Class 2: Market Structure

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Today's Question

Citadel Securities makes billions “providing liquidity.”

Should you be worried?

Where We've Been	Where We Are	Where We're Going
Market structure basics	Market makers, bid-ask spreads, price discovery	Measuring risk and return

"Market-Making Is Making Markets"

Key themes to consider as we go through today's material

Learning Objectives

By the end of today's class, you should be able to:

1. Explain how market makers profit and why that might (or might not) be a problem
2. Calculate effective trading costs including bid-ask spread
3. Describe how information gets incorporated into prices

To answer this, we need to understand:

1. How do modern markets actually work?
2. What do market makers do?
3. How do they make money?
4. What does it cost you?

What kinds of markets are there?

1. Specialist Markets
2. Over-the-counter (OTC) markets
3. Electronic Communication Markets

What types of orders are there?

- **Market order**
  - Buy or sell order to be executed immediately at prevailing bid/ask price
- **Limit order**
  - Buy or sell order with a pre-specified limit for the price
- **Stop order**
  - Buy or sell order at the market price if specified threshold is crossed

		Condition: Price below the limit	Condition: Price above the limit
Action	Buy	Limit-Buy	Stop-Buy
	Sell	Stop-Loss	Limit-Sell

Limit orders make up a limit order book

Bid Orders		Ask Orders	
Price	Order Size	Price	Order Size
89.06	400	89.12	70
89.05	100	89.13	100
89.04	300	89.15	300
89.03	400	89.16	600
89.01	100	89.17	300
89.00	100	89.18	400
88.95	200	89.24	200
88.92	300	89.26	300
88.56	30	89.29	300

Limit orders make up a limit order book

Book Viewer » BZX BYX EDGX EDGA

Shows the top bids and asks for any symbol.

Market Quality Statistics

BAC

	Orders Accepted	Total Volume
BANK AMER CORP COM	248,575	3,215,870

TOP OF BOOK			LAST 10 TRADES		
	Shares	Price	Time	Price	Shares
ASKS			13:19:56	23.38	100
	17,437	23.42	13:19:56	23.38	100
	16,322	23.41	13:19:56	23.38	200
	142,969	23.40	13:19:56	23.38	500
	14,896	23.39	13:19:56	23.38	300
BIDS	7,800	**23.38**	13:19:56	23.38	100
	16,048	23.37	13:19:56	23.38	200
	13,695	23.36	13:19:56	23.38	135
	13,180	23.35	13:19:56	23.38	66
	13,963	23.34	13:19:49	23.38	34

Last updated 13:20:02

Types of Markets: Specialist Exchanges

- Example of a specialist exchange: NYSE
- Trading traditionally occurred through a combination of an auction (the order book) and a market maker (the specialist)
- Orders sent to exchange may be cleared electronically or sent to specialist
  - Only one specialist for each stock
  - Specialist may act as broker or as a dealer

Roles of specialists in specialist exchanges

- **Broker**
  - Matches buy and sell orders
  - Income generated by commissions
- **Dealer**
  - Specialists maintain their own bid and ask quotes and fill orders with own account if market spread too high
  - Historically, participated in about 25% of all transactions
  - Maintained price continuity

What's a market maker?

Here is not what a market-maker does:

> "bring together buyers and sellers of securities."
>
> "lining up buyers and sellers of assets."
>
> "make money matching buyers and sellers."

Nope! A market-maker makes markets. What is a market? Here is a market: [2]

This caption is a little superfluous but here we are.

The Bid-Ask Spread

- Market makers post two prices:
  - **Bid**: Price they'll **buy** at
  - **Ask**: Price they'll **sell** at
  - **Spread**: Ask - Bid
- Example: Apple stock
  - Bid: $150.00
  - Ask: $150.02
  - Spread: $0.02 (2 cents)
- If they buy 100 shares at $150.00 and sell 100 shares at $150.02:
  - Revenue: 100 × $150.02 = $15,002
  - Cost: 100 × $150.00 = $15,000
  - **Profit: $2** (in milliseconds!)

Calculating Your Trading Costs

Suppose you want to buy 500 shares of Netflix (NFLX):

- Current quote:
  - Bid: $100.50
  - Ask: $101.00
  - Mid-point: $100.75
- You pay the **ask**: 500 × $101.00 = **$50,500**
- If you immediately sold, you'd get the **bid**: 500 × $100.50 = **$50,250**
- **Implicit cost of the round-trip: $250** (0.125% of your investment)
- This doesn't include:
  - Exchange fees
  - Broker commissions (often zero now!)
  - SEC fees

Bid-Ask Spreads Vary by Stock

Stock	Bid	Ask	Spread	Spread %
Apple (AAPL)	$150.00	$150.02	$0.02	0.013%
Netflix (NFLX)	$100.50	$101.00	$0.50	0.49%
Small Cap Stock	$5.00	$5.10	$0.10	2.0%

Why the difference?

- Trading volume (liquidity)
- Price volatility (risk to market maker)
- Competition among market makers

Types of Markets: OTC Markets

- Trades negotiated dealer-to-dealer
- Nasdaq (National Association of Securities Dealers Automated Quotation system)
  - Originally, a price quotation system
  - Large orders may still be negotiated through brokers and dealers
  - Today, NASDAQ provides electronic trading (less OTC)

Types of Markets: Electronic Communication Networks

- Private computer networks that directly link buyers with sellers for automated order execution
- To attract liquidity, networks may pay rebates to liquidity providers (market makers)
- Electronic clearing facilitates high frequency trading

Electronic Communication Networks and high-frequency trading

- Risks of high speed algorithmic trading include market disruption
- **Flash Crash (2010)**
  - On May 6, 2010, US indices fell by more than 5% in a matter of minutes, before rebounding almost as quickly
- **Knight Capital (2012)**
  - Flawed deployment of new trading program bankrupts major market maker
  - Lost 440 million dollars from one programming mistake

Electronic Communication Networks and flash crashes

SEC findings suggest the decline was triggered by a large automated sell order for S&P futures by a mutual fund

- Existing low volume due to high market uncertainty
- Sell order (75K contracts) was an automated algorithm that directed to sell 9% of prior minute's trading volume
- HFTs responded to high volume of trades, but could not find fundamental buyers (SEC describes a game of "hot-potato")
- High volume led to acceleration in sell order speed, which drove higher volatility and volume

Price Discovery

- Markets aggregate information from millions of traders
- When new information arrives, traders update their beliefs and trade

Example: Apple announces better-than-expected iPhone sales

1. Traders with the information want to buy
2. They submit market orders or aggressive limit orders
3. Limit order book gets cleared at increasing prices
4. Market makers see buy pressure, widen their spreads, move quotes up
5. New equilibrium price emerges in seconds (or milliseconds)

Price Discovery: A Simple Example

Suppose Apple is trading at $150.00 / $150.02 (bid/ask)

News breaks: Apple signs major deal with Disney

- Informed traders rush to buy
- Limit order book at $150.02 gets exhausted
- Next level: $150.05, then $150.10
- Market makers see the pressure, pull their quotes
- New quotes: $150.50 / $150.52

Result: Price moved from $150 to $150.50 in seconds

- This is price discovery in action
- Information $\longrightarrow$ Trading $\longrightarrow$ Price adjustment

- Efficient price discovery requires:
  - Liquid markets (lots of buyers and sellers)
  - Transparent pricing (visible quotes)
  - Fast execution (information gets incorporated quickly)
- Market makers and HFTs contribute to this by:
  - Providing liquidity (always willing to trade)
  - Narrowing spreads through competition
  - Speeding up price adjustments
- But there are costs and risks (Flash Crash!)

(Important for later in the course)

Short-Selling: The Basic Idea

Think of borrowing your friend's bike:

1. You borrow your friend's bike (worth $100)
2. You immediately sell it for $100
3. Later, you buy a bike for $80 to return to your friend
4. You keep the $20 difference

(You are probably a bad friend if you do this without telling them.)

Short selling is the same idea, but with stocks.

- Borrow shares you don't own
- Sell them at today's price
- Buy them back later (hopefully cheaper)
- Return the shares and keep the difference

Why Would You Short?

Two main reasons:

1. **You think a stock is overpriced**
   - Tesla is trading at $300, but you think it's only worth $200
   - Short it: profit if you're right
2. **Hedging (pairs trading)**
   - You own Ford and want to hedge against auto industry risk
   - Short GM to isolate your bet on Ford vs. GM
   - If the whole industry tanks, you're protected

Short-Selling Mechanics: Step by Step

Let's say Stock A trades at $100 and you think it will fall.

Step 1: Borrow 1 share of Stock A from your broker

- Your broker finds someone who owns it (maybe a pension fund)
- You now OWE 1 share back

Step 2: Immediately sell that share in the market

- You get $100 cash
- But remember: you still owe 1 share!

Step 3: Wait for the price to change...

Short-Selling Mechanics: Two Scenarios

You borrowed and sold Stock A at $100.
Now what?

Scenario 1: Price drops to $75 ✅

- Buy 1 share for $75 to return it
- Profit: $100 (sold) - $75 (bought back) = **$25**

Short-Selling Mechanics: Two Scenarios

You borrowed and sold Stock A at $100.
Now what?

Scenario 2: Price rises to $150 ❌

- Buy 1 share for $150 to return it
- Loss: $100 (sold) - $150 (bought back) = **-$50**

Key Risk: Losses are unlimited (stock can go up forever)!

The Collateral Requirement

Your broker won't just let you walk away with the $100.

Initial Position (when you short at $100):

- You have $100 cash from the sale
- But you also need to post $50 extra as collateral (50% margin requirement)
- Total: $150 in your account

Why?

- The broker wants protection in case the stock goes up
- If Stock A rises to $150, you owe $150 but only have $100 from the sale
- The extra $50 collateral covers some of this risk

If the stock keeps rising, you'll get a **margin call** → must add more money or close the position

Short-Selling: The Math (Simple Example)

Stock A is $100. You short it. What's your return if it drops to $25?

Initial:

Assets	**Liabilities**
Cash: $100	Short position: $100
Collateral: $50	Equity: $50

After stock drops to $25:

- Buy back the share for $25
- Return it to the lender
- You have: $100 + $50 - $25 = $125
- Profit: $25 on $50 equity = **50% return**

(Note: Different from the 75% return if we assume $100 capital because of margin requirements)

Pairs Trading: Combining Long and Short

Instead of just shorting, you can **pair** a short with a long position.

Example: Ford vs. GM

- You think Ford will outperform GM
- Both at $100 per share

Your Strategy:

- Buy $100 of Ford (go long)
- Short $100 of GM (borrow and sell)
- Total invested: $100 of your own money (plus collateral)

What happens?

- If Ford goes up 10% and GM goes up 5% $\longrightarrow$ you profit
- If Ford goes down 5% and GM goes down 10% $\longrightarrow$ you profit
- You're betting on the **relative** performance, not the market direction

Pairs Trading: The Math

Initial Setup:

- Buy 1 share of Ford at $100
- Short 1 share of GM at $100
- Post $50 collateral (margin requirement)
- Total capital: $150

Scenario: Ford → $110, GM → $95

Close the positions:

- Sell Ford for $110 (profit: $10)
- Buy back GM for $95 (profit on short: $5)
- Total profit: $15 on $100 investment = **15% return**

You made money even though both stocks moved—you just needed Ford > GM!

Pairs Trading: The Protection

What if the whole market crashes?

Scenario: Both stocks drop 20%

- Ford: \$100 ⟶ \$80 (you lose \$20)
- GM: \$100 ⟶ \$80 (you gain \$20 on the short)
- Net: \$0 (you're protected!)

What if the whole market rallies?

Scenario: Both stocks rise 20%

- Ford: \$100 ⟶ \$120 (you gain \$20)
- GM: \$100 ⟶ \$120 (you lose \$20 on the short)
- Net: \$0 (you're protected!)

This is called "market neutral" trading—you don't care about market direction!

The Short Rebate (Borrowing Cost)

When you short, your $100 cash sits with your broker. It earns interest!

$$\text{Short Rebate} = r_f - \text{Securities Lending Fee}$$

Normal stocks (easy to borrow):

- Lending fee: 0.1-0.3% per year
- You get most of the risk-free rate back

"Hot" stocks (hard to borrow):

- Lending fee: 5%, 10%, even 50%+
- Your rebate goes **negative**—you're paying to short!
- Sometimes shares can't be borrowed at all

The Short Rebate (Borrowing Cost)

Example: During GameStop, lending fees were 50%+. Shorting was EXPENSIVE.

Before moving into our example, a quick poll.

1. Were you aware of Gamestop's unusual stock market activity in 2021?
2. Did you buy either Gamestop or AMC or any related "stonks"?

The peculiar case of GameStop and r/WallStreetBets

- GameStop is a videogame retail company with poor outlook pre-pandemic, and little strategy for the pandemic
  - potential for a “turnaround” with new board members, etc. but unlikely
- Shorting this stock is a natural strategy
- However, coordinated stock purchasing (a short squeeze) can make this untenable
  - Why? Short covering creates a feedback loop


@CitronResearch
Tomorrow am at 11:30 EST Citron will livestream the 5 reasons GameStop $GME buyers at these levels are the suckers at this poker game. Stock back to $20 fast. We understand short interest better than you and will explain. Thank you to viewers for pos feedback on last live tweet
23:58 · 19 Jan 21 · Twitter Web App

GameStop price action

[redacted]

GME

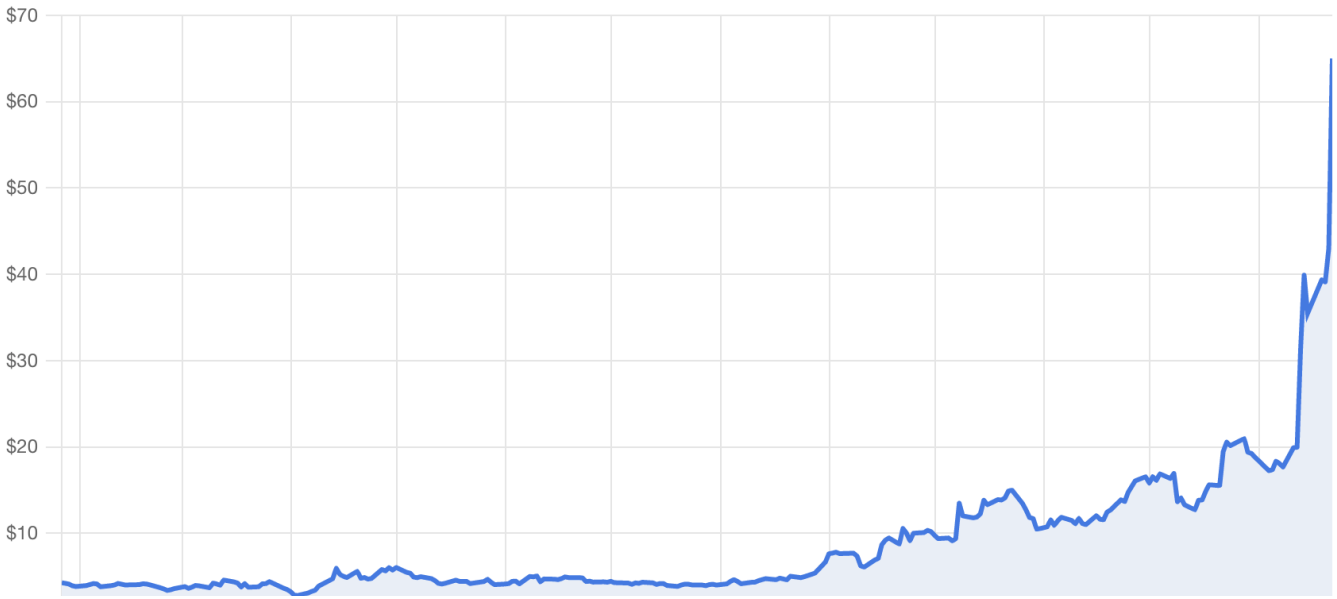
$21.98 ▲ 51.1%

Price as of January 22, 2021, 9:00 p.m. EST

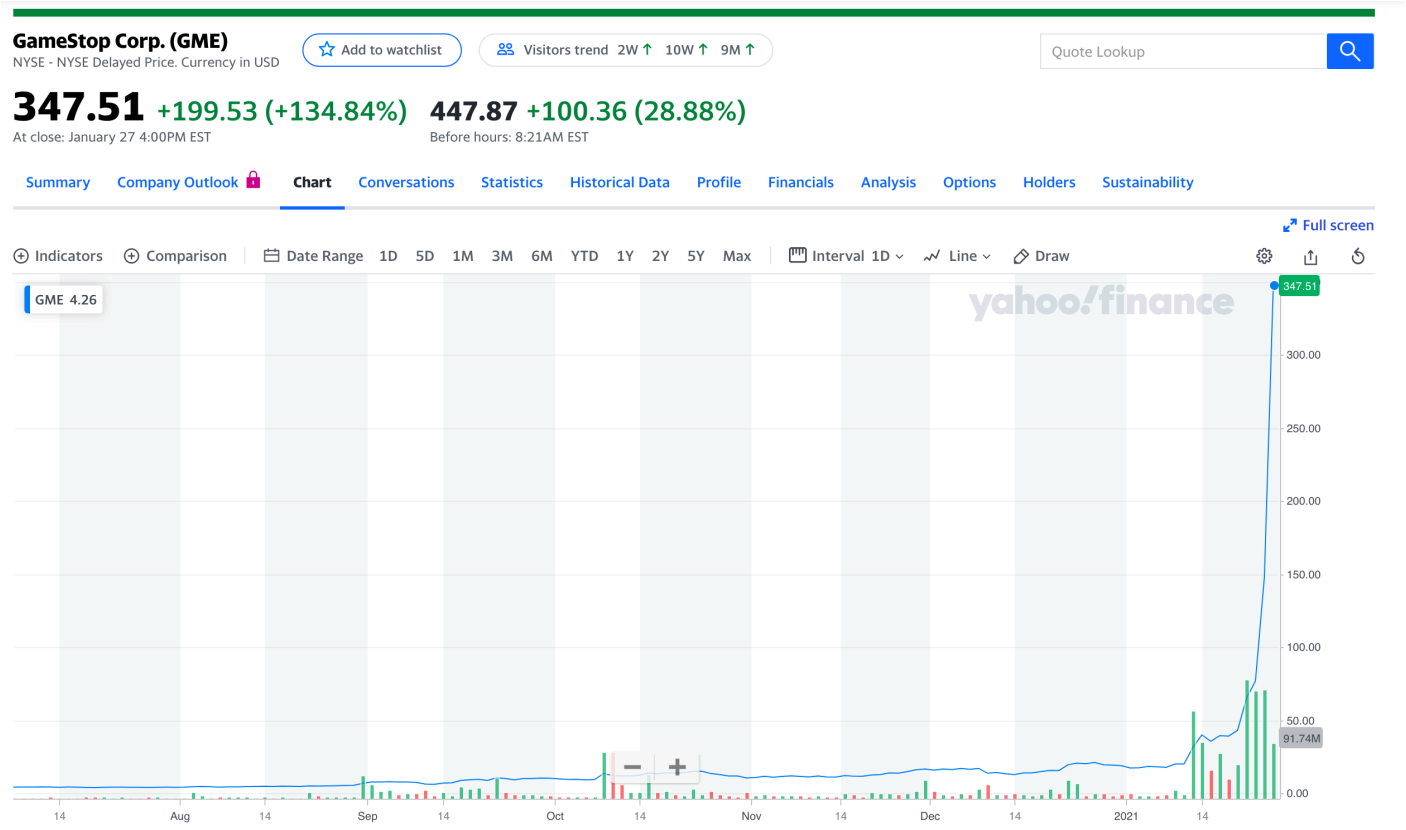
View Interactive GME Charts

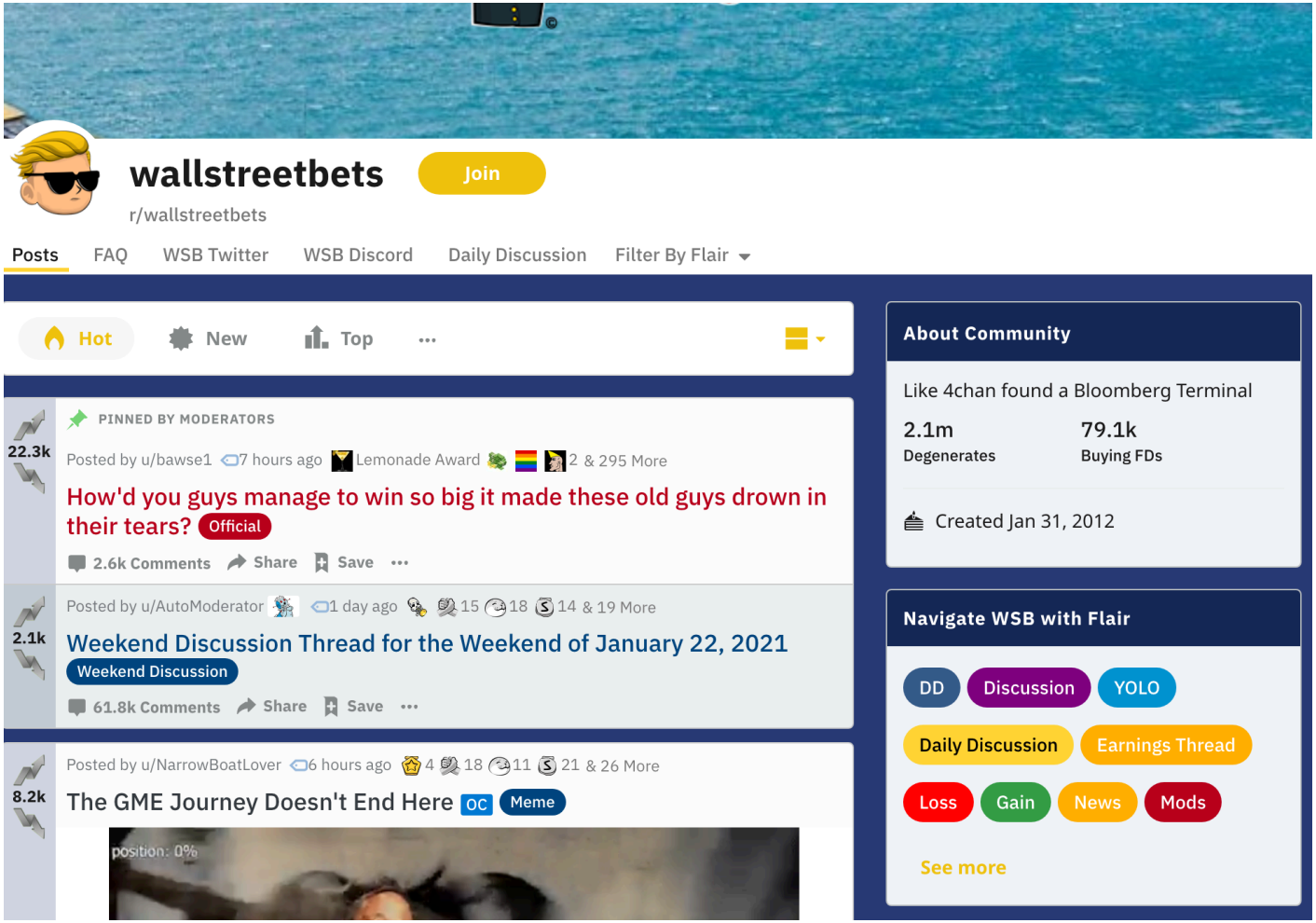
The Company is a retailer of video game products and PC entertainment software.

INTERACTIVE CHART



GameStop price action

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Weekend Discussion Thread for the Weekend of January 22, 2021
Weekend Discussion
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It’s not about money...


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Key events
100
80
60
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20
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2019
2020
2021
2022
2023

Alternative ways to short stocks: synthetic shorts

Consider the following replicating strategy:

- Buy a put and sell a call at the current strike price
  - Have the option to sell stock at current price (put option)
  - Give someone else the option to buy the stock at today's price (call option)
- What happens if real stock goes down 10x? up 10x?
- However, options traded on less than half of publicly traded firms
- Moreover, options market behaves badly for "hot shares"
  - Put-call parity is violated by large amounts of short interest

Back to Our Opening Question

Citadel Securities makes billions "providing liquidity." Should you be worried?

The Case FOR Market Makers (like Citadel)

Benefits:

- Tighter spreads than ever before
  - 1990s: Spreads were 12.5+ cents
  - Today: Often 1-2 cents (or less)
- Instant execution
- Deep liquidity (can trade large size)
- Zero commissions for retail investors
  - Payment for order flow subsidizes this

Evidence:

- Retail investors pay less in trading costs today than any time in history
- Market quality metrics (spreads, depth, speed) have improved dramatically
- Competition among market makers keeps spreads tight

The Case AGAINST Market Makers (concerns)

Concerns:

- Conflicts of interest
  - Trading against their own customers
  - Access to order flow data (legal, but…)
- Payment for order flow
  - Do brokers send orders to highest bidder or best executor?
- Market concentration
  - Citadel + Virtu dominate retail flow
- Systemic risk
  - What happens if a major market maker fails?

The GameStop Episode:

- Robinhood had to restrict trading
- Why? Clearinghouse capital requirements
- But also: Citadel's role was murky
- Raised questions about who serves whom

The answer: It's complicated

- You benefit from lower costs
- But there are legitimate concerns about market structure
- Regulation matters (SEC is watching)
- Transparency matters (knowing how orders are executed)

For this course:

- Market makers provide liquidity $\longrightarrow$ this affects bid-ask spreads
- Bid-ask spreads are a real cost $\longrightarrow$ matters for portfolio returns
- Understanding market microstructure helps you be a better investor

So... Should You Be Worried?

Bottom line: Market makers like Citadel have made trading cheaper and faster for retail investors, but concentration and conflicts of interest deserve ongoing scrutiny.

Next Class: January 27

- Topics: Risk and Return
  - Measuring returns (arithmetic vs. geometric)
  - Historical performance of stocks and bonds
  - Risk measures
- Matt Levine Reading: “When Everything Is Too Safe, Add Risk”