Market Microstructure: An Interactive Exercise

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ABSTRACT

Although a lecture on microstructure serves to initiate the inspiration of students, in this paper we attempt to take the traditional lecture format one step further by creating an interactive market microstructure exercise. One of the challenges in teaching market microstructure is getting the students to understand the intricacies of each market participant involved in establishing intraday stock prices. Having students play the role of various market participants provides a good base for explaining bid/ask spread, how market makers and specialists work, and how stocks prices change throughout a single day of trading.

INTRODUCTION

In this interactive trading exercise, student groups are assigned to operate in different roles in order to simulate a day of market trading. We find that interest in market microstructure increases when stock market trading is discussed in finer details and students discover how much stocks move during the duration of a single trading day. Many students are unaware of the significant swings in stock prices and how rapidly and why such movements take place. Students simulate the way trades impact the overall markets and how market makers update their bid and ask quotes to deal with fluctuating market conditions.

Groups are assigned roles such as market maker, information trader, liquidity trader, and day trader. The role of market maker is the key role in this assignment, two to three groups depending on class size are assigned as market makers. These groups are given the task of making the market for each stock, and must always have both a bid and ask for each of the three stocks in which they make a market for. This is a key role because they set the levels at which stocks may be bought and sold. Market makers are forced to price stocks competitively as they are competing for business against other market makers. Their primary source of profits is through the bid/ask spread, although market makers can trade for profit as well. Market makers are given a challenging task as the market changes quickly and they must update their bid/ask prices immediately to avoid buying or selling at adverse (less than market) prices.

The remaining groups make up the various traders for this exercise. These groups use their information to achieve the overall goal of maximizing profits while at the same time trying to meet some given objectives. Traders in these groups impact what happens to the prices of stock throughout the trading day. If traders purchase stock they force market makers to quickly adjust their bid and ask higher and when selling pressure exists market makers quickly change the bid and ask in the opposite direction. To add price revelation to the trading exercise, the private information provided to these different traders is revealed throughout the trading day, which quickly impacts the different prices of the three stocks. Similar to the market, these price changes may be large or small and may challenge common intuition in the short-run after an announcement. It is common to see over or under reaction to the different announcements, which is consistent with market trading.

This exercise focuses on accomplishing three major goals. First, it adds to students' excitement and learning as to how the stock market works and how prices are updated. This is accomplished within the exercise as students quickly begin to call out orders as traders would on the stock market. Students are also interested to see how stock prices and volatility change as the exercise proceeds. Second, it provides some insight to how market makers work and the speed in which they must change prices. Often during the trading exercise market makers open up opportunities for traders to make arbitrage profit as they do not change their bid/ask spread quickly enough to incorporate other market makers bid/ask spreads. Third, it shows how bid/ask spread is affected by both informed traders and information releases.

THE MARKET MICROSTRUCTURE EXERCISE

To begin the exercise, students are placed into the following groups:

- Market Makers (Groups A, B, and C)
- Information Traders (Groups A, B, and C)
- Liquidity Traders (Groups A, B, and C)
- Day Traders (Groups A, B, and C)

All groups are provided with the overview and then each group is given their corresponding information provided in the Appendix. The groups are not to see the information provided to the other groups. Market makers are tasked with setting their bid/ask spread for each of the three stocks based upon their closing price and any additional information they may have on the stock. After the market makers set their bid/ask spread and write them on the board in the classroom, the trading day begins.

The informed traders may initially try to take advantage of market makers as they have private information about the stock. As this occurs, the market maker groups typically increase their spread as they observe increased pressure on either the bid or ask side of a stock. When the trade offers are heavily weighted on one side of the bid/ask spread, the other market makers realize the pressure and tend to increase the spread of the stock. This is consistent with a risk based argument for a higher bid/ask spread.

The trading goes for about 15-20 minutes before the first piece of information is released. The first piece of information made public is that Stock A will have an equity offering. Groups should immediately realize that equity offerings are typically a negative signal, market makers should lower their bid/ask prices and traders should be selling at this time or potentially covering if they had shorted the stock before the news was released. Often, immediately after the private information is revealed, the bid/ask spread tends to increase sharply, again supporting a risk argument pointing to a higher bid/ask spread.

The next information release comes around 10-15 minutes later regarding Stock C. It is announced that Stock C has surpassed earnings expectations by 20 cents per share. Groups should immediately realize that this is a positive sign and market makers should increase their bid/ask prices. Traders should be buying at this time or potentially selling if they had bought the stock before the news was released. Again, often the bid/ask spreads of each market maker increases after the information is released. Another information release comes around 10-15 minutes later stating that Stock B has been named as a target for acquisition with a 30 percent premium. Students should recognize this announcement is a positive sign.

Finally, the last piece of information is released. This piece of information may be on any of the three stocks and is designed to reverse the way the stock has been trading. For example, it could be announced that Stock A is using the money from the equity offering to take on a positive NPV project which would increase earnings far more than any dilution from the equity offering. Releasing this information would obviously alter the trading pattern of Stock A as it now should exhibit a positive trend. Market makers and traders must quickly adjust to this change in order to profit from the other participants. The information released should be one no trader possessed in order to surprise all traders and have a significant impact on trading.

At the conclusion of the exercise, the traders are given 10-15 minutes to finish all trades. The price of the last trade for each stock indicates the final (last) price for the day. This closing price is used to measure all gains and losses.

TEACHING NOTES

Depending on the level of the course, it is helpful to explain to the market makers how profits are made off the bid/ask spread. For example, if the market maker sets the quote for Stock A at $20-$20.25 then as the traders place orders to sell their shares of Stock A the market maker will purchase the shares at $20. Subsequently, buy orders from traders will be filled at $20.25. The market maker is effectively buying shares at $20 and selling them for $20.25. The wider the spread, say $20–$20.50, the greater the profit for the market maker. However, students typically need to be reminded that their quotes must competitive given there are other market makers placing bid/ask quotes on the same security.

A summary of the initial buying and selling sentiments for each stock is presented in tables A, B, and C. Table A reveals a net selling pressure for stock A of 155,000 shares. Stock B has a net selling of 60,000 shares, while Stock C has outstanding buy orders which exceed sell orders by 175,000 shares. The students will not be aware of the strong negative sentiment for Stock A, or the strong positive outlook and outstanding orders for Stock C. These selling or buying pressures will impact the final (last) price of each stock and forces prices to fluctuate throughout the trading day.

<insert Table A here>
<insert Table B here>
<insert Table C here>

At the Open

The student group representing Market Maker A may lower the opening bid and ask for Stock A below $20 as they are told of potential weakness in Stock A. They may recognize if the stock trades lower for the day then they will have the opportunity to buy it back at a lower price later in the trading day any shares they may sell. The interesting dynamic is to observe the subsequent actions taken by Market Makers B and C. These two groups are often focused on increasing the bid/ask price in anticipation of Stocks B and C trading higher and tend to ignore the lower bid/ask price on Stock A from Market Maker A. At this stage you may want to remind the trading groups (depending on the level of cleverness of the class) to look for arbitrage across the three market makers when opportunistic bid/ask spreads are posted.

The trading groups now begin to call out buy and sell orders with predominantly sell orders for Stock A and buy orders for Stocks B and C. The informed traders may initially try to take advantage of market makers as they have private information about the stock. As this occurs, the market maker groups typically widen their spread as they feel additional pressure on either the bid or ask side of a stock. When the trade offers are heavily weighted on one side of the bid/ask spread, the other market makers realize the pressure and tend to increase the spread of the stock.

Information Announcements

When information is made public as described in the exercise, groups begin calling out orders and market makers rush to change their bid/ask spreads. Often, immediately after the private information is revealed, the market makers increase the bid/ask spread in an attempt to augment profits. During the most active periods of trading the market makers tend to open up opportunities for traders to make arbitrage profit as they do not change their bid/ask spread quickly enough to incorporate other market makers bid/ask spreads.

Concluding the Exercise

At the conclusion of the exercise, a discussion of the profits and losses for each group should ensue along with a discussion of what decisions drove each group's profits. It is also helpful to discuss the mistakes that were made by each group and what each group would do differently if they could repeat the exercise.

The market makers should compare not only their profits and losses but also any changes in their inventory for each stock. The market making groups may need to be reminded that one of the objectives was to make profits from trading and the bid-ask spread by buying and selling securities without increasing or decreasing exposure too much from the previous day. This is also a good time to discuss any arbitrage opportunities occurring during the trading day.

The liquidity traders compare the prices at which they bought and sold during the exercise to determine which group traded at the best prices. The information traders and day traders will compare profits and losses as well as their final inventories in each of the three stocks. The students should be reminded of the objective for information traders was to end the day with the lowest exposure to any of the three securities. The objective for the day traders was to end the exercise with no exposure in any stock. At this point, discussions are finalized and the exercise is concluded.

Table A

This table provides a list of the initial outstanding buy and sell orders for each trading group for Stock A. Any positive or negative sentiment for the stock is also included in the table.

Stock A

Student Group	Buy	Sell (shares)	Sentiment
Market Maker A			Negative
Information Trader A			Negative
Liquidity Trader A		40,000	
Liquidity Trader B		40,000	
Liquidity Trader C		75,000	
Day Trader A			Negative
Net Summary		**Sell 155,000(shares)**	**Negative**

Table B

This table provides a list of the initial outstanding buy and sell orders for each trading group for Stock B. Any positive or negative sentiment for the stock is also included in the table.

Stock B

Student Group	Buy	Sell (shares)	Sentiment
Market Maker B			Positive
Information Trader B			Positive
Liquidity Trader A		40,000	
Liquidity Trader B	80,000		
Liquidity Trader C		100,000	
Day Trader B			Positive
Net Summary		**Sell 60,000(shares)**	**Positive**

Table C

This table provides a list of the initial outstanding buy and sell orders for each trading group for Stock C. Any positive or negative sentiment for the stock is also included in the table.

Stock C

Student Group	**Buy**	**Sell (shares)**	**Sentiment**
Market Maker C			Positive
Information Trader C			Positive
Liquidity Trader A	150,000		
Liquidity Trader B		75,000	
Liquidity Trader C	100,000		
Day Trader B			Positive
Net Summary	**Buy 175,000(shares)**		**Positive**

Appendix

This information is to be provided to all participants.

All Groups

Market Makers – have inventory for 3 stocks and must make market in each stock. The goal is to make profits from trading and the bid-ask spread by buying and selling securities without increasing/decreasing exposure too much from the previous day. Be careful to set your bid-ask spread competitively with the other market makers.

Information Based Traders – have a subset of information on the stock and will use it try and make the most profit. The goal is to make the most money possible by using your information, but end the day with the lowest possible exposure in the stock. Information traders are permitted to short sell stocks as they see fit.

Liquidity Traders – need to buy or sell a security in the amount desired to obtain the best possible price for the day (examples include institutional investors and mutual funds).

Day Traders –Make the most money possible, but would like to end the day with the no exposure in any stock. Essentially you play on trends you think will make you money and get in and get out quickly. Day traders are permitted to short sell stocks as they see fit.

The stocks closed at following prices the day before:
Stock A --- $20
Stock B --- $35
Stock C --- $15

Directions:
Buy and sell in even lots (lost of 100 shares)
Traders cost to trade is $10 per trade
Traders buy stocks using market orders (in other words buy at the ask price and sell at the bid price)

The following information is asymmetric and is not to be shared across groups.

Market Maker A

Must make market in 3 different stocks meaning you must have a bid/ask for all three stocks and be willing to offer at least 100 shares for both. The market maker can change both bid and/or ask whenever they feel it is reasonable to do so. Have inventory of the 3 stock in varying amounts:
Stock A --- 250,000 shares
Stock B --- 50,000 shares
Stock C --- 100,000 shares

Private Information: Your analyst informs you Stock A will announce a stock offering today and feel as company A's stock price will decrease by some amount today.

Market Maker B

Must make market in 3 different stocks meaning you must have a bid/ask for all three stocks and be willing to offer at least 100 shares for both. The market maker can change both bid and/or ask whenever they feel it is reasonable to do so. Have inventory of the 3 stock in varying amounts:
Stock A --- 50,000 shares
Stock B --- 200,000 shares
Stock C --- 80,000 shares

Information: Your analyst informs you Stock B may be a target to be bought out by a rival firm.

Market Maker C

Must make market in 3 different stocks meaning you must have a bid/ask for all three stocks and be willing to offer at least 100 shares for both. The market maker can change both bid and/or ask whenever they feel it is reasonable to do so. Have inventory of the 3 stock in varying amounts:
Stock A --- 85,000 shares
Stock B --- 80,000 shares
Stock C --- 250,000 shares

Information: Your analyst informs you Stock C will announce earnings today and feel as company C's earnings will come in better than expected. The analyst feels this company's intrinsic value is actually around $17.50 per share.

Information Trader A

Private Information - Information Trader A
Information: It is your belief that company A will be issuing new stock to raise money in the very near future.

Information Trader B

Private Information - Information trader B
Information: You have a strong feeling it will be announced that company B will be a target of a takeover.

Information Trader C

Private Information - Information Trader C
Information: You know company C will issue an earnings announcement. You have a strong feeling they will announce earnings that will beat expectations by at least 5 cents per share and possibly more.

Liquidity Trader A

Private Information - Liquidity Trader A
You are a mutual fund and you want to make the following changes to your portfolio at some point during the day of trading.

Buy 150,000 shares of stock C
Sell 40,000 shares of stock B
Sell 40,000 share of stock A

Liquidity Trader B

Private Information - Liquidity Trader B
You are a mutual fund and you want to make the following changes to your portfolio at some point during the day of trading.

Sell 75,000 shares of stock C
Buy 80,000 shares of stock B
Sell 40,000 share of stock A

Liquidity Trader C

Private Information - Liquidity Trader C
You are a mutual fund and you want to make the following changes to your portfolio at some point during the day of trading.

Buy 100,000 shares of stock C
Sell 100,000 shares of stock B
Sell 75,000 share of stock A

Day Trader A

Private Information - Day Trader A
You think stock A may go down today as you have seen some negative action in the stock within the last few days. You have $100,000 in equity in your margin account.

Day Trader B

Private Information - Day Trader B
You think stock B may go up today as you have seen some positive trading action within the stock in the last few days. You have $100,000 in equity in your margin account.

Day Trader C

Private Information - Day Trader C
You think stock C may go up today as you have seen some positive action in the stock in the last few days. You have $100,000 in equity in your margin account.