

Asset Market (Bubbles & Crashes)

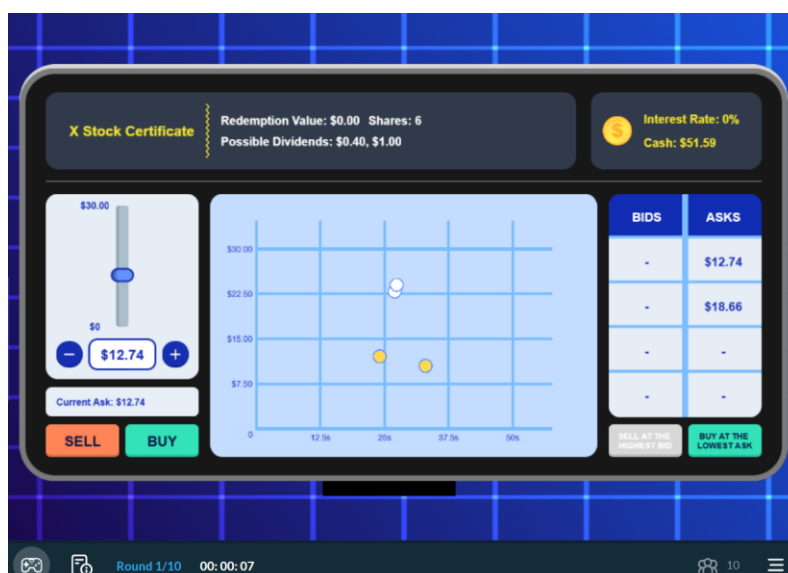
Teaching Note | MobLab x Harvard Business Impact

Primary Topic:	Finance, Behavioral Economics, Financial Markets, Asset Pricing
Typical Duration:	Prep & Instructions: 5-10 min Game: 15-20 min Debrief: 15-20 min
Group Size:	6-20 students per market; multiple markets can run simultaneously
Difficulty Level:	Intermediate / Advanced
Prerequisites:	Basic understanding of present value and expected value. Works well after or alongside a lecture on asset pricing and the Efficient Markets Hypothesis.

1. Simulation Overview

In this simulation, students receive an endowment of cash and shares in a company and trade those shares with each other over 10 rounds using a double auction market. At the end of each round, every share pays a random dividend (either \$1.00 or \$0.40, each with 50% probability) and cash earns interest at the specified rate. After the final round, each remaining share pays a terminal (redemption) value.

The critical feature of the game is that the asset's fundamental value is fully calculable from publicly available information. With default parameters, the fundamental value is simply \$0.70 times the number of dividend-paying rounds remaining — \$7.00 at the start of round 1, falling by \$0.70 each round to \$0.70 in the final round. The maximum possible value (assuming the high dividend is realized every period) is \$1.00 per remaining round — \$10.00 at the start.



In the game, it is common for transaction prices to rise above the maximum possible value as students buy in anticipation of selling later at an even higher price. The bubble eventually collapses, often dramatically, as the end approaches and speculative demand evaporates. Students experience the full arc of a speculative bubble firsthand: the rise, the peak, and the crash.

Default Fundamental Values — Reference Table

With default parameters (dividends of \$1.00 and \$0.40, each 50% likely; no interest; no terminal value):

Round	Max Value (if \$1.00 dividend every period)	Fundamental Value (expected @ \$0.70/period)
1	\$10.00	\$7.00
2	\$9.00	\$6.30
3	\$8.00	\$5.60
5	\$6.00	\$4.20
8	\$3.00	\$2.10
10 (Final)	\$1.00	\$0.70

Key Observation: Any transaction price above the Max Value column is definitively a speculative bubble — it cannot be justified by any realization of future dividends and can only be explained by the expectation of reselling to another buyer at an even higher price (the 'greater fool' theory).

Learning Objectives

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

- **Bubble Formation:** Explain how speculative asset bubbles can arise even when the asset's dividend distribution and terminal value are common knowledge, and identify the belief in future resale at higher prices as the mechanism sustaining prices above fundamental value.
- **The Greater Fool Theory:** Articulate the logic by which individually rational speculative purchases (buying an overpriced asset expecting to sell it to someone else at an even higher price) can collectively produce and sustain a bubble until the supply of buyers runs out.
- **Asset Pricing:** Calculate an asset's fundamental value as the present discounted value of expected future dividends (plus discounted terminal value), and use this benchmark to classify observed transaction prices as consistent with risk-neutral, risk-loving, risk-averse, or speculative demand.
- **Experience and Learning:** Describe how repeated exposure to the game reduces (though does not eliminate) bubble formation, and connect this finding to debates about market efficiency and the conditions under which financial markets learn.

- **Real-World Parallels:** Identify historical and contemporary examples of speculative asset bubbles such as the 2008 U.S. housing market, the dot-com bubble, and cryptocurrency volatility.

2. Classroom Setup

Configuration	Recommended Setting
Number of Rounds	Default: 10 rounds. Sufficient to see the full bubble arc. Fewer rounds compress the timeline but reduce the drama of the eventual crash.
Dividends	Default: \$1.00 and \$0.40, each with 50% probability. Expected dividend = \$0.70/round. Do not change without updating your pre-game instructions. Students need to be able to calculate fundamental value.
Interest Rate on Cash	Default: 0%. Set to 10% (with a \$7.00 terminal value) to produce a flat fundamental value of \$7.00 across all periods
Terminal (Redemption) Value	Default: \$0. With a 10% interest rate and 0% terminal value, fundamental value declines by \$0.70/round. Adding a terminal value can stabilize the fundamental value over time.
Starting Cash	Higher starting cash balances appear to facilitate larger bubbles — students with more cash to deploy are more willing to speculate. Consider this when designing treatment comparisons.
Group Size per Market	6-20 students per market. Larger markets are more liquid and typically produce cleaner bubble dynamics. Smaller groups may see higher price volatility.
Experienced vs. Inexperienced	Run the game in two sessions (same class, different weeks, or across semesters). Experienced players form bubbles less frequently and less severely.
Robot Players	Robots bid randomly between 1x and 4x the expected stock value. This produces a regression toward the mean as expected value falls round by round.

3. Pedagogical Instructions

Pre-Game Briefing

The pre-game briefing is especially important for this experiment because students must understand how to calculate fundamental value before they can recognize a bubble forming. Take 5-10 minutes to cover the following:

- Each student starts with both cash and shares. During each of 10 rounds, they can buy or sell shares in a double auction by submitting bids to buy or asks to sell, or transacting immediately at the best available price.

- At the end of each round, every share pays a dividend: either \$1.00 or \$0.40, each equally likely. Students do not know in advance which dividend will be paid, but the probabilities are common knowledge.
- Walk through the fundamental value calculation explicitly: with 10 rounds remaining, the expected payout per share is $\$0.70 \times 10 = \7.00 . With 5 rounds remaining, it is $\$0.70 \times 5 = \3.50 . With 1 round remaining, it is \$0.70.
- The maximum possible value is $\$1.00 \times$ remaining rounds. Any price above this cannot be justified by future dividends alone.

Instructor Tip: Write the fundamental value table on the board (or project it) and leave it visible throughout the game. Knowing that students can see the benchmark at all times makes it all the more striking when prices exceed it — which they typically will anyway.

The Gameplay Experience

The typical trajectory across 10 rounds follows a recognizable pattern:

- Rounds 1-3 — Prices Rise Above Fundamental Value: Even in round 1, with fundamental value at \$7.00, many transactions occur at \$8-9 or higher. Students with spare cash purchase shares expecting prices to keep rising. The 'ride it up' strategy Prof. Pettis described in Chinese markets ('I know this is a bubble, I'm going to ride it on the way up and I'll be able to get out before it breaks') emerges naturally.
- Rounds 4-7 — The Peak and the Hold: Prices often peak somewhere in the middle rounds, with some transactions well above the max value. Watch for the moment when a few students start trying to sell. Early sellers often get good prices and will have interesting things to say in the debrief.
- Rounds 8-10 — The Crash: As the final round approaches, the logic of the bubble unravels. Students who were buying in hopes of reselling face the reality that there are fewer rounds left and fewer buyers willing to speculate. Prices often collapse sharply — sometimes below fundamental value in a panic. This crash is one of the most vivid moments of the experiment.

Instructor Tip: During the game, resist the urge to comment on prices. Let students discover the bubble and the crash without external framing. After the game, ask: 'Did you know prices were too high? If so, why did you keep buying?' The answers are the heart of the debrief.

Facilitator Checklist

1. Configure rounds, dividends, and starting cash before class. Use Preview Activity to verify the setup.
2. Project the fundamental value table so all students can see it throughout the game.
3. Open the activity and wait for students to join. Add robot players if needed to ensure sufficient market liquidity.
4. During play, monitor the transaction price graph in real time. Note the rounds where prices first exceed max value.

5. After the game, save the results graph (use the Save As Image button at top right) before the debrief.
6. If running a second experienced session, use Repeat to run the same parameters again — do not modify dividends or starting cash so the comparison is clean.

4. Debriefing & Discussion

Plan for 15-20 minutes. Open by projecting the results graph without commentary and asking students to describe what they see. The visual — prices spiking above the red max-value line and then crashing — speaks for itself and generates immediate reactions.

Suggested Discussion Questions

- Look at the results graph. The blue line is the fundamental value, the red line is the maximum possible value. In which rounds were prices above the red line? What does that mean — what would have to be true for that price to be rational?
- During the game, did you know prices were too high? If yes, why did you keep buying? If no, what information were you using to decide prices were reasonable?
- Who made money in this game, and how? Did the people who made the most money do so by correctly valuing the asset, or by correctly predicting what other people would do?
- The game is set up so that the fundamental value is publicly known to everyone. If everyone knows the right price, why don't prices stay at the fundamental value?
- In the final rounds, prices crashed. Why? What changed about the incentives of buyers and sellers as the end approached?
- Think about real-world examples. How does the logic you just experienced apply to those cases? What was different about those markets?
- If you played this game a second time, knowing everything you know now, would you behave differently? Why do experienced players form smaller bubbles but still form them at all?

Theoretical Connections

This experiment connects to some of the deepest and most debated ideas in financial economics:

- Fundamental Value and Discounted Cash Flow: The asset's fundamental value is the present discounted value of expected future dividends. With a 0% interest rate and expected dividend of \$0.70/round, this is simply $\$0.70 \times \text{remaining rounds}$. Prices above this level cannot be justified by any rational assessment of the dividend stream.
- The Efficient Markets Hypothesis: Strong-form EMH predicts that prices should reflect all available information, including the publicly known dividend distribution. The Asset Market experiment is one of the most powerful laboratory refutations of EMH: even with perfect information symmetry, markets consistently produce bubbles.
- Rational Bubbles and the Greater Fool Theory: Purchasing an asset above fundamental value is individually rational if you expect to sell it to someone else at a higher price before the bubble collapses. This 'greater fool' logic requires only that there be someone more optimistic than you willing to buy later. The crash occurs when the supply of greater fools runs out.
- Speculative vs. Risk-Based Pricing: The results graph distinguishes between three regions. Prices between the blue (expected) and red (max) lines are consistent with risk-

loving preferences. Prices below the blue line are consistent with risk-averse preferences. Only prices above the red line require speculative demand — the expectation of resale above intrinsic value.

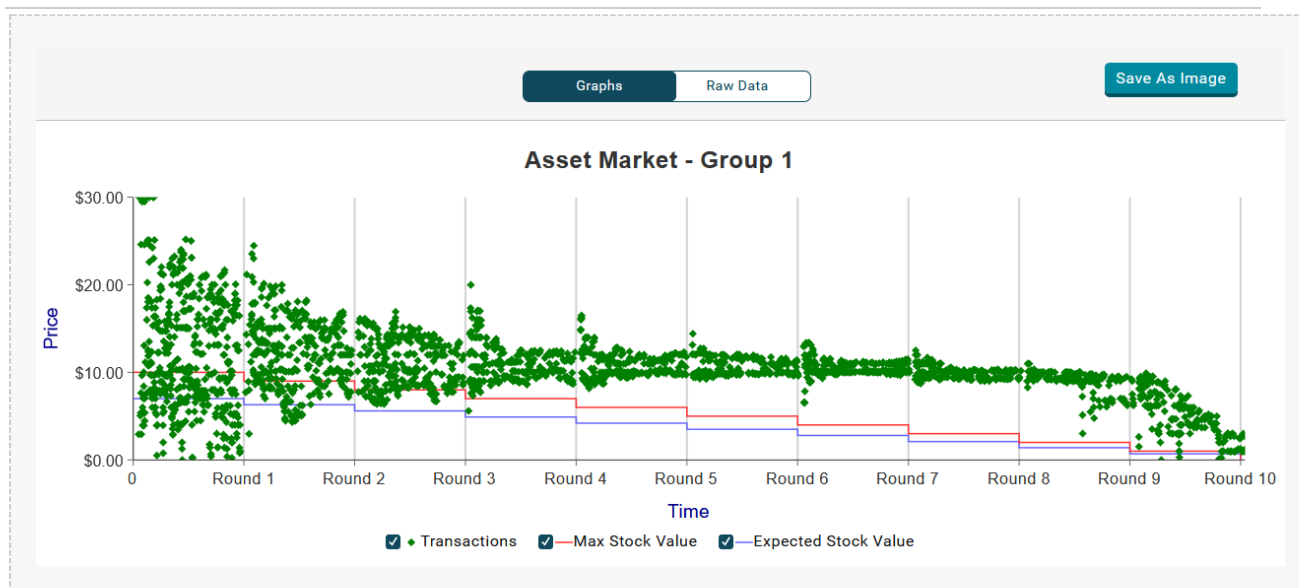
- **Experience and Market Efficiency:** Smith, Suchanek, and Williams (1988) showed that experienced traders form smaller bubbles than novices — a finding replicated in the MobLab data. But experience rarely eliminates bubbles entirely. This suggests markets can learn, but slowly and imperfectly, and only with direct personal experience of the collapse.
- **Merger Arbitrage:** The game's logic extends naturally to merger situations. When a takeover bid is announced at a premium, the spread between the current market price and the bid price reflects the market's collective estimate of the probability the merger will succeed. Hedge funds that buy into this spread are engaging in exactly the same speculative logic as students buying above fundamental value: betting on resale at a higher price.

5. Results & Data Interpretation

Reading the Results Graph

The main results display is a transaction price chart with three reference lines and individual transaction dots:

- **Blue Line — Fundamental Value:** The expected value of the asset if held to the final round, assuming risk neutrality. This is $\$0.70 \times \text{remaining rounds}$ with default parameters. Transactions on the blue line represent rational risk-neutral pricing.
- **Red Line — Maximum Value:** The asset's payout if the high dividend (\$1.00) is realized every remaining period. Transactions above this line cannot be explained by any risk preference — they require the expectation of future resale at a higher price. A cluster of transactions above the red line is evidence of a speculative bubble.
- **Yellow Line — Minimum Value:** The asset's payout if the low dividend (\$0.40) is realized every remaining period. Transactions below this line are consistent with extreme risk aversion or very pessimistic expectations.
- The scatter of dots shows the full distribution of prices in each round. A bubble is visible as a cluster of white and black dots rising above the red line in the middle rounds, followed by a collapse toward or below the blue line in the final rounds.



Common Outcome Patterns

- Classic Bubble and Crash (most common, inexperienced players): Prices rise above the red line by round 2-4, peak somewhere in rounds 5-7, then collapse sharply in rounds 8-10 as the end approaches. The crash often overshoots downward, with prices falling below the blue fundamental value line in the panic.
- Gradual Decline Toward Fundamental Value (experienced players): Prices start closer to fundamental value and track the blue line more closely throughout, though still with upward deviations in the middle rounds. Full convergence to fundamental value is rare even with experienced traders.
- Pre-Crash Selling Rush: Watch for a round where the transaction volume spikes and prices drop suddenly — this is the moment when early sellers trigger a cascade. Students who held shares through this round lose significantly; those who exited just before gain the most. This asymmetry generates excellent debrief discussion.
- Post-Crash Undershoot: After a bubble collapses, prices often fall below the blue fundamental value line as panicked sellers accept any price. This mirrors real-world post-crash dynamics and is a useful discussion anchor for the concept of fire-sale pricing and liquidity crises.

6. Extensions & Variations

Flat Fundamental Value (Asset Pricing Focus)

To combine this game with a focused lesson on present value and asset pricing, configure parameters to produce a flat fundamental value across all periods. With the default dividends (\$1.00 and \$0.40, 50% each), set:

- Interest Rate on Cash: 10%
- Terminal Value: \$7.00

This produces a fundamental value of \$7.00 in every period (the expected dividend of \$0.70 divided by the 10% interest rate, stabilized by the terminal value). This configuration makes the rational price easier to benchmark — it should always be \$7.00 — and makes deviations even harder to justify. Bubble formation under flat fundamental value is a particularly clean demonstration that bubbles are not caused by uncertainty about the fundamental value trajectory.

Teaching Tip: To increase bubble likelihood under the flat fundamental value setup, try doubling both the expected dividend and the interest rate simultaneously. This leaves the fundamental value unchanged at \$7.00 but appears to increase speculative activity — a striking demonstration that bubble formation is not simply about the level of prices.

Experience Treatment

The most powerful single variation is running the game twice with the same group of students — once as novices and once as experienced players. Ideally, run the first session at the start of a course and the second session two to four weeks later (or in a separate class session). Key observations:

- Bubble size (measured as peak price minus fundamental value) typically falls significantly in the second session.
- Bubbles still form in most second sessions — full convergence to fundamental value requires multiple rounds of experience.
- Use the Compare function to show both sessions' results simultaneously. The difference in peak prices is often striking and opens a productive discussion about what 'learning' means in financial markets.

Cross-Disciplinary Connections

- Financial History — The 2008 Housing Crisis: Mortgage-backed securities were priced far above the value of the underlying assets because buyers expected to resell them at higher prices. The collapse followed the same logic as the game's final rounds: when buyers disappeared, prices crashed catastrophically. The game provides an experiential foundation for understanding how rational individual behavior produced a system-level catastrophe.
- Behavioral Finance — Cryptocurrency Markets: Bitcoin and other cryptocurrencies have displayed extreme bubble-and-crash dynamics driven largely by speculative demand rather than intrinsic cash flow. The game's mechanics — holding an asset with uncertain but bounded fundamental value and watching prices detach from that value — map directly onto crypto market dynamics.
- International Finance — The 2015 Chinese Stock Market Crash: The Shanghai Composite rose 150% in 12 months before losing one-third of its value in three weeks. Beijing University finance professor Michael Pettis described participants' strategy: 'I know this is a bubble, I'm going to ride it on the way up and I'll be able to get out before it breaks.' This is identical to the dominant student strategy in the game.
- Corporate Finance — Valuation and IPOs: Tech IPOs frequently trade above any discounted cash flow valuation of future earnings. The game provides students with personal experience of why this happens and what conditions eventually bring prices back to fundamental value.

7. References & Further Reading

The following resources pair well with this experiment:

- Smith, V.L., Suchanek, G.L., & Williams, A.W. (1988). Bubbles, Crashes, and Endogenous Expectations in Experimental Spot Asset Markets. *Econometrica*, 56(5), 1119-1151. The foundational paper establishing that speculative bubbles form in laboratory asset markets even with common knowledge of fundamental value.
- Bostian, A.J. & Holt, C.A. (2009). Price Bubbles with Discounting: A Web-Based Classroom Experiment. *Journal of Economic Education*, 40(1), 27-37. The classroom experiment that directly inspired MobLab's Asset Market game.
- Shiller, R.J. (2000). *Irrational Exuberance*. Princeton University Press. The canonical account of speculative bubbles in U.S. financial markets, written just before the dot-com crash.
- Fama, E.F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance*, 25(2), 383-417. The foundational statement of the Efficient Markets Hypothesis — the benchmark against which the bubble results are most usefully interpreted.
- Kindleberger, C.P. & Aliber, R.Z. (2005). *Manias, Panics, and Crashes: A History of Financial Crises*. Wiley. A comprehensive historical survey of speculative bubbles and their aftermath; useful for connecting the classroom experiment to real events.