity completed

You have completed all your decisions. Stay on this page and wait for the instructor's directions.

Cumulative ECU: 108		
Round	Net profit	Round score
1	8	108

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

Figure 3.8: The terminal summary confirms completion and preserves the round history.

Extended treatments

4.1 Negotiated package licensing of complements

In Joint licensing of complements, one owner proposes a total package charge and the other accepts or rejects. Acceptance replaces separate charges; it does not add another royalty layer. Receipts are shared equally. Rejection leads to simultaneous independent charges in the same round. The proposing position alternates across ten rounds while market membership remains fixed. The teaching question is whether participants can implement mutually beneficial coordination when agreement requires an explicit decision. The joint-revenue reference is 6 under basic parameters, but the program does not force that proposal or predict that every proposal will be accepted.

Compare accepted packages with the basic complementary mechanism, examining charge, output, owner profit, downstream profit and consumer surplus. Agreement frequency is a separate outcome from the charge conditional on agreement. A high average payoff among accepted packages may reflect selection, so it should not be interpreted as the effect of offering negotiation to everyone. The mechanism is a classroom adaptation of the coordination problem discussed by [Haugen and Juranek \(2023\)](#); its proposal-and-rejection sequence is specific to this implementation.

Before decisions, one person proposes an integer joint charge for the technology package. The other accepts or rejects. If accepted, the firm pays only that charge per unit; joint receipts are divided according to the announced percentages. No individual charges are added. If rejected, both people set their charges separately. The proposer alternates between A and B each round; free-text communication is unavailable.

If agreed: 50% of licensing receipts go to the proposer and 50% to the other person. Each person pays 0 ECU when accepting, even if no units are produced. Charges and costs apply only to this round.

Total per-unit charge for the technology package

Enter an integer from 0 to 12. The other person will see this proposal before accepting or rejecting it.

Continue

Figure 4.1: The proposer sets one package charge and reads the sharing rule.

Proposed charge: 6 ECU

If agreed: 50% of licensing receipts go to the proposer and 50% to the other person. Each person pays 0 ECU when accepting, even if no units are produced. Charges and costs apply only to this round.

If you reject, charges are chosen separately in this round.

☐ Accept the proposal

☐ Reject the proposal

Continue

Figure 4.2: The other owner accepts or returns the market to independent charges.

4.2 Agreement costs and unequal shares

Joint licensing with agreement costs subtracts 2 ECU from each owner's payoff whenever the proposal is accepted, even if output is zero. It is a real administrative resource cost, not another owner's receipt. At a package charge of 6, gross licensing receipts remain 18 and each owner's net receipt falls from 9 to 7. Total surplus falls by 4 relative to the otherwise identical agreed package. Relative to the symmetric independent outcome, owners would earn 8 each, so this agreement no longer makes both better off even though it still raises output and consumer surplus. This separates a social gain from every participant's private incentive to support it.

Joint licensing with unequal shares instead awards 70 percent of licensing receipts to the proposer and 30 percent to the responder. There is no agreement cost. At charge 6, those receipts are 12.6 and 5.4 ECU. The package's quantity and total surplus are unchanged by the split, but the responder may prefer the independent-pricing continuation. Alternating proposal rights does not eliminate the current-round participation question. These are disclosed distribution and transaction-cost adaptations of the licensing framework, not replications of a separately estimated behavioral treatment. Compare acceptance and rejected-market outcomes before attributing rejection to spite, confusion or a dislike of cooperation.

4.3 Substitutes with independent or joint licensing

Substitute technologies use the lower charge, with equal splitting at a tie. The key prediction is stronger competitive pressure than under complementary rights; the integer grid permits both zero and equal charges of 1 as pure equilibria. The instructor can ask students to contrast the incentive to raise a complementary charge with the incentive to undercut a substitute. A patent's technological role therefore matters even when ownership, matching, initial accounts and the number of participants remain unchanged. Licensing receipts are reported by position, but output is counted once per market rather than once for every technology owner.

Joint licensing of substitutes adds the same proposal-and-response institution used for complements. An accepted package now restricts competition between alternative technologies, rather than removing several essential tolls. Compare consumer surplus and output, not merely whether owners reach agreement or earn more. If an accepted package raises owner profit and reduces output,

this is compatible with reduced competition under the announced model. It does not establish a legal violation in a real industry. The technological and institutional distinction is the substantive connection to [Lerner and Tirole \(2004\)](#) and [Shapiro \(2001\)](#); the simple market and negotiation protocol are the laboratory's adaptation.

Example for understanding the rules

Example without agreement: $A = 12$, $c = 0$ and both charges are 2. R is the lower charge, 2; $Q = 5$ and $P = 7$. Equal charges split Q equally, so each owner receives 5 ECU. Charges on alternative technologies are not added.

Figure 4.3: Equal substitute charges are compared, not added.

4.4 Fixed payments and bounded royalties

Fixed access payments allow each owner to request an amount independent of output. The automated firm operates when total fees are no greater than its operating profit before fees. In the basic calibration that threshold is 36 ECU, and equality permits operation. While the firm operates, output stays at 6, regardless of how the fees divide the surplus. Above the threshold, output and receipts become zero. A class can therefore observe efficient marginal pricing conditional on operation alongside failed access. The report shows requested individual fees and actual receipts separately; a large requested fee is not money received if the firm closes.

Per-unit charge limit restricts each complementary royalty to at most 3. With two basic owners, both choosing the cap produces total royalty 6 and output 3. This gives the same quantity as the joint-revenue-maximizing package without requiring a proposal, but it is an imposed constraint rather than a voluntary agreement. Compare acceptance costs, distribution and strategic freedom before declaring the institutions equivalent. The cap is a transparent classroom comparative static, not a claim about a particular real-world regulatory standard. Students should also explain why a cap selected for one demand and cost calibration need not have the same consequences after those parameters change.

Example for understanding the rules

Example: $A = 12$ and $c = 0$. If both requested fixed fees are 0, the firm retains operating profit of 36 ECU and produces $Q = (A - c)/2 = 6$, with $P = 6$. Changing those payments does not alter Q while the firm keeps operating. The example does not recommend a particular fee.

Figure 4.4: Fixed fees affect operation; output conditional on operation follows another formula.

4.5 Three owners, demand and production costs

Three complementary technologies require groups of three. Every technology is essential, and the automated firm pays all three per-unit charges. At the symmetric continuous reference, each charge is 3, the total is 9 and output is 1.5. This is lower than output of 2 with two independently pricing owners, even though each individual charge is smaller. The action bound is 4 in this treatment. The integer grid supports several asymmetric profiles as well as (3,3,3), which the report enumerates. This extension makes the distinction between the number of rights and the

charge on one right visible. Comparing individual mean charges alone would miss the greater combined burden.

Higher product demand changes the intercept from 12 to 16 while preserving two complementary owners and zero production cost. The symmetric continuous royalty becomes $16/3$, subject to integer choices. Positive production cost instead keeps the intercept at 12 and sets downstream cost to 3; the corresponding symmetric continuous charge is 3. These comparisons help students distinguish a movement caused by access charges from a change in the product market itself. They are parameter-based extensions of the announced model, not evidence that every industry responds identically. Compare the actual parameter table, grid reference, output and surplus, and avoid interpreting a higher nominal charge as greater market power without accounting for demand and costs.

4.6 Announced duration and charge-free access

Duration and subsequent charge-free access retains complementary royalties in the first half of active rounds and sets both to zero thereafter. With the default ten-round session, students choose charges in rounds 1–5 and receive charge-free results in rounds 6–10. Instructions announce the calendar in advance. The latter phase asks for no royalty choice, because charging would contradict the access rule. Under unchanged basic demand and cost, the automated firm then produces 6, sells at 6 and earns 36. Owners receive no royalties, while consumers obtain surplus of 18. There is no accumulated plant or innovation investment in this activity.

The extension is useful for discussing who gains and loses from a change in access conditions. It does not identify an optimal patent length: research investment, innovation arrival and future discoveries are absent. A before-and-after change also combines the announced institution with time and experience, so the class should not call it an independently randomized causal effect. Use a separate stable-rule comparison session if that distinction matters for the course. The general issue of access to a collection of rights connects to [Shapiro \(2001\)](#); this deterministic duration sequence is an explicit teaching adaptation.

4.7 Producing firms: zero, variable and fixed reciprocal payments

Production with charge-free reciprocal licensing replaces the automated downstream firm with two active producing participants. Each chooses an integer quantity from 0 to 6 under basic demand. There is no outgoing per-unit royalty. This establishes the quantity-setting comparison before licensing incentives are introduced. Production with reciprocal royalties sets $f = 2$ for both firms. A firm's own output generates a payment to the rival, while the rival's output generates receipts. At quantities 3 and 3, those payments happen to offset, but a unilateral quantity increase still costs the extra royalty. The aggregate and individual comparisons developed in Chapter 2 explain why profits can rise while consumers lose.

Production with reciprocal fixed payments sets the per-unit royalty to zero and has each firm pay and receive 6 ECU independently of quantity. Both fixed payments occur even if a firm chooses zero output; they cancel in its account. The game therefore has the same quantity incentives and net payoffs as the charge-free reference. This treatment is deliberately simple: it does not add liquidity constraints, default or an outside licensing authority. Those features would create another mechanism. Ask students to identify which term enters the marginal decision and which is constant. The comparison follows the contract distinction motivating the cross-licensing classroom framework rather than asserting that fixed and variable contracts are equivalent in every setting.

Your decision

Starting account each round 100 ECU	Your role in this round Firm A	Round 1 / 10
---	--	------------------------

Product demand	$P = 12 - Q$
Cost per unit produced	0 ECU
Maximum decision	6
People in your market	2

The table shows your actual conditions. In licensing to the automated firm, c is that firm's cost. When two participants produce, c is your own cost. Quantities may be fractional only when calculated by the automated firm.

Each participant controls a firm and a technology. The firms need access to each other's technology. Each simultaneously chooses an integer quantity; Q is the sum and $P = 12 - Q$. Sales revenue is P times your quantity. You pay f for each unit you produce and receive f for each unit the other firm produces. The initial reciprocal charge is $f = 2$ ECU. Each firm also pays and receives 0 ECU as a reciprocal fixed payment; these payments offset each other. Profit is sales revenue minus production cost, plus licensing receipts minus licensing payments. Both firms know the per-unit costs: $A = 0$ ECU and $B = 0$ ECU.

Applicable reciprocal charge: 2 ECU

Quantity your firm will produce

Choose an integer from 0 to 6. Your starting account this round is 100 ECU.

Confirm decision

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

Figure 4.5: The firm chooses output using the current royalty and announced costs.

4.8 Negotiated royalties and asymmetric producing costs

Negotiated reciprocal royalties lets one firm propose an integer f between 0 and 6, followed by the other's acceptance decision. Acceptance applies the same f to both firms; rejection sets $f = 0$. Only after that stage do the firms choose quantities simultaneously. This is distinct from sharing package receipts among nonproducing owners. The received royalty depends on the rival's production, and no 50–50 sharing rule is imposed on product-market profits. Examine acceptance, the negotiated charge and subsequent quantities separately. The no-agreement grid reference shown in the report does not solve the full negotiation game or guarantee that the chosen royalty maximizes joint profit.

Reciprocal royalties and unequal costs keeps $f = 2$ but gives firm A zero production cost and firm B a cost of 2 per unit. The cost is displayed to each participant in the parameter table. At the continuous reference, quantities are 4 and 2. The lower-cost firm produces more, pays more in royalties and receives fewer royalty payments than the other firm. This separates productive efficiency from licensing income. Position-level tables are particularly useful here; a pooled average can hide the asymmetry. The experiment does not elicit private costs or model screening, so differences should not be explained as a response to unobserved information. Both producing-cost conditions are part of the announced rules.

Report and evidence

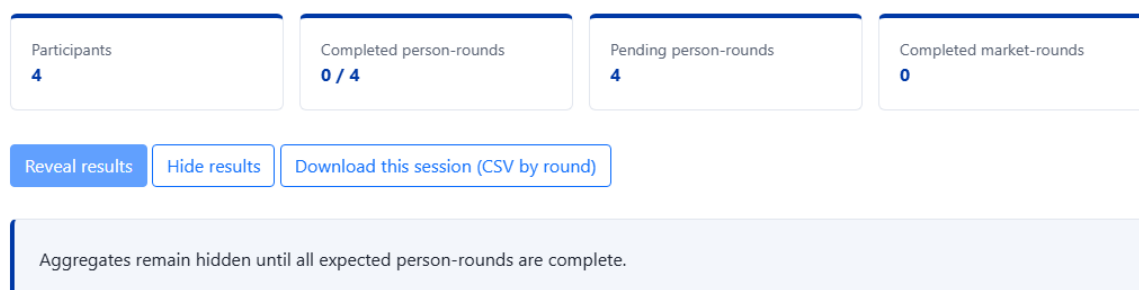
5.1 Progress and controlled revelation

The private report first shows participants, completed person-rounds, pending person-rounds and complete market-rounds. A person-round is one participant's settled outcome in one active round. A market-round is one complete set of interacting decisions. Four participants in ten rounds generate forty expected person-rounds and twenty pair-market-rounds. Three owners per market change that relationship. The report aggregates active rounds explicitly, so an administrative link opened from the tenth technical period still reports a one-round session correctly. Technical periods that are not active are not treated as missing decisions that students must complete.

BEER LAB

Instructor report: patents and licensing

Complementary technologies · One interaction



The custom CSV includes only this session and all active rounds, including pending rows. Uncalculated results remain blank; an observed zero stays zero. The native wide file may include columns for all ten technical rounds even when fewer rounds are active.

Figure 5.1: While decisions remain pending, revelation is disabled and results stay hidden.

Revelation is enabled only after all expected person-rounds are complete. The instructor can reveal and hide the aggregates; reloading the page returns them to the hidden state. Use this to collect students' predictions before displaying realized outcomes. A disabled button during a partial session is expected behavior. If one market is finished and another is waiting, the teacher can inspect counts without exposing the completed market's decisions prematurely. The report requires administrative access. Participant links do not lead to it, and anonymous browser access should request instructor authentication rather than reveal data.

5.2 Quantities, prices, transfers and surplus

The overview calculates means across complete market-rounds. Output is counted once per market. The final product price is measured in ECU per product unit, while consumer surplus and total surplus are measured in ECU. The effective per-unit charge means the sum for complements, the minimum for independently licensed substitutes, the package charge after agreement, and the reciprocal royalty in the production block. In fixed-access-fee sessions the effective per-unit charge is zero, even when requested fixed payments are positive. If output is zero, the displayed demand-intercept price is a quote without transactions, not a price at which a product was actually sold.

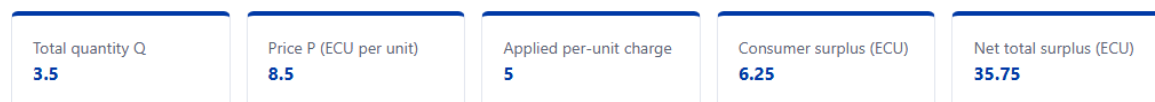


Figure 5.2: Compare output, price and surplus; licensing income alone is incomplete.

Licensing payments are transfers between parties inside the modeled economy. Adding both a payment and the recipient's receipt to social cost would double count it. Real production costs and the agreement-cost treatment use resources and therefore reduce total surplus. The report adds participant profits, automated-firm profit where present and consumer surplus, after those real costs. It excludes the renewed 100 ECU classroom accounts. Consequently, total score is not an efficiency measure: it changes with the number of participants and rounds, whereas economic surplus describes the modeled product market.

5.3 Distributions, positions and dynamic graphs

The histogram uses complete person-rounds, including observed zeros. In licensing sessions it shows the individual charges requested or assigned by an agreed package; these are not always independent decisions. In fixed-fee sessions, a requested amount can be positive even when no payment occurs because the firm closes. In cross-licensing sessions the histogram shows firm quantities. Intervals cover the feasible range, their sample size is printed, and frequencies are counts rather than probabilities inferred from a fitted distribution. Before projecting the graph, explain which of these quantities is being counted. A bar at zero can represent a meaningful action, rather than an empty answer.

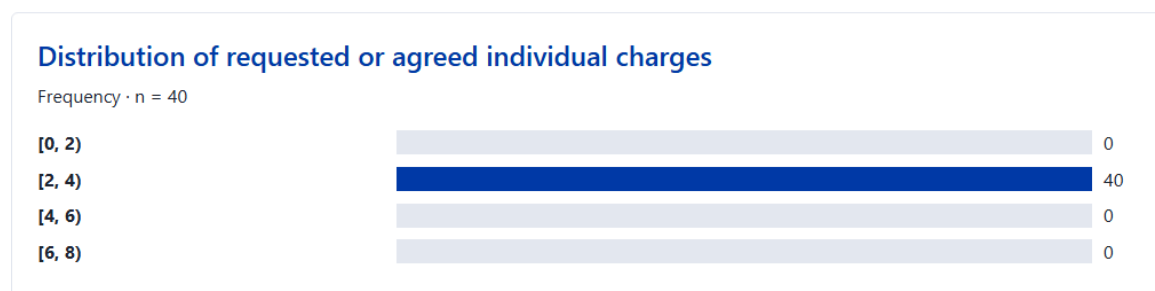


Figure 5.3: Read the histogram's quantity, intervals and person-round denominator.

The position table separates A, B and, when relevant, C. It reports the number of completed observations and mean individual charge or quantity, licensing receipts, payments and net profit. In fixed markets, these positions persist; the proposing position alternates within negotiation treatments. In random reassignment, positions need not represent a fixed person over time. Position labels are therefore economic roles in the current grouping, not participant identifiers. Use the

table to see unequal-cost or unequal-share consequences, and avoid inferring a stable personal type from a sequence whose positions have changed.

Results by position					
Position	n	Individual charge / quantity	Licensing receipts	Licensing and agreement payments	Net profit
A	20	3	3	3	18
B	20	3	3	3	18

Figure 5.4: Separate positions and distinguish licensing receipts from net production profit.

The demand diagram shows the last complete market, identified by round, rather than an average market assembled from inconsistent observations. The horizontal axis measures output, the vertical axis measures product price, and the point lies on $P = A - Q$. The separate evolution graph shows mean consumer surplus and total surplus by active round, with both series in ECU. The round table supplies quantity, price, effective charge and the number of complete markets. In a one-round session the graph has a point, not a fictitious trend. In a duration treatment, use the announced phase boundary when interpreting the change.

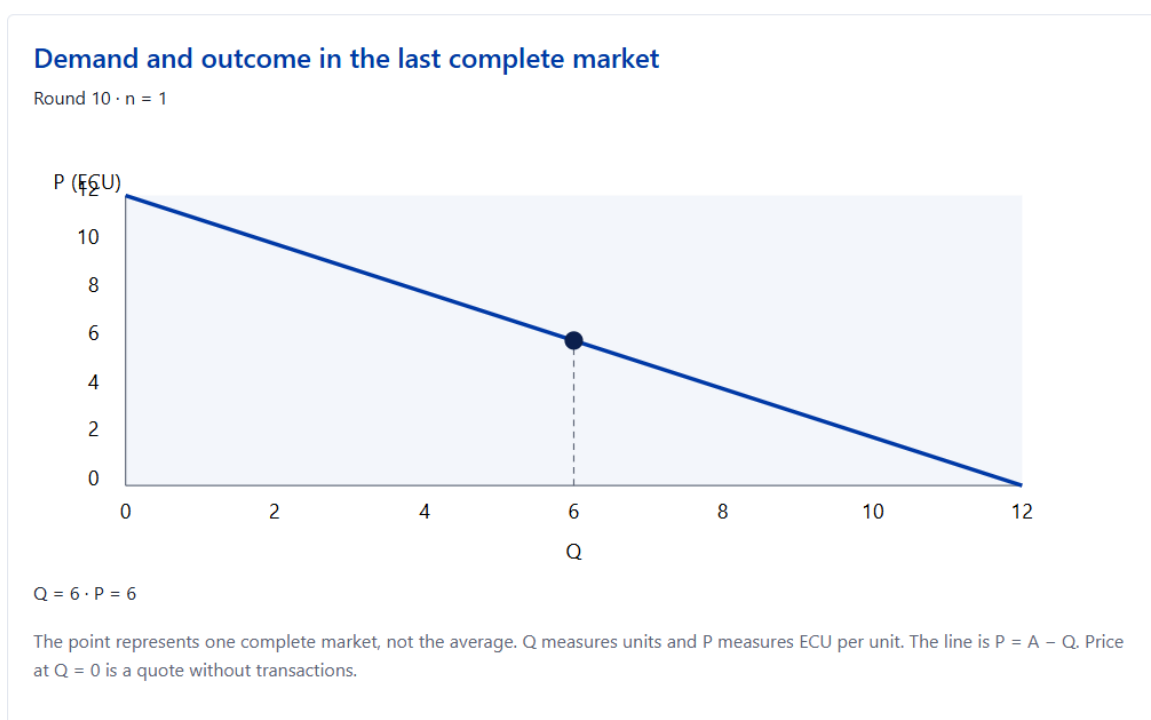


Figure 5.5: The demand point is one actual complete market, not an average.

5.4 What a classroom observation can establish

Separate three claims in the debrief. An observation might be that total royalties fell from 8 to 6, output rose from 2 to 3, and the class accepted more proposals later. A mechanism consistent with that observation is internalization of the pricing externality and learning about counterpart behavior. A stronger conclusion, such as a causal estimate of fairness preferences or the effect of a legal institution in an industry, requires further design and evidence. The application does not



Figure 5.6: Compare round means while retaining each round's market count.

elicit beliefs, research expenditure, patent validity, risk attitudes or intentions. Those mechanisms should not be presented as measured merely because a familiar pattern appears in the report.

The source literature provides theoretical and instructional support, not a promised dataset for this class. [Haugen and Juranek \(2023\)](#) describe classroom licensing experiments and ways to discuss their strategic implications. [Lerner and Tirole \(2004\)](#) develop a theoretical analysis of pools, while [Shapiro \(2001\)](#) organizes broader issues surrounding multiple rights, cross-licenses and standards. This guide does not attach invented treatment averages, statistical significance levels or effect sizes to those sources. Screenshots display fictitious local verification sessions, and numerical examples are calculated from the implemented rules. Actual class behavior should be described as the class's own outcome.

Repeated observations are dependent. Two markets observed for ten rounds are not twenty independently randomized markets, and four students are not forty independent people. The same partner comparison also changes the possibility of learning and informal reputation, even though free-text communication is unavailable. Random reassignment weakens a particular relationship but can still permit repeated meetings. If comparing sections, record assignment procedures, attendance and treatment order. For a rigorous treatment comparison, assign independent markets where possible, hold parameters constant and define the unit of analysis before seeing the results.

Attention

Do not interpret a rise in owner profit as proof of greater efficiency, equal incoming and outgoing royalties as proof of unchanged incentives, or a rejected package as proof of misunderstanding. Reconstruct the specific contract, the continuation after rejection, the product-market response and the distribution of receipts before assigning a behavioral explanation.

Classroom practice and data

6.1 A first class and an advanced comparison

For a 50-minute introduction, allow approximately eight minutes for access, laboratory rules and comprehension; eight minutes for a basic interaction and initial predictions; twelve minutes for a package-license comparison; seventeen minutes for the report and calculations; and five minutes for a short written closure. These are planning estimates, not measured completion times. Keep time for participants who need a specific comprehension correction. Prepare both sessions before class if the laboratory's operation permits it, and make sure students know when they are entering a new session rather than a continuation of the old one.

Before the basic decisions, ask students to record what will happen to quantity when the other owner raises a charge. Collect predictions without showing the equilibrium calculation. After decisions, ask them to reconstruct the result at one anonymous market. Then introduce joint licensing and ask whose objective is changed by choosing a package charge. Reveal aggregate output and price before producer profits. Finish with consumer surplus and total surplus, so the class can distinguish private gains from social gains. A simple board has four columns: contract, product-market response, private distribution and total gains.

For a 75-minute industrial-organization class, use the charge-free and reciprocal-royalty production treatments. Give about ten minutes to the common instructions, twenty to two short sessions, twenty to best responses and the report, fifteen to negotiated royalties or fixed payments, and ten to assessment. An instructor can reduce the number of repeated rounds only after choosing and announcing that horizon in the session configuration. Do not secretly truncate a ten-round session during play. If the class has already studied Cournot, spend less time on algebra and more on why royalties alter the best-response function despite offsetting at a symmetric outcome.

For competition policy or innovation economics, compare complementary and substitute licensing before adding agreement costs or unequal shares. The same cooperation label has different consequences when the technological relationship changes. Ask students to identify the operative technological assumption rather than vote generally for or against pools. Discuss the role of independent alternatives and the difference between access to a package and eliminating competing options. The exercise contains no innovation investment stage, so the static access calculation cannot establish the best long-run intellectual-property policy. That omission is an explicit boundary of the lesson rather than a defect to be concealed.

Feedback script

Ask a student to calculate the accounting result at equal quantities. Then hold the rival's quantity fixed and ask what changes if the student produces one additional unit. The answer must include the outgoing royalty on that new unit and the reduction in product price, while the incoming royalty remains unchanged. This separates equal realized payments from unchanged incentives.

6.2 Worked exercises and response guidance

Exercise 1: independent complementary charges. Under $A = 12$, $c = 0$ and charges 2 and 4, calculate total royalties, output, price and each owner's profit. *Guidance:* $R = 6$, $Q = 3$ and $P = 9$. Receipts are 6 and 12. The downstream firm earns $(9 - 6)3 = 9$, consumer surplus is 4.5 and total surplus is 31.5. Equal total royalties do not imply equal owner receipts. The group can compare this profile with a package charging 6 and splitting receipts equally: output is the same, but ownership income is redistributed.

Exercise 2: a unilateral deviation. Start at charges 4 and 4. If the first owner changes to 3 while the other remains at 4, what happens? *Guidance:* total royalties become 7, output becomes 2.5 and the first owner's receipts become 7.5, below the initial 8. Moving both charges to 3 instead gives each 9 because output rises to 3. One person's deviation and a coordinated change are different comparisons. This calculation explains why mutually better package pricing need not emerge from unilateral incentives.

Exercise 3: a costly package. An accepted charge of 6 yields 18 ECU in licensing receipts. Equal shares and a real agreement cost of 2 per person give each 7. The downstream firm earns 9 and consumers 4.5, so total surplus is 27.5. Compare this with the symmetric independent result of 22 total surplus and 8 per owner. *Guidance:* the package improves total surplus but neither owner privately gains at that charge. The 4 ECU agreement expense is a real cost, while licensing payments between parties are transfers.

Exercise 4: unequal division. The same package charge with 70–30 shares gives 12.6 to the proposer and 5.4 to the responder. *Guidance:* quantity, price and total surplus remain unchanged without an agreement cost. Whether the responder accepts depends on the continuation value and preferences, not on the package's total revenue alone. In a repeated setting, future proposal rights may matter, but the report does not measure a participant's beliefs about those future rounds. Describe that interpretation as a possibility, not an estimated motive.

Exercise 5: substitute technologies. Charges are 2 and 3. *Guidance:* the firm selects the technology charging 2, so output is 5, price is 7, receipts are 10 for that owner and zero for the other. If both instead charge 2, each receives 5. The combined royalty is not 5 in the first profile and not 4 in the second. Ask students to identify the technological rule that determines which calculation applies before performing the arithmetic.

Exercise 6: fixed fees. The two requested fees are 12 and 24. *Guidance:* their sum is 36, so the firm operates at the stated equality rule, produces 6 and earns zero after access payments. Consumers retain surplus 18. If the second fee rises to 25, the sum is 37, the firm does not operate and neither owner is paid. A fixed-fee claim is not automatically an enforceable payment when the automated firm chooses not to enter under the announced participation rule.

Exercise 7: reciprocal payments. With $f = 2$, zero production costs and quantities 2 and 4, calculate profits. *Guidance:* total output is 6 and price is 6. Firm A has sales of 12, pays 4 and receives 8, so its profit is 16. Firm B has sales of 24, pays 8 and receives 4, so its profit is 20. Total royalty receipts equal total royalty payments across firms, but the distribution is unequal.

Consumer surplus is 18 and total surplus is 54.

Exercise 8: another unit. Hold the rival at quantity 3 and compare own quantities 3 and 4 with $f = 2$. *Guidance:* at 3, price is 6 and profit is 18. At 4, price is 5, sales are 20, outgoing royalties are 8 and receipts remain 6, also giving profit 18. This is an integer-grid tie. Producing 5 gives price 4 and profit 16. Equal performance of two neighboring quantities does not make every quantity optimal, and the tie should be recognized when interpreting observed deviations from the continuous reference.

Exercise 9: the three-owner comparison. All three owners choose 3. *Guidance:* total royalties are 9, output is 1.5, price is 10.5 and each owner receives 4.5. The downstream firm earns 2.25 and consumer surplus is 1.125. Total surplus is 16.875. The model displays up to three decimal places for derived quantities; the participants' own payments in these examples remain compatible with the two-decimal ECU account. Compare the total burden and output with the two-owner case rather than concluding that lower individual royalties necessarily help consumers.

Exercise 10: duration and inference. Output rises after royalties disappear in round 6. Is that a causal estimate of the effect of patent expiration on innovation? *Guidance:* no. The activity changes access charges but contains no innovation decision, and the phase also occurs later in the session. The change illustrates the model's access mechanism. A separate stable-rule session or randomized market comparison could improve the design for a narrower access question, while an innovation question requires a different stage and data.

6.3 Exporting, organizing and protecting session data

The report's download button creates a long-format CSV for the open session only. Each row represents a participant in an active round; repeated sessions therefore have several rows per person. Pending rows are retained. Uncalculated outcome fields remain empty, while an observed zero is exported as zero. A missing submitted charge can also be legitimate: an accepted package assigns the charge without another independent choice, and the charge-free phase requires no charge. Distinguish those cases using agreement, phase, completion and effective-decision fields. Do not replace every empty cell with a numerical zero.

The custom export records session and participant identifiers, round, language, edition, treatment, matching, market, position, completion, submitted decision, proposal, agreement, parameters, reciprocal charges, account, comprehension attempts, effective individual values, transfers, profit, score and market outcomes. Identifiers are needed for analysis and session separation, but they are absent from the projected report. Save the original CSV before deriving a teaching table. Preserve round and market membership when examining adjustment, and explain whether an average uses people, person-rounds or market-rounds. In substitute sessions, do not sum each owner's licensed quantity as if all technologies were essential.

The native Data export is a separate option. Its wide file has one row per participant and period-specific columns, including technical columns for up to ten periods even if fewer were active. Those columns are not proof that participants skipped a required decision. Filter by configured active rounds and completion, or use the report's own active-round file. Native application and custom exports can also be downloaded for a selected session. Ensure the selected session code is included in the download route when isolating one class. A global Data download can contain several fictitious or real sessions from this family.

6.4 Troubleshooting and a short assessment

If a participant remains on a wait page, first check whether the other required person has submitted the current decision. In a proposal stage, distinguish waiting for the proposer from waiting for acceptance; in an independent decision stage, every member must respond. If attendance is incompatible with the market size, prepare a valid session rather than pretending an absent owner has charged zero. If a participant link no longer exists, use a link from a new session in the current database. Refreshing the server is not a reason to reset a production database or delete data from an earlier class.

If output is unexpectedly low, reconstruct demand, cost, total or minimum royalty, fixed-fee threshold and agreement status. A substitute session accidentally interpreted as complements produces a misleading explanation even when the code is correct. If the report seems empty, check progress and active rounds before concluding that data were lost. If a download opens in one spreadsheet column, import it as a comma-delimited UTF-8 file. Keep the original download unchanged. For a local preview, remember that localhost addresses work only on the computer running the instance; public access requires the laboratory's deployed hostname.

End with an exit ticket asking students for one equation, one observation and one boundary of the inference. A strong answer explains a response rule or marginal incentive, cites an actual aggregate without identifying a classmate, and states something the activity cannot establish. For example: "The royalty on my extra unit is a marginal cost; in our session quantities fell after a reciprocal charge was introduced; this does not by itself measure the effect of patent policy on innovation." This assessment checks conceptual transfer without rewarding memorization of the exact charge selected by one market.

Checkpoint

Before closing the class, verify that participants reached the completion screen, the intended aggregates were revealed, the session CSV was downloaded, the active horizon is recorded and no individual identifiers were projected. Preserve the original data and record technical interruptions or departures before interpreting patterns.

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