



Instructor's Guide to Market Microstructure

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 prepares instructors to teach a multi-level limit order market and its information variants. It follows the English interface and covers the same basic and extended logic as the Spanish edition. Begin with the summary table and the public-value mechanism; use the numerical reconstruction before comparing institutions. The extended chapter is a menu of teaching contrasts rather than a requirement to run every scenario. Operational instructions, records and limitations are explained once. All screenshots are actual local interfaces, and the published catalogue was checked to distinguish this institution from the existing asset and double-auction activities.

Author

This guide was prepared by Stanislao Maldonado, research professor in the Department of Economics at Tecnológico de Monterrey, Monterrey Campus. For questions or suggestions about its content, please contact the author at stanislao.maldonado@tec.mx.

For the instructor

Use complete eight-person markets and record predictions before revealing the private report. Do not project participant codes or connect outcomes to personal identities. Prepare comparison sessions before opening trading.

Contents

How to use this guide	i
1 Quick reference and access	1
2 Teaching purpose and the economic problem	4
2.1 Why use an order-book experiment?	4
2.2 Learning objectives and appropriate claims	5
2.3 People, resources and the inventory target	5
3 Orders, execution and a complete accounting example	6
3.1 Price-time priority and the resting price	6
3.2 Reservations, affordability and prohibited positions	6
3.3 A sweep through two price levels	7
3.4 Fees, rebates and external accounts	7
4 Theory, evidence and experimental interpretation	11
4.1 Liquidity provision and the cost of immediacy	11
4.2 What the supporting research contributes	11
4.3 Signals, priors and selection into trades	12
5 Extended comparisons and their teaching use	13
5.1 Choosing a reference before interpreting a treatment	13
5.2 Limit orders with public value	13
5.3 Market orders and depth sweeps	14
5.4 A five-ECU price increment	14
5.5 Symmetric execution fees	14
5.6 Maker-taker charges and rebates	14
5.7 Visibility limited to the best level	15
5.8 Finite automatic liquidity provision	15
5.9 An uncertain value with a common prior	15
5.10 Noisy private signals	16
5.11 One exact-information holder	16
5.12 Two exact-information holders	16
5.13 Public disclosure during trading	17
5.14 An informed observer who cannot trade	17
5.15 Observable information types	17
5.16 A two-unit inventory target	17
6 Running a class and interpreting its records	19
6.1 Preparation and access	19
6.2 A feasible 75-minute session	20
6.3 What each report observation means	20

6.4	Session-scoped exports and reconstruction	21
6.5	Exercises with answer guidance	21
6.6	Assessment, troubleshooting and a responsible close	22

List of Figures

1.1	Demo: the eighteen configurations in this language.	2
1.2	Rooms: four isolated family rooms.	2
1.3	Basic room creation form; check group size and duration.	3
3.1	Initial portfolio and available resources.	8
3.2	Two displayed ask levels: 100 and 101 ECU.	9
3.3	Question-specific correction after an incorrect response.	10
6.1	Actual individual settlement.	23
6.2	Revealed private report: summary and denominators.	23
6.3	Timed public release in a 30-second demonstration (Spanish interface).	24

Quick reference and access

Purpose	Understand how orders, reservations, execution and information shape liquidity and prices.
Experimental unit	An eight-person market-period; rematching requires two markets.
Basic edition	One market; ten periods with fixed groups; ten with reassignment.
Extended edition	Fifteen conditions: order types, tick, execution fees, depth visibility, finite liquidity supply, prior, signals, exact information, disclosure, trading restrictions, visible types and inventory targets.
Decision	Submit, cancel or take buy/sell orders subject to available cash and units.
Outcome	Final cash plus units times redemption value plus a separate 50-ECU inventory bonus.
Participants	Eight per market; at least sixteen for basic rematching.
Suggested duration	50–75 minutes including preparation and feedback; trading 300 seconds or 120 per repeated period.
Topics	order book; liquidity; price discovery; transaction costs; asymmetric information; insider information.
JEL	C92; D47; G12; G14.

https://microstructure.beer-lab.org/room/microstructure_en

Attention

The routes are proposed for this new family. The local package is prepared; the public domain requires deployment. Use the isolated local preview at <http://localhost:8103/demo.36> configurations and four rooms belong to this family. One synchronous worker is required; prepare sessions before active trading in the installed local runtime.

[EN] Market microstructure — one market
[EN] Market microstructure — ten periods, fixed groups
[EN] Market microstructure — ten periods, rematched groups
[EN] Extended microstructure — Limit orders and public value
[EN] Extended microstructure — Market orders and depth sweep
[EN] Extended microstructure — Five-ECU price increment
[EN] Extended microstructure — Fee per executed unit
[EN] Extended microstructure — Liquidity provision and taking fees
[EN] Extended microstructure — Best-quote visibility
[EN] Extended microstructure — Automatic liquidity supplier
[EN] Extended microstructure — Uncertain value and common probabilities
[EN] Extended microstructure — Noisy private signals
[EN] Extended microstructure — One exact private signal
[EN] Extended microstructure — Two exact private signals
[EN] Extended microstructure — Public disclosure during trading
[EN] Extended microstructure — Informed observer without trading
[EN] Extended microstructure — Observable information types
[EN] Extended microstructure — Two-unit inventory target

Figure 1.1: Demo: the eighteen configurations in this language.

Rooms

Current rooms:

Microestructura — Básico [ES]
Microestructura — Extendido [ES]
Market microstructure — Basic [EN]
Market microstructure — Extended [EN]

Figure 1.2: Rooms: four isolated family rooms.

oTree Demo Sessions Rooms Data Server Check Logout

Room: Market microstructure — Basic [EN]

Create a new session

Session Config

[EN] Market microstructure — one market

Number of participants

Complete groups of 8 participants. Use a multiple of 8; minimum 8.

Create

[Configure session](#) ⚙️

App sequence

limit_order_market_game (10 rounds)	Price-time priority, reservations, execution and information in a multi-level limit order book.
--	---

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://127.0.0.1:8103/room/microstructure_en

Figure 1.3: Basic room creation form; check group size and duration.

Teaching purpose and the economic problem

2.1 Why use an order-book experiment?

A quotation is an opportunity to trade under conditions. It is not a prediction that an exchange will occur, and it is not necessarily the price available for a larger transaction. Students often arrive in a finance course treating the latest transaction price as if everybody could buy or sell any quantity at that price. A short market makes the missing qualifications visible. A posted buy order commits cash, a posted sell order commits units, and an incoming request may exhaust the first quotation before reaching a less favorable price. These are choices and resource constraints that students can observe directly.

This family teaches those institutions with a single security, eight people per market, a finite trading interval, and explicit terminal redemption. It differs from the laboratory's asset-market activity, which teaches dividends, a declining fundamental value and bubbles across persistent portfolios. It also differs from the continuous double auction for induced buyer values and seller costs. Here the distinctive object is a persistent book with several price levels, quantities, cancellation, partial fills and price-time priority. Insider information belongs to the extensions of this family because it changes who knows the security's value while leaving the same trading institution in place.

Use the activity to ask how a transaction becomes possible before asking whether its price is efficient. A participant choosing a limit order gives up certainty of execution to control price. A participant choosing a market order gives up control over the final execution price to seek immediacy, subject to available liquidity. Neither decision is automatically superior. Their relative appeal depends on the existing book, urgency, information, fees and the chance that the book changes before the message arrives. The exercise makes these conditions concrete without requiring students to master a professional trading platform.

For the instructor

Begin with a public redemption value and limit orders. Ask students to explain a single execution in words: whose order was resting, which request arrived, why the two prices were compatible, how many units could trade, and which resources changed. Introduce information asymmetry only after these questions can be answered.

2.2 Learning objectives and appropriate claims

After the session, a student should distinguish an order from a trade, a limit from an execution price, and cash from total wealth. Students should be able to reconstruct a partial fill, identify the reserved resources remaining after it, calculate a volume-weighted execution price and compare that price with the first visible quotation. They should also distinguish trading gains from an externally funded inventory-target bonus. These objectives are assessable through short calculations rather than a student's willingness to trade frequently.

The experiment illustrates mechanisms under controlled rules. A single class does not estimate the effect of a real exchange regulation. Participants are a convenience group, groups share histories, and their order submissions respond to other submissions. A larger number of trades does not create an equally large number of independent experimental subjects. When comparing treatments, the market-period is usually the relevant assignment unit. Individual outcomes remain useful, especially for explaining how trading gains are distributed, but they do not remove dependence within a market.

2.3 People, resources and the inventory target

Every human trader starts each active period with 500 ECU in cash and five units. ECU means Experimental Currency Units. A public-value period redeems each unit at 100 ECU, so initial marked wealth is 1000 ECU. In uncertain-value conditions the redemption value is 80 or 120 with equal probability. Initial marked wealth is therefore 900 or 1100, although initial cash and units are unchanged. Trading gains compare final pre-bonus wealth with that same period's initial portfolio at the realized redemption value. This comparison prevents a favorable value draw from being mislabeled as trading skill.

Each ordinary trader receives a private inventory target: increase or decrease holdings by at least one unit relative to the initial five. Reaching the target adds 50 ECU, financed by an external teaching account. The target creates a reason to trade even when the value is public. A buyer who pays 101 for a unit worth 100 loses 1 in trading wealth but can gain 50 from meeting a one-unit target. That action can be sensible within the activity. The higher-target treatment requires two net units for the same 50-ECU bonus; it does not pay 50 for each unit traded.

Targets concern final net inventory, not turnover. Buying and then selling one unit does not meet a purchase target if holdings return to five. Selling four units and buying three leaves net holdings one below the starting amount and meets a one-unit sale target. The target is private; students should not announce it. Its direction follows a stated seat-and-period rule and changes across periods. A restricted exact-information observer has no trading permission and no bonus target, so an unattainable target is not assigned to that person.

What participants will see

Before deciding, identify three quantities on your screen: cash available for another buy order, units available for another sell order, and the final inventory needed for your target. Reserved cash remains part of your cash balance, but it is unavailable for a second commitment. An inventory bonus is part of this activity's payoff rule, not evidence that a trade created value.

Orders, execution and a complete accounting example

3.1 Price-time priority and the resting price

An incoming limit buy at 102 may trade with a resting sell at 98 because the buyer permits a price up to 102 and the seller accepts 98. The transaction price is 98, the price already in the book. The buyer's willingness to pay 102 does not change that price. If the lowest ask is 103, the request cannot execute immediately and the unfilled buy remains at 102. A new participant may later sell into it. Likewise, an incoming sell at 97 can execute against a resting buy at 99, at 99.

The engine first sorts compatible opposing orders by price: lowest asks for a buy, highest bids for a sell. At an equal price, the earlier server sequence has priority. The browser's clock does not determine this sequence. A participant cannot backdate an order or gain priority by editing a client timestamp. Changing an order is implemented by cancellation and a new submission; the new order receives a new sequence. This teaches the difference between keeping queue position and revising a price.

A limit order can be partly executed and partly retained. Suppose a sell offers three units at 100 and a new buy seeks one unit at 102. One unit trades at 100; two units remain offered at 100 with the original priority. Cancelling afterward removes only those two remaining units. It does not reverse the completed trade. The interface labels this action as cancellation of the remainder. Students should be able to point to both the completed transaction and the surviving commitment before the instructor reveals aggregate outcomes.

3.2 Reservations, affordability and prohibited positions

The system reserves the cash required by outstanding buys and the units required by outstanding sells. With no fees, a pending buy of two units at 100 reserves 200 ECU. The trader still owns 500 in cash but has only 300 available for another order. A second buy of four units at 90 would need 360 and is rejected. Without this rule, several apparently affordable orders could execute together and create unintended borrowing. Reservation is therefore an economic constraint as well as a software requirement.

Sell orders use the same logic for units. A trader holding five units who offers four has only one unit available for another sell. The activity does not permit short sales. Units bought in a completed trade become available for later sale, and sale proceeds become available for later buys, after allowing for fees and existing commitments. Cancellation releases the remaining reservation immediately. At the close, all unfilled orders expire and all remaining reservations are released;

final wealth is calculated from actual holdings rather than displayed order quantities.

Fees are reserved conservatively. A limit buy includes the highest positive per-unit fee that it could incur as either a resting or incoming order. This may reserve more than the fee ultimately paid, but prevents a filled order from exhausting cash that has already been promised elsewhere. A market buy checks the cost of its feasible execution plan against available cash. Unfilled market quantity does not become a new reservation. The same account cannot trade with itself: an opposite-side own order that would be crossed must first be cancelled.

Checkpoint

For any accounting exercise, write initial cash, initial units, outstanding commitments, executed quantity, execution price and fees in separate columns. Check available cash and units before the next request. At settlement, remove commitments and retain only actual cash and actual units. This sequence catches most student errors.

3.3 A sweep through two price levels

Consider three traders with the standard 500 ECU and five units. The first posts a sell of two units at 100. The second posts a sell of two units at 101. A third trader submits a market buy for three. The order takes both units at 100 and one unit at 101. Total spending is 301 ECU, average price is $301/3 = 100.333\dots$, and the buyer finishes with 199 ECU and eight units. The first seller ends with 700 ECU and three units. The second ends with 601 ECU and four units, with one unit still offered at 101.

The first visible ask was 100, but three units were not available at that price. Measured against that initial ask, the buyer's average execution price is about 0.333 ECU higher per unit. This is a simple example of slippage caused by consuming displayed depth. It is not a fee and does not imply an error in price-time priority. A limit buy for three at 100 would instead acquire two units at 100 and leave a one-unit bid at 100. That choice protects the price but leaves the intended quantity incomplete.

At a public redemption value of 100, the market buyer's wealth is $199 + 8(100) = 999$. Relative to initial wealth of 1000, trading gain is -1 . If this person had a purchase target of one or two units, the final inventory satisfies it and adds 50, producing 1049 ECU. The bonus does not erase the trading loss: report the components separately. The first seller has wealth 1000 and zero trading gain; the second has wealth 1001 and a trading gain of 1. Before bonuses, the human trading gains sum to zero when fees are absent and there is no external liquidity supplier.

If the buyer requests five market units when only four are available, only those four can execute. Any remaining market quantity is cancelled. The engine does not invent a seller, extend credit or leave an unlimited buy in the book. An empty opposite side produces no trade and an unfilled cancellation, not an execution at the last price. This is why the interface's recent-trades panel must be read separately from currently executable quotations.

3.4 Fees, rebates and external accounts

In the symmetric-fee condition, each side pays 1 ECU per executed unit. A one-unit trade at 100 transfers 101 from the buyer, credits 99 to the seller and leaves 2 with the external exchange operator. If an order never executes, it pays no execution fee. Cancelled quantity pays none either. The two fees reduce participants' combined wealth by 2, while the expanded accounting including the exchange remains balanced. A student who sums only buyer and seller cash should therefore

expect a difference equal to the fees.

The maker-taker condition gives the resting side a 0.5-ECU rebate and charges the incoming side 2 ECU per unit. A resting seller at 100 receives 100.5; the incoming buyer pays 102. The exchange retains 1.5. If the resting order is a buy, that buyer pays 99.5 and the incoming seller receives 98. The rebate changes the distribution of execution costs, but it does not guarantee that posting a limit order is preferable. A limit order may never fill or may be selected precisely when its price becomes unfavorable.

Theoretical foundation

Pre-bonus wealth is cash plus final units at realized redemption. Trading gain subtracts the same-period initial portfolio marked at that value. Experimental payoff adds the inventory-target bonus. In symbols, $W_i = C_i + q_i V$, $G_i = W_i - (500 + 5V)$ and $P_i = W_i + B_i$. These quantities answer different questions and should not be used interchangeably.



Period 1/1

Trading decisions

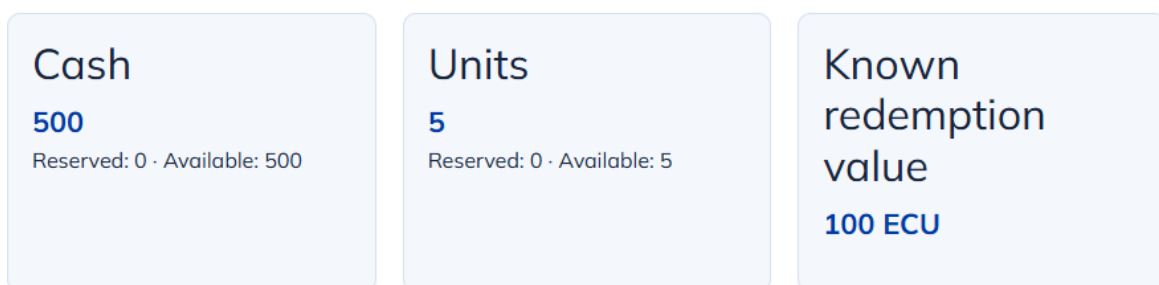


Figure 3.1: Initial portfolio and available resources.

Public order book			
Best-quote spread: —			
Bids		Asks	
Price in ECU	Quantity	Price in ECU	Quantity
		100	2
		101	2

Figure 3.2: Two displayed ask levels: 100 and 101 ECU.



Period 1/1

Trading decisions

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.

Comprehension check

How much cash do you receive at the start of each period, in ECU?

Your answer: 400. The correct answer is 500. Initial cash is 500 ECU plus five units; cash and total wealth are different quantities.

A resting sell order asks 98. A new buy limit allows up to 102. At what price does it execute, ignoring fees?

Your answer: 102. The correct answer is 98. The resting order sets the execution price: 98 ECU; 102 is the buyer's maximum.

In an example without fees, how much cash does a pending two-unit buy at 100 ECU reserve?

Your answer: 100. The correct answer is 200. Without fees, two units at 100 ECU reserve $2 \times 100 = 200$ ECU.

[Continue](#)

Figure 3.3: Question-specific correction after an incorrect response.

Theory, evidence and experimental interpretation

4.1 Liquidity provision and the cost of immediacy

Displayed depth is a set of commitments, not a promise that future orders will appear. A trader posting a limit sell makes units available at a stated minimum price. A trader taking that order obtains immediacy at the existing terms. Provision and consumption of liquidity are therefore roles of orders, not permanent identities of people. The same person may post an order, cancel it, and later submit an aggressive limit or market order. Analyze the sequence rather than assigning a behavioral type from one action.

The spread is the best ask minus the best bid when both exist. If the best bid is 98 and ask 102, the quoted spread is 4 ECU. If one side is absent, the spread is undefined. Coding an absent side as zero would produce a fictitious measure and bias an average. The report excludes those snapshots from the spread mean and shows its observation count. Depth is measured separately, and the printed price distribution uses actual executions rather than unexecuted intentions.

A wider spread can be compatible with inventory concerns, scarce competition, asymmetric information or a larger price increment. This activity does not separately estimate a structural decomposition of the spread. Its value is to let students design comparisons that isolate particular institutions. The public-value market-order condition is the reference for fee and visibility comparisons; the uncertain-value common-prior condition is the reference for information comparisons. Keep duration, participant count, target rule and permitted order types constant when a clean comparison is desired.

4.2 What the supporting research contributes

[Bloomfield et al. \(2005\)](#) study liquidity provision and consumption in an experimental electronic market with different information and liquidity motives. Their work supports teaching the decision to make or take liquidity and examining how order choice relates to information. The present software is a classroom adaptation with its own budgets, targets, quantities and fee schedules. It does not reproduce their treatment estimates or claim that the numerical parameters below are empirical estimates. Students should read the study for its question and design, then identify which elements this activity retains and simplifies.

[Plott and Sunder \(1982\)](#) examine information aggregation in experimental security markets with insider information. Their framework motivates comparing what individual traders know with what becomes reflected in market prices. An informed trader's presence does not mean every execution

instantly equals the realized value. The uninformed population's common prior, incentives to trade, remaining time and endogenous order selection all matter. Here the common-prior reference and one- versus two-exact-card conditions make those distinctions discussable with a single book.

[Glosten and Milgrom \(1985\)](#) provide a theoretical account connecting trading against heterogeneous information with bid and ask prices. That theory motivates a question about adverse selection, not a claim that this activity estimates the model's parameters. The classroom's finite students choose their own quotes, and the automatic supplier uses finite standing orders rather than a strategic pricing algorithm. An observed spread change is evidence to describe under these rules; the theoretical mechanism remains a hypothesis whose relevant assumptions should be checked.

4.3 Signals, priors and selection into trades

In uncertain-value periods, V equals 80 or 120 with equal probability. A noisy card is correct with probability 0.75, independently across people conditional on V . With the symmetric prior, a high card implies a posterior probability 0.75 of the high value and an expected value $0.75(120) + 0.25(80) = 110$. A low card implies expected value 90. These are values of information before accounting for other traders' actions, the target bonus and fees. They do not mechanically dictate a limit price.

An exact card reveals 80 or 120 without error. This gives its holder information that can be valuable, but profitability is not guaranteed. Other traders may avoid unfavorable orders, prices may already incorporate the value, or target incentives may lead the informed holder to accept a trading loss. Realized gains also depend on which opportunities actually execute. Comparing submitted quotes with executed trades helps explain selection: a favorable-looking limit order that never trades contributes no realized gain.

Do not identify increased price accuracy with a welfare improvement of equal size. One trader's pre-bonus gain is another account's loss, except for fees and external supplier participation. More accurate prices can coexist with losses to traders whose targets give them a reason to seek execution. Report accuracy, distribution and trading volume separately. If a treatment changes the target or fee as well as information, those additional channels must be included in the interpretation.

Extended comparisons and their teaching use

5.1 Choosing a reference before interpreting a treatment

The extended selector contains fifteen conditions, including the limit-only reference. This is a set of experimental comparisons, not a recommended sequence that every class must complete. All conditions use the same accounting, price-time matching and eight-person market. Except for the limit-only reference, market orders are enabled. Public-value institutional comparisons should use the market-order condition as their reference. Information comparisons should use the uncertain-value common-prior condition. This distinction avoids attributing an order-type effect or a value-distribution change to the feature named in a treatment.

The parameter values are classroom choices. The supporting papers motivate mechanisms and comparisons; they do not establish that a fee of 1, a rebate of 0.5 or a target bonus of 50 is an empirically optimal amount. The instructor may edit the trading duration through session creation, within the allowed range. Changing economic parameters in code requires corresponding instructions, reservations and validation. The software deliberately does not add borrowing, short sales, hidden venues or adaptive dealer strategies to these conditions.

5.2 Limit orders with public value

The basic reference permits limit orders only and publicly redeems units at 100. A limit order can nevertheless execute immediately if it crosses the best opposite quotation. Thus, limit-only does not mean every submitted order waits. Ask students to compare a buy limit of 100 with a buy limit of 101 when asks exist at 100 and 101. The second may take more depth, while the first leaves an unfilled remainder. The reference makes the price-versus-quantity choice visible before introducing a separate market-order control.

Expect compatible orders to execute according to the rules, but do not promise convergence to 100. Targets can make some prices around 100 acceptable even when they imply small trading losses. The report can show a nonzero spread and no transactions in a rationally cautious group. In feedback, first reconstruct one accepted order and one unfilled order. Ask what additional order would have been needed to execute the latter. The relevant outcome is institutional understanding, not a required level of turnover.

5.3 Market orders and depth sweeps

This condition adds a market-order option. Its remainder is cancelled rather than posted. The request consumes opposing levels in the same price-time order used by an aggressive limit order. Compare realized average execution price with the best quote visible before submission. A multi-level sweep can make the average less favorable without any fee. A market request into an empty book simply fails to acquire units; it is not a guaranteed fill contract.

The interface previews the visible execution plan. The preview is conditional on the displayed book and cannot reserve a future quote. If another request arrives first, execution can differ. Use the replayed sequence to explain such a difference rather than treating it as evidence of a broken rule. The report's average price is quantity weighted, whereas the recent-trades display lists individual fills. Have students calculate both and explain why averaging fill prices without their quantities can give a different answer.

5.4 A five-ECU price increment

The coarse-tick condition requires prices to lie on increments of 5 ECU instead of 1. An attempted quote of 102 is rejected; 100 and 105 are admissible. Order quantities, budgets and matching priority remain unchanged. The larger grid restricts how finely traders can improve quotes and can increase the smallest positive two-sided spread. It does not mechanically determine how much depth appears at each admissible price.

Ask the class to consider a trader willing to buy at 102. With the coarse grid, a quote at 100 preserves price discipline while 105 permits paying more than the original willingness. A student should not say that the system rounds 102 to a preferred price; it rejects the request and leaves the choice to its author. Compare spread snapshots and price levels with the market-order reference. Distinguish the mechanical grid restriction from the endogenous change in posted quantities or willingness to provide liquidity.

5.5 Symmetric execution fees

Each executed unit charges 1 ECU to the buyer and 1 to the seller. Orders and cancelled remainders do not pay this fee. Because buys may become resting or incoming orders, the reservation includes the possible positive charge. A student inspecting only a quote of 100 must therefore recognize that the net cost or receipt is not 100. The numerical example in the accounting chapter provides the benchmark for tracing the exchange's 2-ECU receipt.

A plausible prediction is that costs discourage some otherwise acceptable trades, but target bonuses can preserve demand for execution. Compare volume, target attainment and pre-bonus trading gains, not only final payoffs. If all students meet targets despite fees, a similar final payoff does not show that costs were irrelevant. Ask whose account gained the fees and whether a fee reduction would change total human wealth holding the same trades fixed. This is an accounting counterfactual, distinct from predicting behavioral adjustment.

5.6 Maker-taker charges and rebates

The resting side receives a 0.5-ECU rebate and the incoming side pays 2 ECU. The rule follows the role of an order in each execution, not a permanent classification of a person. A partly executed incoming limit order may leave a remainder that later becomes a resting order and earns the rebate

on later fills. This is a useful case for demonstrating why a trader's fee cannot be assigned from the label chosen at initial submission alone.

The incentive to provide liquidity strengthens through the fee schedule, but execution risk and adverse selection remain. Use order events and completed trades to compare the amount posted with the amount actually filled. A large number of limit orders need not imply high realized liquidity if they are quickly cancelled. The report separates net exchange receipts from participant wealth. Ask students to explain why the exchange receives 1.5 per unit here rather than 2, and why a rebate should not be added again if it already entered cash.

5.7 Visibility limited to the best level

Only the best displayed price and its aggregate quantity on each side are published. Deeper orders still exist, reserve resources and participate in matching. Traders continue to see their own pending orders at all levels. The change concerns public information about depth, not the matching institution or the persistence of orders. A market order may therefore sweep levels that the trader could not previously inspect.

The preview uses visible depth and should be described as incomplete in this condition. It is not a private channel revealing the hidden portion of the book. Compare realized execution cost with the visible first-level information and with full-depth visibility. A difference can illustrate uncertainty about execution quality. Do not conclude that lower displayed depth means fewer underlying orders: in this treatment the observation rule itself has changed. The instructor's private data retain the full book events needed to make that distinction.

5.8 Finite automatic liquidity provision

An external account starts with 1000 ECU and ten units. It posts a bid for four units at 95 and an ask for four at 105. These are finite standing orders; they are not replenished. The automatic account has the same cash and inventory constraints as other accounts and enters the expanded conservation checks. Its role is to supply an initial set of executable opportunities, not to simulate a sophisticated dealer.

A student can buy up to four automatically offered units at 105 while depth remains, or sell into the 95 bid. Other human orders can improve those quotes and obtain priority by price. The supplier can lose or gain at terminal redemption, so its account must be included when reconciling human gains. A decline in human search costs does not imply a costless institution. Ask which account provided immediate execution and how its inventory changed. Avoid interpreting this finite quote intervention as a test of an optimal adaptive market-making strategy.

5.9 An uncertain value with a common prior

No human receives an exact or noisy value card. Everyone knows that redemption is 80 or 120 with equal probability. This condition supplies the information reference while retaining market orders and the same resources and targets. Uncertainty about value can discourage trade absent some separate reason to transact; the inventory bonuses provide such a reason here. Low trading volume is therefore meaningful and should not be hidden by forced transactions.

The unconditional expected redemption is 100, but the realized value is not necessarily 100. A trader can finish with a loss relative to the realized value without having made an unreasonable decision under the prior. Use the pre-bonus benchmark evaluated at the realized value to describe

gains, then discuss information available at the decision time. Ask students to separate a favorable value draw from gains due to acquiring units cheaply from a counterparty. The raw session records allow the two channels to be reconstructed.

5.10 Noisy private signals

Every trader receives a private card correct with probability 0.75. Cards are conditionally independent given redemption. With the common symmetric prior, the two standalone expected values are 90 and 110. Traders do not observe other private cards. The rule creates different private valuations of the same eventual asset rather than separate private redemption values. All units ultimately redeem at one common realized value.

Compare price error and trading gains with the common-prior condition. The information may enter prices unevenly as quotes and executions select among people and histories. A string of trades near 110 does not establish that all traders saw a high card. Ask what additional information would be required to infer the market's posterior from its order flow. For assessment, have students calculate the standalone posterior first and then explain why conditioning on observed orders is a different exercise. The report does not label that calculated posterior as an elicited belief.

5.11 One exact-information holder

One seat receives the exact redemption value. The remaining seven know the prior. The number of exact cards is announced, but personal identities are not disclosed in this condition. The exact seat rotates by period; it is not an additional participant. Initial money and units do not depend on information status. This makes the role difference interpretable as information, subject to differences in targets and realized trading opportunities.

Exact knowledge creates opportunities only if counterparties offer compatible prices. Compare pre-bonus gains across information roles and price error over the period, while keeping the target component separate. If the informed role loses, examine its trades before claiming that information is harmful. The target, fees and selection of available orders can explain the result. Ask whether information could have been valuable as a reason not to accept an order. An absence of trading is a possible information response, not a software failure to be repaired.

5.12 Two exact-information holders

Two seats receive the same exact value. This changes the number of informed traders while holding their information quality constant. Their opportunities may compete: a favorable resting order taken by one is unavailable to the other. Competition can accelerate information incorporation and reduce informed rents, but those are hypotheses rather than guarantees for every classroom realization.

Compare this condition with one exact holder under the same public uncertainty, order types and targets. Use total informed pre-bonus gains as well as the per-person average; otherwise doubling the number of informed seats changes the denominator mechanically. Also examine uninformed gains and aggregate volume. Ask why an improvement in accuracy can coexist with a fall in each informed trader's gain. The finite number of favorable counterparties and endogenous changes in their quotes provide possible explanations that can be checked in the event sequence.

5.13 Public disclosure during trading

One trader initially receives an exact card. When half of the configured maximum trading time elapses, the value becomes public to everyone. The server controls this release; the browser cannot request early disclosure. After release, previously submitted orders remain unless their authors cancel or counterparties execute them. That persistence creates a useful distinction between learning a value and updating outstanding commitments.

Use the event timestamp of disclosure to divide the sequence into before and after intervals. Compare price error and quote adjustment, recognizing that later trades come from a different remaining book. Do not interpret that within-period comparison as a randomized time effect: time remaining and inventory also change. Ask which old orders became attractive or unattractive after the announcement. A teacher demonstration can use a short configured duration, but its screenshots should be identified as a timing demonstration rather than behavioral evidence from a full class.

5.14 An informed observer who cannot trade

One exact-card holder may observe but cannot submit buy or sell orders. The engine enforces that restriction even if a modified browser attempts a request. The observer has no bonus target in that period and retains the initial portfolio until redemption. Other traders know the announced rule but do not receive the value through the observer's private screen. Communication outside the application remains prohibited.

Compare this condition with one tradable exact holder to discuss an information channel removed from order flow. A gain comparison needs care because the observer also lacks a bonus target. Use pre-bonus wealth and the fixed initial portfolio as the relevant baseline, not final payoff alone. This is a hypothetical experimental rule, not an account of current securities law. Ask how price discovery could change when an informed person is present but unable to reveal information through trades, and what outcome would test that channel more directly.

5.15 Observable information types

Orders show whether their author has an exact card or only the common prior. They do not display names, student identifiers or private inventory targets. This treatment changes the information content of order authorship while preserving prices, quantities and priority. A quoted price can now be interpreted jointly with an anonymous information-type tag. The exact value itself remains private until ordinary settlement.

Visibility can cause counterparties to respond differently to orders associated with exact information. That response may reduce informed opportunities or change how information enters prices. It need not reduce every measure of liquidity. Compare submitted and executed orders across types rather than interpreting a lower informed trade count as lack of interest. In feedback, ask why a trader might refuse an otherwise executable order after learning the information type of its author. Keep the discussion about experimental roles and never connect a role's outcomes to a named classmate.

5.16 A two-unit inventory target

The required net change is two units rather than one, while the bonus remains 50 ECU. Initial cash, holdings and redemption are unchanged. This condition increases the quantity needed to earn the

target reward; it does not increase cash resources or require a fixed number of transactions. One two-unit execution and two one-unit executions can satisfy the same net goal. Round trips that return inventory to five still do not.

Compare depth consumption, completion of targets and trading gains with the one-unit market-order reference. Stronger quantity pressure can increase willingness to accept worse prices, but the bonus per required unit is lower. These channels work in different directions, so a prediction should state the assumed behavior. Ask students to calculate the largest loss compatible with a positive total target benefit for a given transaction plan. The report's separate trading-gain and bonus columns make it possible to discuss quantity pressure without describing every costly trade as a mistake.

Running a class and interpreting its records

6.1 Preparation and access

Begin at <https://beer-lab.org/en/> and select CLASSROOM to open <https://teaching.beer-lab.org/en/>. The public catalogue supports title, topic and JEL filters. This new family's proposed domain is <https://microstructure.beer-lab.org/>. Its availability depends on the laboratory's deployment; a locally completed package does not make a public room available automatically. The local rehearsal address is <http://localhost:8103/demo>. Use the same hostname throughout an administrative visit, because localhost and 127.0.0.1 have different browser cookies.

Prepare complete groups of eight. Basic rematching requires at least sixteen people so there is more than one market to reshuffle. With sixteen or twenty-four participants, several independent books run within the same session. They do not share cash, orders or quotations. The basic selector offers one market, ten periods with fixed groups and ten with reassignment. A single basic market has a maximum of 300 seconds. The repeated basic configurations use 120 seconds per period. The instructor may edit duration, from 10 to 900 seconds, before creating the session. A very short duration is appropriate for checking screens, not for claiming a behavioral treatment effect.

Create the sessions and check the language before distributing participant links. Prepare comparison sessions before active trading begins; this avoids mixing administrative creation with live activity in the installed local runtime. The application uses one synchronous worker per family instance. Multiple workers require a separate deployment validation of database locking and must not be enabled merely to increase capacity. These are operational constraints for the laboratory administrator, not extra choices for students. Preserve local and historical databases when restarting a preview; restarting code is not a reason to erase sessions.

The four rooms distinguish Spanish basic, English basic, Spanish extended and English extended. Basic menus contain three configurations each; extended menus contain fifteen each. Demo therefore contains 36 configurations, and Rooms contains four entries, all belonging to this family. Students follow the room their instructor assigns. The instructor uses authenticated session administration, participant links, monitoring, the private report and Data. Do not project individual participant links or raw export identifiers. After a completed episode, use the explicit final page as confirmation rather than sending students to the end of oTree's technical page list.

6.2 A feasible 75-minute session

Spend ten minutes explaining the initial portfolio, the inventory target and a resting-price example. Give only the neutral instructions needed to act; do not tell students that a treatment should improve efficiency or induce aggressive trading. Allow five minutes for comprehension checks and individual questions. Run a five-minute public-value market, then spend ten minutes reconstructing one completed fill and one cancelled remainder. This first discussion establishes shared command of the institution before a comparative condition is introduced.

Use the next fifteen minutes for a second prepared market and its transition, followed by ten minutes of small-group accounting. Allocate ten minutes to reveal and compare aggregates and ten to an individual written exercise. If a class is shorter, omit the second market and complete the accounting exercise carefully. A longer course can devote separate sessions to order types, information and fees. Completing every condition in one sitting is neither necessary nor desirable, because fatigue and cumulative learning would confound the comparisons.

Before revealing results, ask for two predictions that could disagree. For example, wider available depth may lower the cost of a large market buy, while stronger inventory targets may make traders willing to consume that depth more quickly. Have students identify the variable that would discriminate between these predictions. Reveal the report only after the predictions are recorded. Then describe the data, reconstruct incentives and discuss alternative explanations. That order reduces the tendency to invent a unique explanation after observing the outcome.

Feedback script

A practical feedback sequence is: describe one order; trace one execution; close the cash-and-unit accounts; separate the target bonus; read an aggregate with its denominator; compare the relevant reference; and state one conclusion the class cannot establish. End with a revised prediction for a new market, not a judgment about named classmates.

6.3 What each report observation means

A completed market-period is one market whose participants reached settlement. The progress counter distinguishes these completed markets from pending ones. The report can reveal completed aggregates while later periods remain pending. A pending market is not counted as a market with zero trading volume. The role table uses person-period observations, which are correlated within each market. Its wealth measure excludes the target bonus, its gain measure subtracts the marked initial portfolio, and its bonus column shows the externally funded addition.

Volume counts executed units. The transaction count displayed beside it counts fills, so one incoming order that sweeps two levels can create two observations. Mean price weights each fill by its executed quantity. Mean absolute error uses the same unit weights and compares each price with that market's realized redemption value. A price average across uncertain-value markets should therefore not be interpreted without the error measure or the distribution of values. A session with no executions has undefined mean execution price and error; the report shows a dash.

The spread mean uses snapshots taken after accepted order submissions when both sides exist. It is an event-sampled mean, not a time-weighted average spread and not a spread measured after every cancellation. Its N counts qualifying snapshots. The histogram places executed units in bands relative to redemption: more than 10 below, up to 10 below, exactly at value, up to 10 above and more than 10 above. The bar labels and counts should be read together. A narrow distribution can coexist with little volume, and an absent bar is not evidence about unexecuted quotes.

6.4 Session-scoped exports and reconstruction

The report's download contains only the selected session and all ten technical rounds. A one-period configuration labels later records inactive. An unfinished ten-period configuration labels unplayed active records pending. The custom file has record types: player, market, event and order. Each player-period appears once, while a market's events and orders are exported once rather than repeated for all eight people. The JSON record column stores the fields appropriate to that type. This arrangement permits both a compact participant table and detailed reconstruction without pretending that every row is another independent subject.

Native wide export places rounds in columns, usually one row per participant. It is useful for checking accumulated outcomes and joining observations across periods. The custom event form is better for studying order sequencing. Retain session, market and round keys before merging. An order number is local to one book; it is not a global identifier across markets. A participant identifier belongs in an authorized private dataset and never in the projected discussion. Keep an untouched original download before cleaning or reshaping the data.

To reconstruct accounts, start with the market record's initial cash and units, including the external supplier when present. Read trade events in server sequence. Subtract price times quantity plus buyer fee from the buyer, add price times quantity minus seller fee to the seller, and transfer units accordingly. Add both fees to the exchange account; a negative fee is a rebate. Orders and cancellations change reservations but not ownership. At the end, verify that initial units equal final units and that cash plus exchange receipts equals initial cash. Add redemption valuation and target bonuses only after this trading ledger closes.

6.5 Exercises with answer guidance

First give a resting sell of three units at 99 and an incoming buy limit of 101 for two. The execution is two at 99, costing 198 before fees. The sell remainder is one unit at 99 with its old priority. If it is cancelled, one reserved unit is released and the buyer's completed purchase remains. A response using 101 as the transaction price confuses a limit with a resting price. Award credit for both arithmetic and the explanation of the institution.

Second give a trader 500 in cash, a pending two-unit bid at 100 and a proposed four-unit bid at 90, with no fees. The first reservation is 200, available cash is 300 and the new request needs 360, so it is rejected. If the first bid is cancelled, all 500 becomes available and the second becomes affordable. Ask why allowing both would create a problem only when several orders execute. This connects a visible rejection to the prevention of double commitment rather than to a preference imposed by the program.

Third give one unit traded at 100 with the resting seller rebate 0.5 and incoming buyer fee 2. The buyer pays 102, seller receives 100.5 and exchange receives 1.5. At redemption 100, the buyer's trading gain from that unit is -2 and the seller's is 0.5. Any target bonus must be added separately. Fourth, ask whether buying one unit and selling it back satisfies a one-unit purchase target. It does not: terminal inventory returned to five. These exercises distinguish accounting competence from broad statements about market efficiency.

Fifth ask what a missing ask means for a spread calculation. The correct answer is an undefined spread, not an ask of zero. Sixth give a high noisy card and the symmetric 80/120 prior. The standalone expected value is 110. Ask whether this guarantees a profitable purchase at 109. It does not: fees, the realized value, other information in order flow and execution selection still matter. An exact card also does not guarantee that somebody offers a favorable compatible order. Explain the difference between knowing an opportunity's value and being able to obtain it.

6.6 Assessment, troubleshooting and a responsible close

A short rubric can assign equal weight to execution rules, resource accounting, payoff decomposition and inference. A student who calculates a correct final payoff but calls the entire bonus trading profit needs revision on decomposition. A student who recognizes asymmetric information but cannot identify the resting price needs revision on the institution. Ask each student to provide one numerical reconstruction and one limitation of the comparison. Neither a high realized payoff nor frequent trading is by itself a sufficient mark of understanding.

If a participant waits, first check that all eight members reached the same stage and that the correct active links were distributed. Do not solve a missing participant by creating a fictitious outcome. If a quote is rejected, read the localized reason: insufficient available cash, insufficient units, a forbidden own-order crossing, an inadmissible increment or a restricted card. Repeatedly clicking with the same resources will not change those constraints. Refreshing is not needed to update the book; the interface receives server updates and preserves stable cancellation controls when nothing relevant changes.

If an old participant link no longer exists, create a new session deliberately and distribute its current links; do not reset a live database to make an obsolete address work. If the report requests login again, verify the hostname and the family's authentication before changing game parameters. A blank execution average can be correct when there are no trades. A partial report can be correct while later periods remain pending. Treat these states as data conditions and navigation issues before considering a model error.

Close by asking what could change the conclusions outside the classroom: heterogeneous risk preferences, borrowing, short sales, adaptive dealers, fragmented venues, latency competition and changing fundamentals are outside this design. They are possible future questions, not mechanisms silently implemented here. The contribution of the activity is a transparent mapping from an order and available resources to execution and payoff. That mapping gives students a foundation for analyzing more complex markets without confusing a familiar label with an institution that has actually been specified.



Period 1/1

Trading decisions

Period result

Cash	199,0 ECU
Units	8
Known redemption value	100,0 ECU
Wealth before bonus	999,0 ECU
Initial wealth valued at redemption	1000,0 ECU
Trading gain net of fees	-1,0 ECU
Bonus for meeting the target	50,0 ECU
Experimental result	1049,0 ECU

[Continue](#)

Figure 6.1: Actual individual settlement.

Instructor report: microstructure

Limit orders and public value

Participants: 8 · Completed markets: 1/1 · Pending markets: 0

[Download this session, all rounds \(CSV\)](#)
[Hide aggregates](#)

	Period result	N
Units traded	4	3
Quantity-weighted mean price	100,5	4
Mean absolute error relative to value	0,5	4
Mean spread when both sides exist	—	0
Net external exchange fees	0,0	1
External target bonuses	100,0	8

Figure 6.2: Revealed private report: summary and denominators.

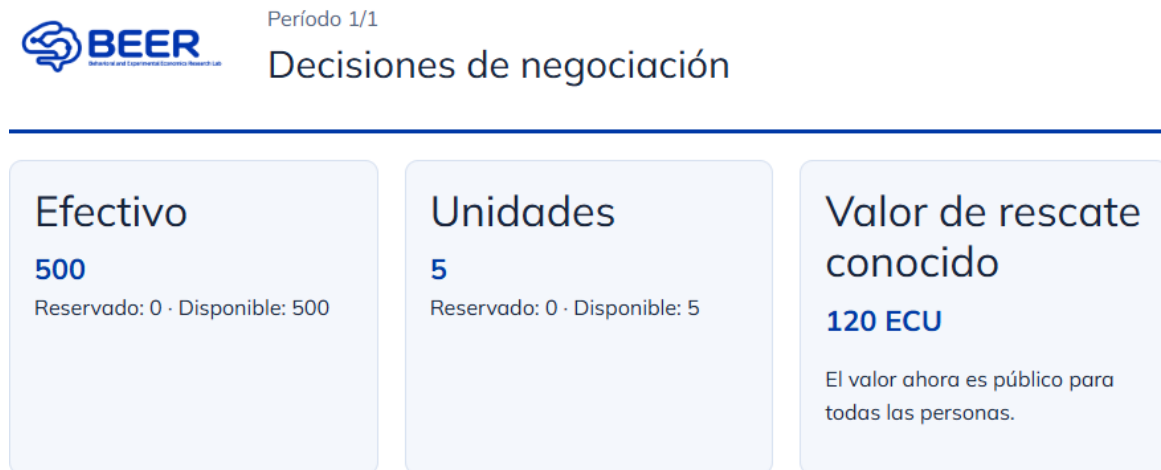


Figure 6.3: Timed public release in a 30-second demonstration (Spanish interface).

Bibliography

- Bloomfield, R., O'Hara, M., and Saar, G. (2005). The “make or take” decision in an electronic market: Evidence on the evolution of liquidity. *Journal of Financial Economics*, 75(1), 165–199. <https://doi.org/10.1016/j.jfineco.2004.07.001>.
- Glosten, L. R., and Milgrom, P. R. (1985). Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics*, 14(1), 71–100. [https://doi.org/10.1016/0304-405X\(85\)90044-3](https://doi.org/10.1016/0304-405X(85)90044-3).
- oTree. Live pages. Official documentation. <https://otree.readthedocs.io/en/master/live.html>. Accessed October 17, 2026.
- Plott, C. R., and Sunder, S. (1982). Efficiency of experimental security markets with insider information: An application of rational-expectations models. *Journal of Political Economy*, 90(4), 663–698. <https://doi.org/10.1086/261084>.