

Lecture 6

Liquidity and Market Dynamics

This session continues our exploration of limit order markets, and in particular its efficiency. We begin by defining market liquidity. This leads into a discussion of profitable trading, market dynamics and the overall efficiency of limit order markets. How do changes in common components to all valuations affect trading patterns and market efficiency? This leads us into an empirical analysis of the Vancouver Stock Exchange to evaluate how efficiently it operated.

Perfectly liquid markets

- ◆ There are many definitions of **liquidity**. They all relate to the idea of how easy or hard it is to buy and sell an asset, or how volatile the market is for idiosyncratic reasons.
- ◆ I adopt the following definition: An asset is **perfectly liquid** if and only if individual traders can buy and sell as many units as they wish at the same price they all anticipate.
- ◆ There is a close relationship between perfect liquidity and a **competitive equilibrium**. In a model of competitive equilibrium traders act as if all stocks are perfectly liquid.
- ◆ This is a common assumption in the analysis of portfolio investment, a topic to be addressed later in the course.

When is a LOM perfectly liquid?

- ◆ Can the concept of competitive equilibrium be adapted to limit order markets?
- ◆ Suppose there are many fully informed potential buyers and sellers, and no one believes he or she can influence transaction prices.
- ◆ Then:
 1. all trades transact at the same price.
 2. the constant transaction price is the bid or the ask.
 3. the market allocates resources perfectly . . . to investors who value the asset the most.

A perfectly liquid LOM has infinite spread

- ◆ Because every (buy and sell) limit order is transacted at one price, no trading occurs at any other price.
- ◆ That is limit order sell (buy) orders placed above (below) the constant transaction price are never filled.
- ◆ Therefore, there is no reason to place:
 1. a limit sell order if the bid is at the transaction price
 2. a limit buy order if the ask is at the transaction price
- ◆ Hence the spread could well be infinite.
- ◆ Although not a perfect analogy, in some taxicab ranks:
 - ❑ sometimes there are unfilled orders (as passengers queue on the curbside)
 - ❑ sometimes there is excess inventory (as cabs queue in the rank)
... *but the fare does not change!*
- ◆ This point also demonstrates that the size of the spread is a very misleading measure of market liquidity.

Trading off immediacy against price

- ◆ Now suppose new orders infrequently.
- ◆ If individuals don't care when their orders transact, then the **law of one price** could be applied here too.
- ◆ But if they care how quickly their order is filled, they might pay a premium to transact earlier (and jump the "queue").
- ◆ This breaks the law of one price.
- ◆ When investors have preferences over "immediacy", we could interpret an LOM for a single security as a mechanism for trading **multiple products differentiated by their placement and withdrawal time window**.

Should I place a market order or a limit order?

- ◆ Consider markets that are not perfectly liquid.
- ◆ Market orders transact immediately. Limit orders might not transact, but if they do, yield greater gains.
- ◆ Suppose I value the stock at $Value$ and the ask price is Ask . Then the gain from buying the stock is:
 $Value - Ask$
- ◆ Suppose I place a limit buy order of B' . Denote the probability of the ask price falling to B' by $Prob[B']$. Then the gain from placing a limit buy order of B' is:
 $Prob[B'] * \{Value - B'\}$.

Market Buy Orders versus Limit Buy Orders

\$price

probability density function for Ask "next period."

Value } Gain from placing market order to buy is (Value - Ask)
Ask

B' } Potential gain from placing limit buy order at B' is (Value - B').
Bid

Hatched area represents the probability of a limit buy order at B' transacting, that is being filled.

$$\text{Is } (Value - Ask) \geq \text{Hatched area} \times (Value - B')$$

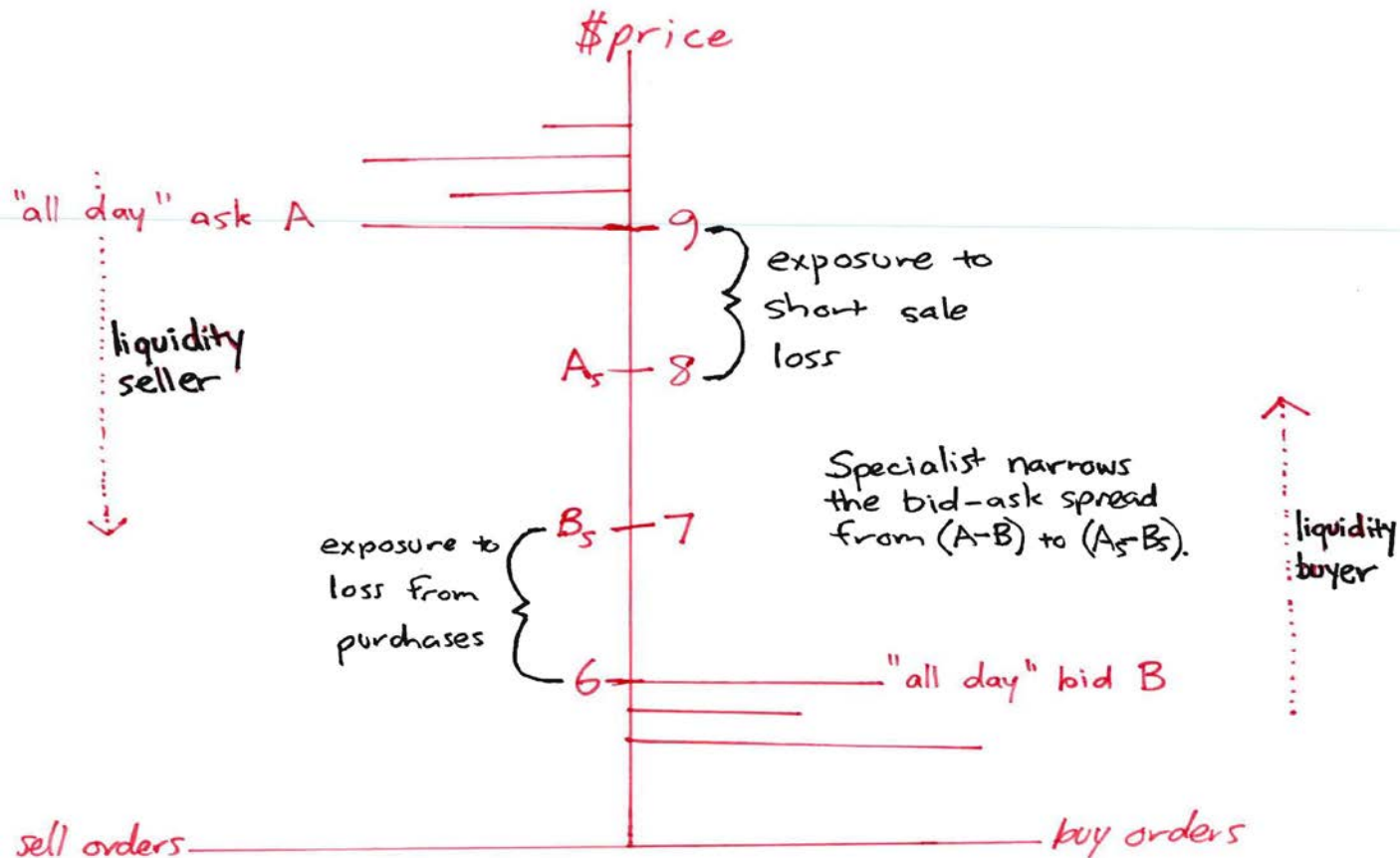
Market makers and specialists

- ◆ Market makers (at NASDAQ) and specialists (at NYSE) play an intermediary role to facilitate the speed with which transactions take place.
- ◆ Market makers compete with each other (about 14 for each type of security) by posting a spread, a bid and an ask, that investors can trade at.
- ◆ Specialists (just one per share) can post a spread at which they must transact at, but they must process orders coming from investors in the exact order they are received without interfering with orders that cross.

Shrinking the spread with limit orders

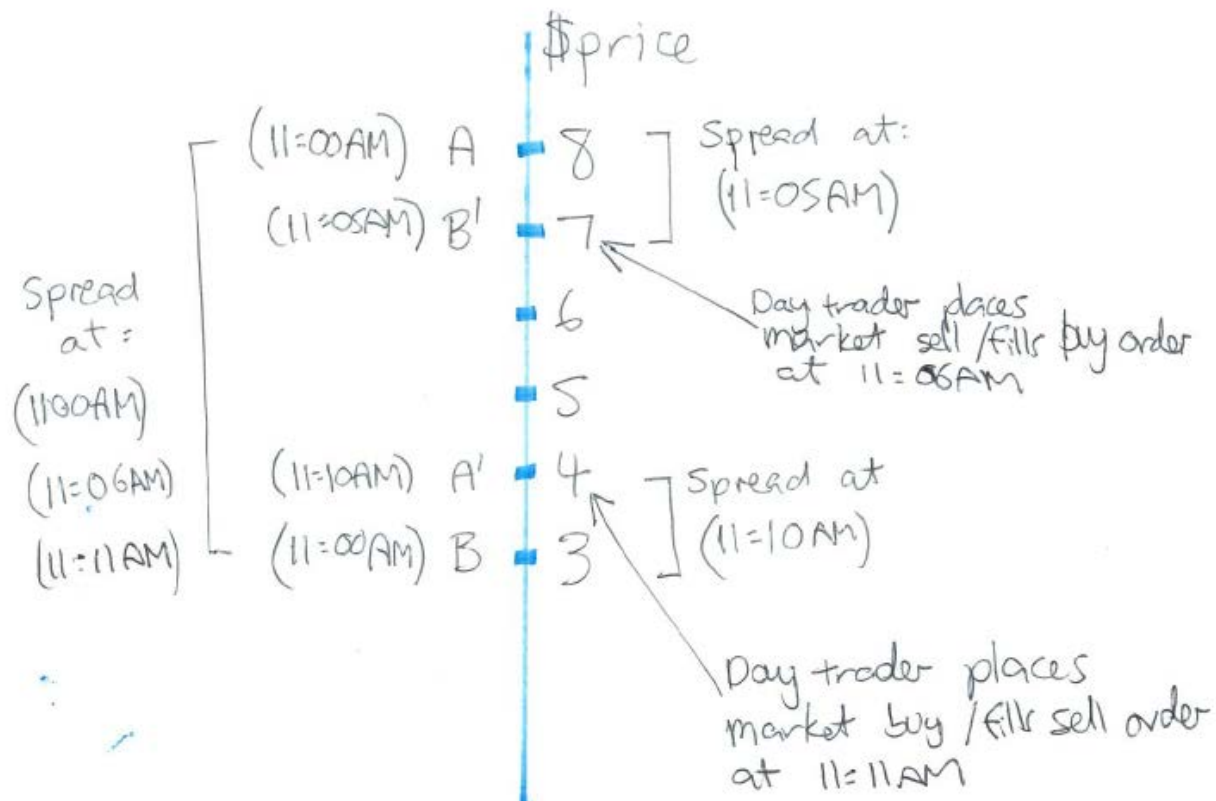
Judiciously placed limit orders may be profitable:

- ❑ Place (personal) quotes inside the spread.
- ❑ That is, shrink bid/ask spread, by offering superior terms of trade.
- ❑ Close position to eliminate risk exposure by placing market orders.



Enlarging the spread with market orders

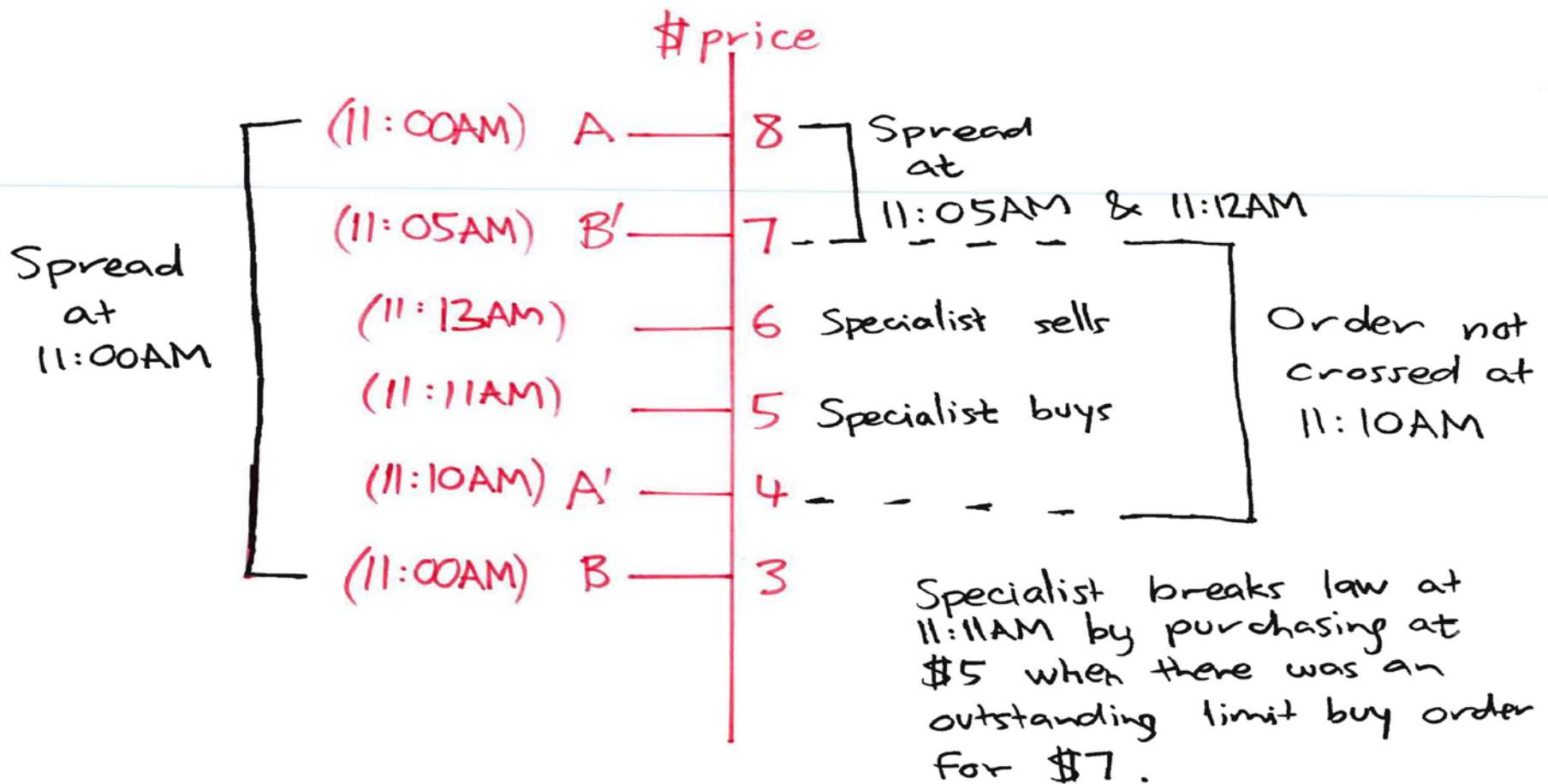
- ◆ Judiciously placed market orders may be profitable too:
 - ❑ Fill an attractive limit order with a market order.
 - ❑ Wait for another attractive limit order on the other side of the market.
 - ❑ Fill this second order to cancel the exposure of the first market order.
 - ❑ Close position by placing market orders to eliminate risk exposure.



Front running

- ◆ Substantial monopoly rents can be made by (illegally) breaking the precedence rule.
- ◆ In this maneuver the specialist prevents buy and sell limit orders from directly crossing each other, and instead extracts the difference between the buy and sell limit prices with two trades.
- ◆ For example the specialist:
 1. enters a limit buy order from an investor client
 2. receives a sell order at a lower price
 3. fills the limit sell order himself at the sell price
 4. resells the asset at the buy price
 5. lies about the timing of the receipt of orders.
- ◆ This illegal practice is punished with jail time.

Front running illustrated



Common components to valuations

- ◆ As information about an asset evolves, traders update its value. For example, consider the fallout from:
 1. A pharmaceutical company discovers a new vaccine.
 2. Changing regulations limit fracking.
 3. Virtual meetings become more palatable.
- ◆ Any one of these developments has wide ranging effects on the asset values of firms in multiple industries:
 1. Pharmaceutical company, theaters, restaurants
 2. Renewable energy firms, vehicle manufacturers
 3. Builders and realtors, hotels, airlines
- ◆ Everyone values dividend streams, so these changes affect its total value to everybody in a very similar way.

Instantaneous information diffusion

- ◆ Suppose an announcement fully and simultaneously informs everybody about a financial event.
- ◆ If the new information raises the value of the asset to enough investors:
 1. every limit sell order lower than the new ask will be withdrawn immediately.
 2. transaction prices after the announcement will instantaneously jump to reflect the new information.
- ◆ Similarly, if the new information lowers the asset value :
 1. every limit buy order higher than the new bid will be withdrawn immediately.
 2. transaction prices after the announcement will instantaneously drop.

Differential information diffusion

- ◆ Alternatively suppose investors have differential access to financial events.
- ◆ When new information arrives that raises (lowers) the value of a security to everybody, new market buy (sell) orders quickly snap up the most attractive limit order sell (buy) orders if they are not withdrawn or reset quickly enough.
- ◆ Investors with slower reaction times who place limit orders are disadvantaged, because they are more likely to be filled when the underlying value of the security moves against them.

A reason for tracking limit orders

- ◆ Thus limit orders give better prices than market orders but:
 1. might not be filled
 2. face **picking off risk** if left unattended.
- ◆ If I place a limit buy order, leave it unattended and the asset value to everyone:
 1. increases due to a favorable announcement. Then the bid increases and my order is not filled.
 2. decreases due to an unfavorable announcement. Then my limit order becomes the bid and fill at the price I selected before the unfavorable news.
- ◆ Summarizing, not tracking the changes in the underlying asset value of my unfilled limit orders, increases the probability of execution when I least want it.

These limit orders are exposed to picking-off risk.

Picking-Off Risk

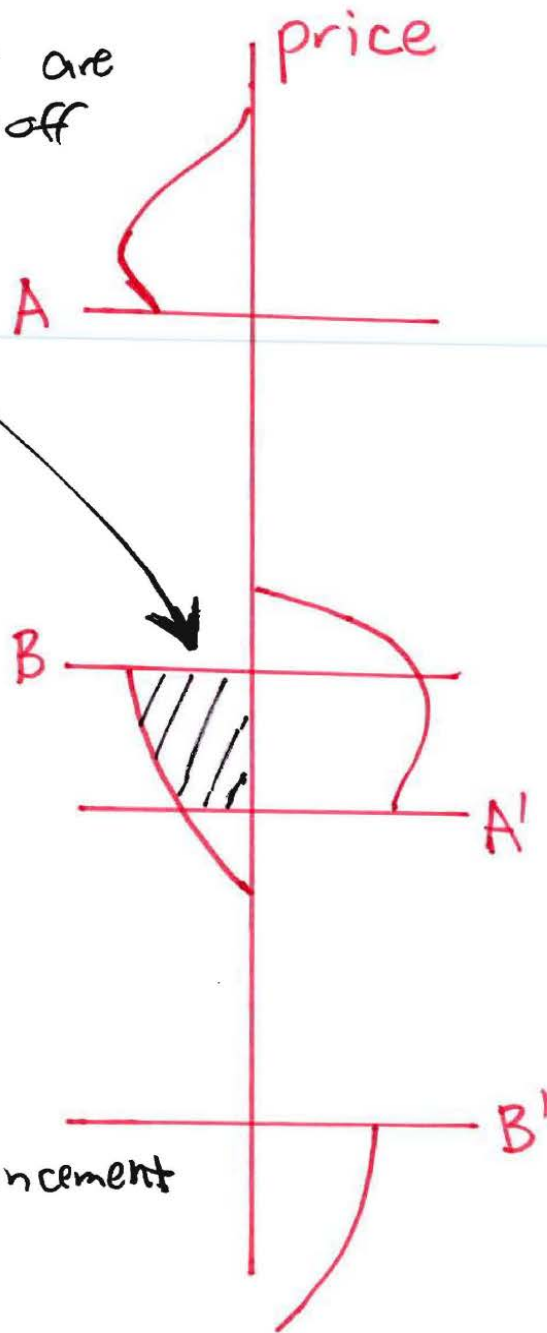
BEFORE

AFTER

Suppose all valuations fall by the same amount because of an unfavorable earnings announcement

If everyone adjusted instantaneously the announcement effect of this financial event would be:

$A \rightarrow A'$
 $B \rightarrow B'$



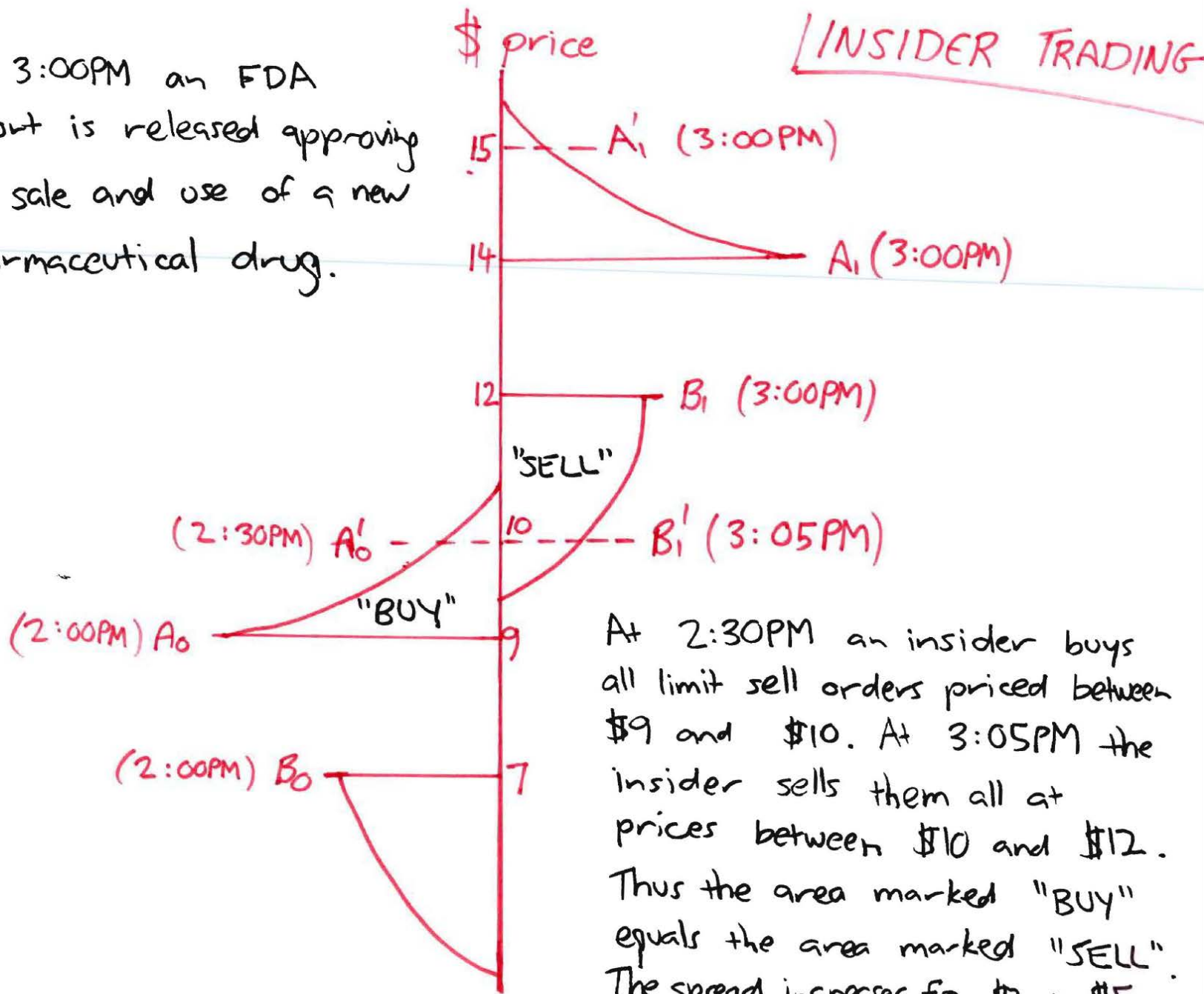
Differential information shrinks the market

- ◆ In imperfectly liquid markets the sporadic arrival of information creates an incentive to deviate from the law of one price.
- ◆ Instead of waiting for their order to be filled investors would offer a more attractive price, or withdraw from the market: it reduces their exposure to picking off risk.
- ◆ More generally differential information discourages market entry, because the informationally disadvantaged are less likely are (rightly) afraid of being burnt.
- ◆ Conversely discouraging investors from acquiring information about the assets they might hold leads to inefficiencies . . . Investors make better decisions if they are more informed about distribution of their asset returns.

Insider Trading

- ◆ Insider trading laws discourage managers and other associates from using privy information about the firm to their advantage when trading stock.
- ◆ The FTC enforces these laws by reviewing evidence of whether a large volume of shares traded hands just before a financial event, (and in the case of a negative event where there would be a short sale before just after as well)
- ◆ They check to see whether the people who profited might have known one another, who their source might be, and typically use wire tapping procedures for self incriminating statements.

At 3:00PM an FDA report is released approving the sale and use of a new pharmaceutical drug.



At 2:30PM an insider buys all limit sell orders priced between \$9 and \$10. At 3:05PM the insider sells them all at prices between \$10 and \$12. Thus the area marked "BUY" equals the area marked "SELL". The spread increases from \$2 to \$5.

How efficient are limit order markets?

- ◆ I conducted an empirical investigation into the efficiency of LOMs with Prof Hollifield and two other researchers.
- ◆ We analyzed three stocks previously traded on the Vancouver Stock Exchange (VSE) to see how much of the potential gains from trade are realized in limit order markets.
- ◆ Published in the Journal of Finance, ours is the first study to quantify the gains from trading on an LOM.
- ◆ The main reason for choosing the VSE is that data were available on all limit orders, not just transaction data.

A brief history of the VSE

- ◆ The VSE was:
 - ◆ incorporated 1906.
 - ◆ merged into the Canadian Venture Exchange (CDNX) in 1999.
 - ◆ subsequently absorbed into the Toronto Stock Exchange (TSE).
- ◆ The VSE became fully automated by 1990:
 - ◆ listing 2,300 stocks at the time.
 - ◆ with more than 2/3 in gold, silver, oil and gas businesses.
- ◆ Annual trading increased from C\$4 billion in 1991 to \$6.7 billion in 1993.

An unsavory reputation

- ◆ Yet the VSE had an unsavory reputation reminiscent of the wild west:
- ◆ In 1989, Forbes magazine christened it "scam capital of the world".
- ◆ A 1994 report by James Matkin (of the VSE & Securities Regulation Commission) referred to "shams, swindles and market manipulations" within the VSE.
- ◆ The summary judgement of Investopedia.com is that "the VSE is an example of one of the world's less successful stock exchanges."

Types of inefficiency

- ◆ LOMs might not realize all the potential gains from trade for four reasons:
 1. Limit orders are not executed when they should be .
 2. Traders do not submit orders when they should.
 3. Traders submit “wrong sided” orders, such as a buy order rather than a sell order.
 4. Traders submit orders when they should not.
- ◆ Our estimates possibly understate the efficiency of LOMs, because we did consider coordination problems between investors arriving at the market at different times when computing the maximal gains from trade.

conditions hold at the computed monopoly bid and ask quotes at each observation. The three sample stocks are Barkhor Resources (BHO), Eurus Resources (ERR), and War Eagle Mining Company (WEM).

	BHO	ERR	WEM
Gains			
Maximum gains as a % of the common value			
	9.07	8.61	6.75
Current gains as a % of the common value			
Lower bound	7.88	8.09	6.08
Upper bound	8.45	8.31	6.40
Average	8.16	8.20	6.24
Maximum gains minus current gains			
Lower bound	0.62	0.30	0.35
Upper bound	1.20	0.52	0.67
Average	0.91	0.41	0.51
Current gains as a % of maximum gains			
Lower bound	86.79	93.97	90.07
Upper bound	93.13	96.57	94.81
Average	89.96	95.27	92.44
Decomposition of Losses			
No execution as a % of total losses			
Sell side	32.32	31.20	33.05
Buy side	40.10	39.01	41.85
Subtotal	72.42	70.21	74.90
No submission as a % of total losses			
Sell side	2.24	0.62	0.41
Buy side	1.98	0.15	0.71
Subtotal	4.22	0.77	1.12
Wrong direction as a % of total losses			
Sell side	0.86	0.02	0.39
Buy side	0.20	0.05	0.63
Subtotal	1.06	0.07	1.02
Extramarginal submissions as a % of total losses			
Sell side	9.81	11.87	10.30
Buy side	12.49	17.07	12.66
Subtotal	22.30	28.94	22.96
Total	100.00	100.00	100.00
Monopoly Gains			
Monopoly gains as a % of the common value			
	5.02	5.57	4.18
Monopoly gains as a % of maximum gains			
	55.31	64.71	61.87
Current gains as a % of monopoly gains			
	162.65	147.23	149.41

Comparing the assessments

- ◆ Our high frequency time series data based estimates paint a glowing picture of capitalism at work in the VSE, in stark contrast to the historical narrative.
- ◆ The historical narrative is puzzling:
 1. If the VSE was so unsuccessful, why did the trading volume grow substantially?
 2. When the VSE was being absorbed into the TSE several European exchanges also merged. Was this:
 - i. driven by the electronic exchange technology?
 - ii. evidence of an unsuccessful exchange?

Key pointers

◆ Liquidity

- How much does transaction price vary when it is the bid (filled by a market sell order) versus the ask (filled by a market buy order).

◆ Market orders (shrink the book)

- Require attentiveness to fill attractive limit orders
- Less lucrative than limit orders

◆ Limit orders (shrink the spread)

- Do not always transact
- Exposed to picking off risk

◆ Both are exposed to **risk when closing position** (with market orders).

◆ Market integrity

- Front running
- Insider trading

◆ Overall evaluation of LOM conduct and performance

- A raging success