

# FIN2010 Financial Management

## Lecture 15: Trading on Financial Markets



# Agenda

- How do financial markets work?
  - Dealer markets and exchanges
  - How does an exchange work
- Trading Game
  - Quick Review and Q&A of the Trading Game
  - Demo
  - Practice Session
  - The real game
- What are real financial markets like today?



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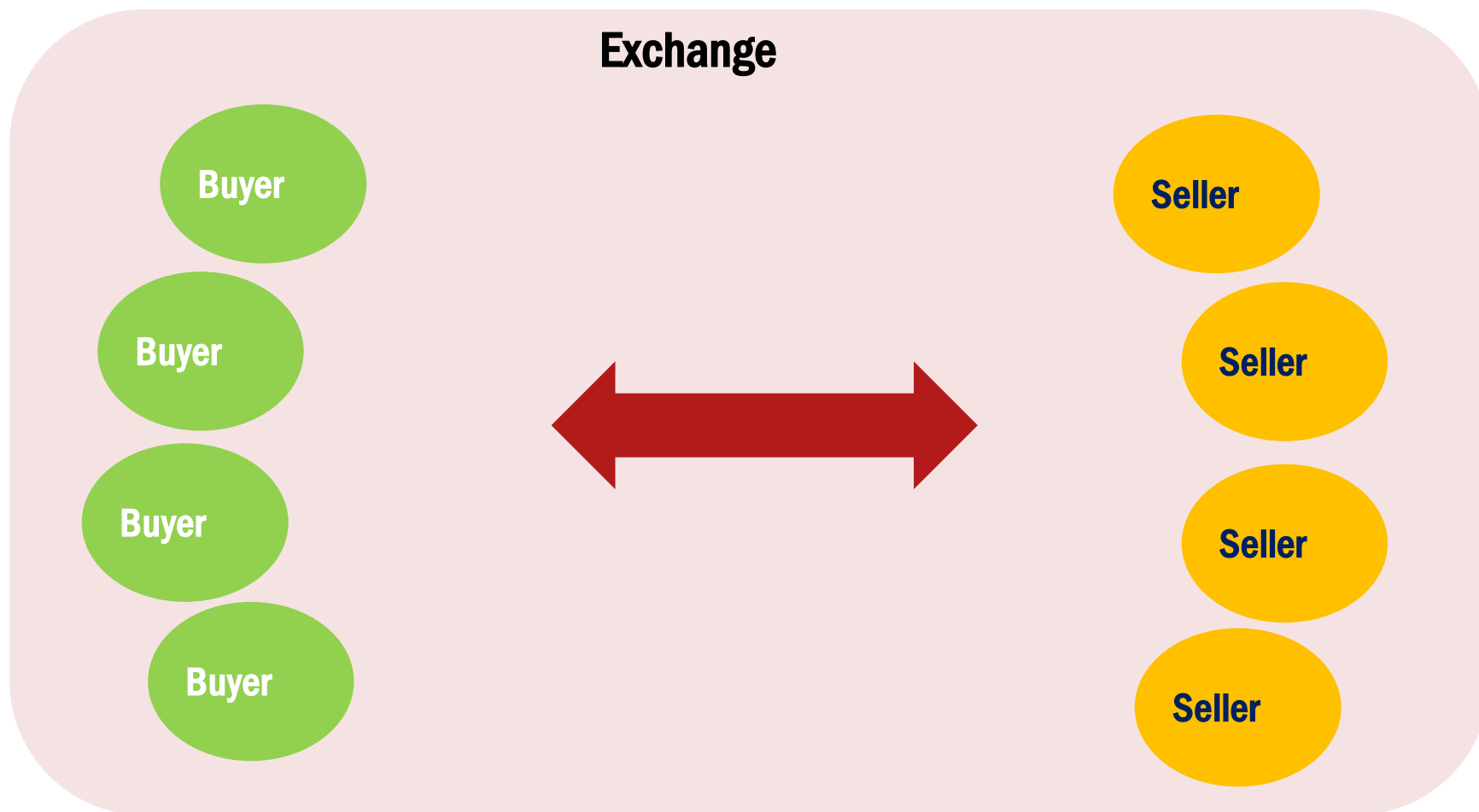
# Dealer Market

- Every trade involves a dealer



# Exchange

- Everyone trade with everyone



# Dealer Market vs. Exchange



## Car dealership



宝马 5系 2012款 535Li 3.0 手自一体 领先型  
¥23.8万 深圳  
上牌 2012 里程 8万公里



奔驰 E级 2011款 E260L 1.8 手自一体 时尚型CGI  
¥18万 深圳  
上牌 2011 里程 11万公里



本田 飞度 2016款 1.5 SES CVT 时尚天窗版  
¥7.38万 深圳  
上牌 2016 里程 5万公里



丰田 锐志 2008款 2.5S 手自一体 特别纪念版  
¥8.38万 深圳  
上牌 2008 里程 15万公里



宝马 3系 2015款 328Li 2.0T 自动 xDrive豪华设计套装  
¥24.88万 深圳  
上牌 2015 里程 7.38万公里



奔驰 E级 2014款 改款 E260L 运动豪华型  
¥25.88万 深圳  
上牌 2014 里程 8万公里



奥迪 A6L 2014款 35 FSI 豪华型  
¥26.78万 深圳  
上牌 2014 里程 8.9万公里



奥迪 A6L 2005款 2.0T 自动 标准型  
¥6.8万 深圳  
上牌 2006 里程 13万公里



铃木 科雷傲 2012款 2.5 自动



雪佛兰 科鲁兹 2009款 1.6 自动



别克 君越 2013款 2.4 SIDI 手自一体



奥迪 A6L 2008款 2.0T 自动 标准型

Craigslist/  
58.com

# How does an exchange work?

- Continuous double auction
  - An exchange collects buying and selling intentions of traders into an order book
    - Bid: an intention to buy at a certain price
    - Ask: an intention to sell at a certain price
  - A trade occurs when the bids and asks cross
    - In this example, the current  
Best ask= 117.61  
Best bid = 117.60
    - If someone is willing to buy at a price  $\geq 117.61$ ,  
or if willing to sell at a price  $\leq 117.60$ , then a trade would happen

MM Name	Bd Sz 341	Price	Ask S 751	MM Name
		<b>117.75</b>	42	BATS,ARCA,...
		117.74	16	BATS,ARCA,...
		117.73	14	BATS,ARCA,...
		117.72	11	BATS,ARCA,...
		117.71	70	BATS,ARCA,...
		<b>117.70</b>	58	BATS,ARCA,...
		117.69	24	BATS,ARCA,...
		117.68	24	BATS,ARCA,...
		117.67	23	BATS,ARCA,...
		117.66	29	BATS,ARCA,...
		<b>117.65</b>	40	BATS,ARCA,...
		117.64	33	BATS,ARCA,...
		117.63	37	BATS,EDGE...
		117.62	34	BYX,BATS,A...
		<b>1 @ 117.61</b>	9	
IEX,DRCTEDGE...	41	<b>117.60</b>		
BYX,BATS,ARC...	38	117.59		
BATS,ARCA,NS...	37	117.58		
BATS,EDGEA,A...	34	117.57		
BATS,ARCA,NS...	40	117.56		
BATS,ARCA,NS...	22	<b>117.55</b>		
BATS,ARCA,NS...	36	117.54		
BATS,ARCA,NS...	24	117.53		
BATS,ARCA,NS...	23	117.52		
BATS,ARCA,NS...	15	117.51		
BATS,ARCA,NS...	26	<b>117.50</b>		
BATS,ARCA,NS...	9	117.49		





# Order Types

- **Limit order (限价委托单):** buy or sell at a specific price
  - Suppose you submit a limit order to buy 10 units at 117.50. The order will be listed on the order book but will not be executed right now. If the price falls in the future and someone is willing to sell at 117.50, then the order will be executed.
  - If you submit a limit order to buy 50 units at 117.65, then it will result in 3 trades: 117.61X9, 117.62X34 and 117.63X7.
- **Market order (市价委托单):** buy at the current best ask, or sell at the current best bid
  - If you submit a market order to sell 100 units, you will get 117.60X41, 117.59X38 and 117.58X21.
- Depending on the exchanges, there can be other order types (hidden, immediate or cancel, etc.)

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# Who are the Traders?

- Depending on the trading motives, investors are classified into four types.
- Informed traders: those who know more than the others
  - E.g., fund managers, company insiders
- Liquidity traders: those who must trade a certain amount
  - E.g., Mr. A's parent got cancer and he has to sell; a mutual fund gets money from investors and it has to buy
- Noise traders: those who trade without good reasons
  - E.g., irrational traders acting on irrelevant signals (Obama vs 澳柯玛)
- Market makers: agents who stand in the market all the time and bridge buyers and sellers

Note: they are not mutually exclusive. A trader can belong to more than one group.



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# Trading Game

- **Goals:** to simulate the trading environment in an exchange
  - Understand how continuous double-auction work
  - Understand the players involved in a typical trading environment
  - Experience the concerns of each type of trader
- **Caveat:** how the real world is different
  - Continuous information flows
  - Some markets have market makers
  - It is a bit naïve to divide traders into liquidity trader and informed trader. Investors trade for many different reasons.



# Brief Review of Rules

- A quick demo, 1 practice session, 4 real session
- In each session, a random integer value  $V \in [0,100]$  for the asset is drawn (independent of previous sessions, normally distributed)
  - 8 informed traders knows the range of the value
    - 4 given a higher range and 4 given a lower range
  - 8 liquidity trader needs to meet a target position
    - Punished by  $50 * |\text{position difference}|$
- Continuous double auction trading
  - To submit an order, please raise your name tag and yell out your order
  - Submit a bid (intention to buy): group 1 bids 48 for 3 units
  - Submit an ask (intention to sell): group 2 asks 52 for 2 units
  - Cancel an order: cancel the 48 bid by group 1
  - Submit a market order: group 3 buys 10 units
  - Trades occur when bid and ask cross, with price-time priority



# Brief Review of Rules

- You start with \$0 cash and 0 shares. Can buy and sell any amount.
  - If you buy 5 shares at \$50: cash balance=-\$250, asset position is 5 shares.
  - If you sell 5 shares at \$50: cash balance=\$250, asset position is -5 shares.
- At the end of the session, true value  $v$  will be announced
- Your goal is to maximize your profit.
  - Liquidity trader's  $P/L = \text{cash balance} + \text{asset position} * v - 50 * |\text{target position} - \text{asset position}|$
  - Informed trader's  $P/L = \text{cash balance} + \text{asset position} * \text{value}$
- Each session is 8 min. 1 practice session and 4 actual sessions.
- After the four sessions, the group with the highest total P/L wins the chocolate!

**Any question?**



# Example – Trade table

- If you sell 10 shares at \$50/share to group 4:

Trade#	1	2	3	4	5	6	7	8	9	10
Price	50	46								
ΔPosition	-10									
ΔCash	500									
Counterparty	4									

- If you buy 8 shares at \$45/share from group 5:

Trade#	1	2	3	4	5	6	7	8	9	10
Price	50	45								
ΔPosition	-10	8								
ΔCash	500	-360								
Counterparty	4	5								



# Example – Profit/loss (P/L)

- If the true value is 57

Trade#	1	2	3	4	5	6	7	8	9	10
Price	50	45								
ΔPosition	-10	8								
ΔCash	500	-360								
Counterparty	4	5								

- Your profit/loss = cash position + asset value =  
 $(500 - 360) + (-10+8) * 57 = 26$
- Why?
  - In the first trade, you sell 10 shares at \$50/share while it is worth \$57/share.
    - Your loss =  $-\$7 * 10 \text{ shares} = -70$
  - In the second trade, you buy 8 shares at \$45/share while the true value is \$57/share.
    - Your profit =  $\$12 * 8 \text{ shares} = 96$
  - Total profit = \$26





# Example – Penalty for Liquidity Traders

- **Liquidity traders will be penalized for not reaching the target asset position!**
- If you are a liquidity trader and your target is -5 shares
  - In the previous example, you have -2 shares in the end and have not reached your goal
  - You will be penalized \$50 for each unit deviation from the goal
  - Total profit =  $\$26 - 50 \times 3 = -124$
- Therefore, for liquidity traders, reaching the target position is your primary concern. Even trading at an unfavorable price is beneficial to you compared to not reaching the goal.



# Demo

- Suppose  $v = 55$
- Group 1 and 2 needs to buy 10, group 3 and 4 needs to sell 10
- Group 5 and 6 see  $v \in [40, 60]$ , group 7 and 8 see  $v \in [50, 70]$

## Possible Scenario:

1. G1 bids at 40 for 2 units –as liquidity trader, trading at 40 is better than not reaching target
2. G6 bids at 42 for 1 unit –informed trader speculates that price is around 50
3. G3 asks at 42 for 1 unit, resulting a trade –liquidity trader sees price improve and seeks a quick trade
4. G7 bids at 43 for 10 units –informed trader knows the price is too low, but don't want to reveal all information
5. G8 bids at 45 for 10 units –competition from the other informed trader
6. G5 asks at 55 for 5 units –informed trader (erroneously) think  $v$  is at the lower part of the range
7. G4 asks at 50 for 3 units –liquidity trader is getting impatient
8. G2 bids at 50 for 5 units –G2 think they get a reasonable deal
9. G7 bids at 50 for 10 units –since G7 knows  $v \geq 50$ , they know this must be profitable



# The Trading Game

- Practice session
- <http://fin2010.mswr.xyz/user>
- Session 1
- Session 2
- Session 3
- Session 4



10:00

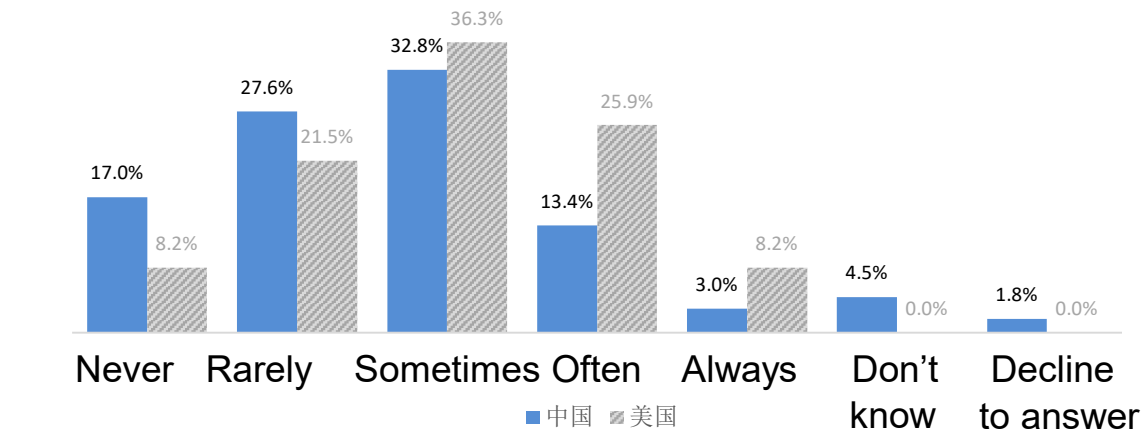
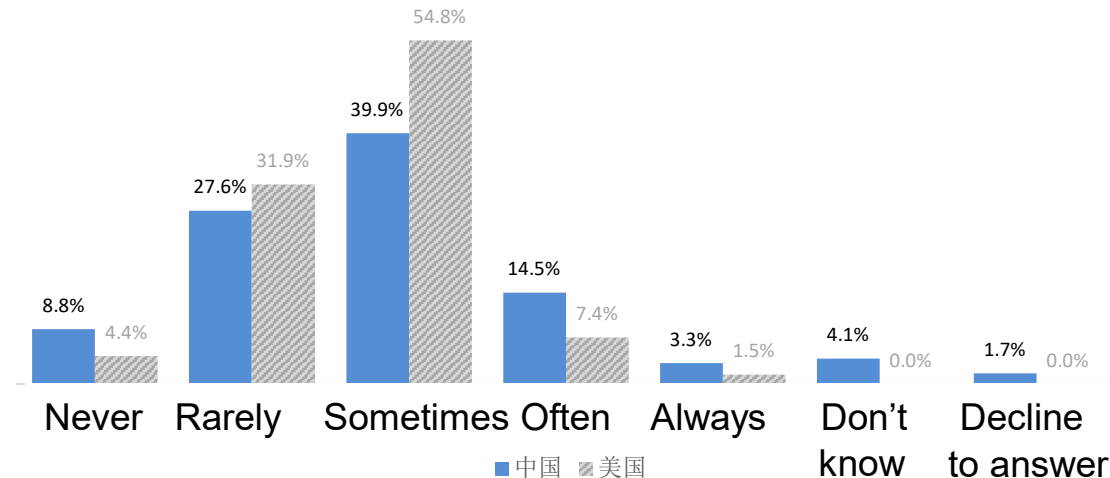


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# Be aware of your information disadvantage

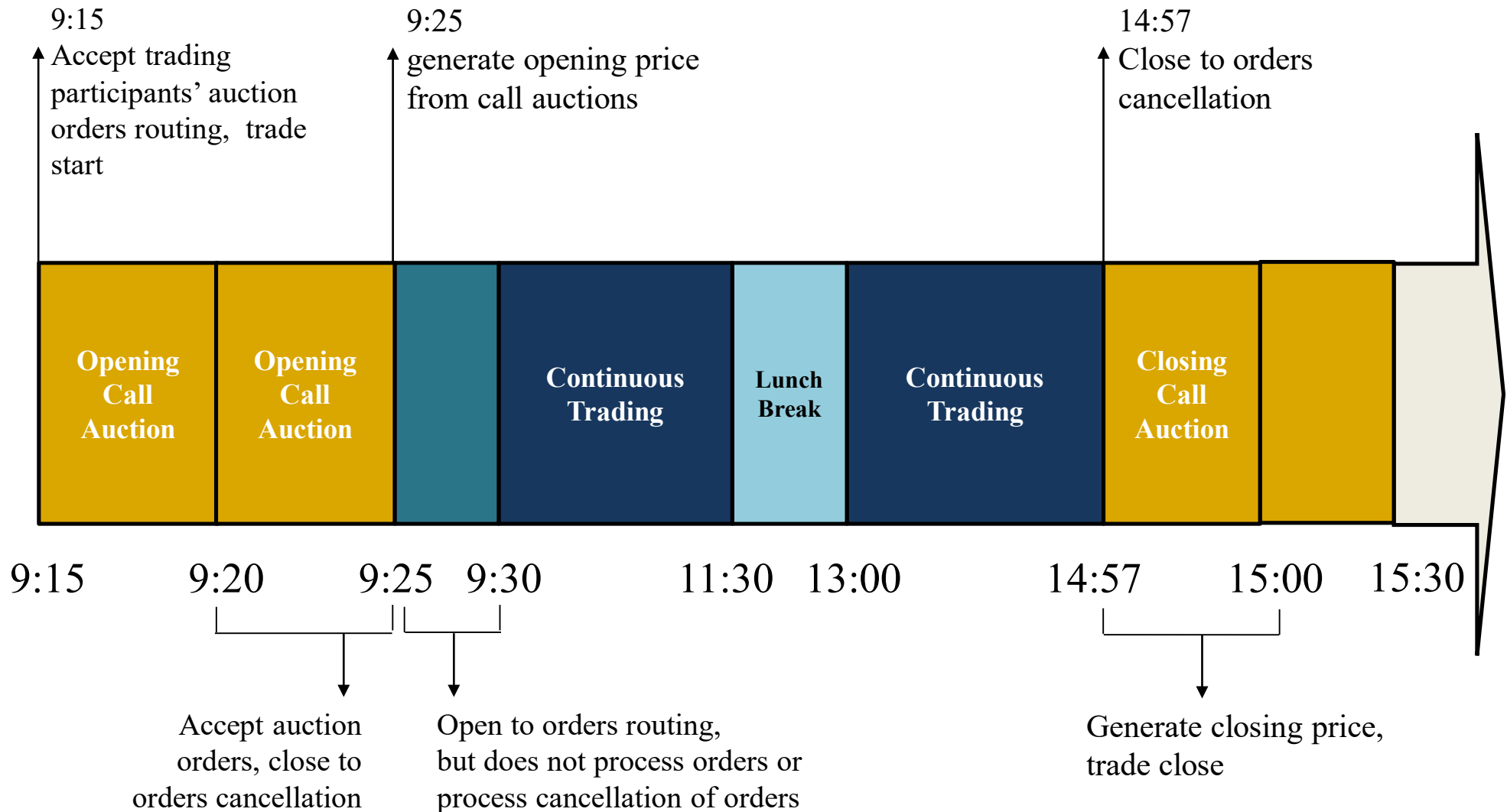


When you decide to trade a stock, how often do you worry that other investors know about the stock better than you do?

**Many retail investors are not aware that they could be taken advantage by informed traders if they know little about stocks.**



# Opening and Closing of Shenzhen Stock Exchange

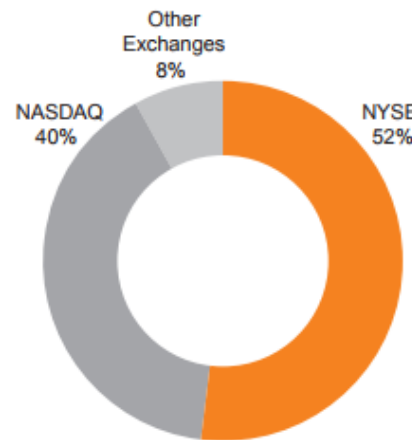


# What is the US equity market like today

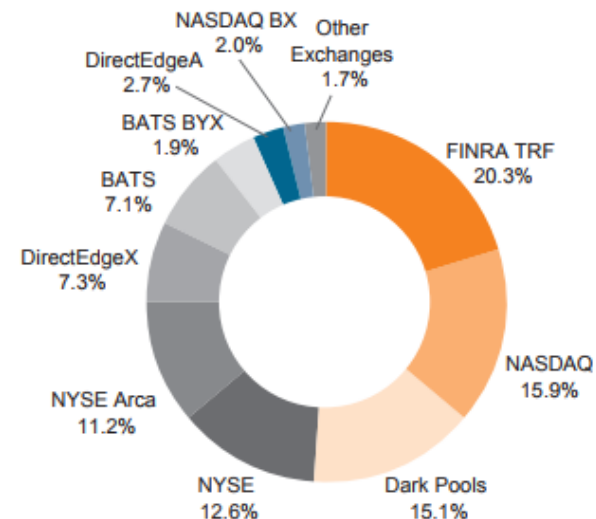
- Fragmented:

- 13 Exchanges
- Over 40 venues

1998 U.S. Equity Market Share



2015 U.S. Equity Market Share



- Fast:

- Done by computers
  - 30% of orders are cancelled within one second

Table 4

Cancellation and Execution Rates of Limit Orders

This table presents estimated cumulative probabilities of cancellation and execution within different time intervals (measured from the submission of the nonmarketable limit order). The probabilities are computed as  $1 - S(t)$ , where  $S(t)$  is the survival function (of cancellation or execution). The survival function is estimated using the life-table method using all nonmarketable limit orders for each of the 100 stocks in the sample. In the estimation for the cancellation process, execution is taken to be the censoring process (and vice versa).

Time	Cumulative Probability of	
	Cancellation	Execution
0.1 seconds	0.115	0.009
1	0.296	0.026
2	0.369	0.034
10	0.601	0.071
1 minutes	0.827	0.158
2	0.910	0.211
10	0.984	0.383
1 hours	0.997	0.568





# High Frequency Traders

- In recent years, most of the market making business is dominated by high frequency traders who use algorithms to trade
    - E.g. [Citadel](#) has 150B assets (0.6% of the equity market), but generates 20% of equity volume and 25% of equity option volume
  - These high frequency traders are very fast
    - Efforts to reduce the round-trip time for cable connecting Chicago and New York:
      - Verizon: 14.5ms with ordinary cable
      - Spread Network: 13ms, making cable route as straight as possible
        - Cost: \$300M, revenue (estimated): \$2B
      - Tradeworx : 8.5ms, using microwave towers
- (Reference: [Flash Boys](#), Michael Lewis)



# Algorithms may unreliable sometimes

- Flash crash: Dow Jones Index dropped 10% in 30 minutes on 2010-5-6
  - The selling pressure was abnormally high on that day, and many market makers that use algorithms were unable to function under such extreme situation



- Everbright Securities' Glitch on 2013-8-16 (光大证券乌龙指事件)<sup>[1][2]</sup>
  - Due to program errors, the company submitted orders to buy ¥23.4B worth of stocks when it intended to buy only ¥5M
  - The Shanghai Composite index was up 6% instantly as the result



# Next Time—Project Evaluation Criteria

- Evaluating a project
  - Net present value
  - Payback period
  - Discounted payback period
  - Internal rate of return
  - Profitability index
- Multiple projects
  - Mutually exclusive projects
  - Capital rationing

