

Chapter 1: **GETTING THE TRADES MADE**

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AVNER WOLF: Good morning, everyone. Welcome to this beautiful vertical campus at Baruch College.

Before I hand over the microphone to Mike, Puneet and Jim, I would like to mention some work involving Bob and I that is related to the presentations that will be made on this panel by Mike and Puneet. In one of our papers, we found that traditional buyers and sellers are commonly in the market together at the same time. An important reason is that they have different views about the stocks they are trading. At this same moment in time, some participants are bulls and some are bears. Some want to buy, while others want to sell. You will see a connection between this reality and Mike Pagano's discussion about book building. Mike's paper, which is being produced with Bob and Archishman Chakraborty, shows how hard it is to get orders out of traders' pockets and onto the books even when some of the big participants are seeking to buy at the same time as others are looking to sell.

In another paper that Bob and I are involved in, we develop a model of price discovery that follows a new, reasonably realistic, and rather unorthodox approach. The paper is based on the assumption that market participants have divergent valuations (again, some are bulls and some are bears) for a security. We show how a divergence of expectations translates in the real world into price discovery being a complex, dynamic process. This view of reality ties in with the discussion that we will be hearing from Puneet about the timing of order placement. Puneet and his co-authors, Bob and Ashish Tiwari, find that floor broker-timed order handling generally lowers execution costs.

Lastly, Jim Ross will talk about these issues from the point of view of a market architect who, as a practitioner, has seen in action what Mike, Puneet, and their co-authors have modeled in theory.

I invite Mike to speak first.

MICHAEL PAGANO: Thanks, Avner. My paper, which is a joint work with Archishman Chakraborty and Bob Schwartz, is titled 'Traders' Dilemma.' We consider how traders enter their orders into a market and build a book. We all know that large, institutional traders typically hold their orders back – in whole or in part – in an attempt to protect themselves from adverse price impact. But holding back results in undesirable outcomes. We talk, for instance, about slicing and dicing, delayed executions and latent liquidity. Ultimately, holding orders back results in markets being less liquid. Our paper models this dynamic. Through a better understanding of it, we hope to gain insights that will lead to the development of more efficient trading mechanisms. In a nutshell, a mechanism is more efficient if it enables large participants to step forward more readily with their orders and trade.

You may have seen the movie, *A Beautiful Mind*, starring Russell Crowe. Crowe played the role of John Nash, the brilliant economist/mathematician who won a Nobel Prize for having developed non-cooperative game theory. His contribution to game theory – the Nash equilibrium – was a significant effort at demonstrating what happens when 'most desirable outcomes' are sought by players in non-cooperative games. In this Nash equilibrium, no player can gain an advantage by unilaterally changing his strategy if the other players do not change their strategies at the same time. Nash's basic insight was that when people compete, they do not necessarily achieve the most desirable results that would be obtained if they instead cooperated. We recognize this behavior in the context of the equity markets and formally model it. Our objective is to obtain, using a game

theory structure, a crisper, more formal understanding of the dynamics of the book building process.

Our conclusions are not based on any assumption of investor irrationality. They are based on the very rational idea that every trader is out for his or her own self-interest. Nevertheless, at the end of the day, each participant does wind up with an undesirable outcome. Recognizing this, we suggest that there is a role for a financial intermediary to play. The role, in our terminology, is that of an ‘animator’ who facilitates the book building process.

Here is a quick primer on game theory. John Nash applied his classic idea, the Nash equilibrium, to a game known as the Prisoners’ Dilemma (Exhibit 1).

The Prisoners’ Dilemma (A Nash Equilibrium)

Two Prisoners (A and B) are accused of a crime:

- ☐ **Both keep quiet**
Both get a moderate punishment
- ☐ **A incriminates B (or vice versa)**
A gets no punishment and B gets very heavy punishment (or vice versa)
- ☐ **Both incriminate each other**
Both suffer heavy punishment

	B keeps quiet	B squeals
A keeps quiet	A: 😊 B: 😊	A: 😞 B: 😊
A squeals	A: 😊 B: 😞	A: 😞 B: 😞

Outcome: Both squeal!

Exhibit 1. The Prisoners’ Dilemma

Assume that two prisoners, prisoner A and prisoner B, have both been accused of a serious crime, and that they are being interrogated in separate cells. Neither knows what the other has or may reveal. They are found

guilty (or not) and are punished (or not) depending on what each of them says when interrogated. The alternatives, for each, are either to keep quiet or to squeal and incriminate the other. If they both keep quiet, instead of facing a very serious charge like the death penalty, they would get off with only a minor charge. As they would both be relatively satisfied with that outcome, that outcome for both of them is the best solution in this game.

Now for the dilemma. Both prisoners have an incentive to deviate from the 'do not confess' option. Each will fair better by squealing and incriminating the other if the other one keeps quiet. In this situation, the 'squealer' (say prisoner A) gets no punishment and can walk free, while the other prisoner (B) receives a very serious punishment. So A has an incentive to incriminate B. For the same reason, B has an incentive to squeal on A so that he can go free. The bottom line is that both are incented to incriminate the other, even though both would be better off if they both kept quiet. Consequently, both squeal. The two prisoners wind up with heavy sentences and are in a worse situation than if they had cooperated (instead of having competed) with each other.

We can bring this idea of the Nash equilibrium into the world of trading (Exhibit2).

The Traders' Dilemma

(A Variation on Prisoners' Dilemma)

Two large traders: A is trying to buy, and B is trying to sell, a large block

- ☐ A & B disclose at opening call
Both trade with no market impact
- ☐ A or B does not enter opening call
A subsequently trades at a better price and B gets very inferior execution, or vice versa
- ☐ A & B do not enter opening call
Both subsequently get inferior executions

	B Uses Call	B Holds Back
A Uses Call	A: 😊 B: 😊	A: 😞 B: 😊
A Holds Back	A: 😊 B: 😞	A: 😞 B: 😞

Outcome: Both hold their orders back to their mutual detriment and the book does not build

Exhibit 2. The Traders' Dilemma

Consider the situation where there are two large traders with large orders to execute. Let each trader know that the other is out there, but neither knows when the other will show up. Let trader A be looking to buy a large block of stock at the same time that trader B is looking to sell a large block of stock. The question for both of them is: Should they enter their orders at a morning call auction or go to the market after the morning call?

We show that trader A and trader B will both hold their orders back from the call. The reason is the same as it is for the prisoners' dilemma. Here, we call it the 'traders' dilemma.' Comparable to what we showed for the prisoners' dilemma, the optimal outcome for both would be for both to go to the opening call. In this case, the two would meet and provide liquidity to each other. In so doing, they would both happily receive an execution with little or no market impact.

But, just as is the case with the prisoners' dilemma, both traders have an incentive to deviate from the mutually beneficial strategy. Trader A will say, 'It makes sense for me to hold my buy order back and to wait for trader B to sell and push down the price. By being patient, I will be able to buy at a lower price. The same logic holds for trader B: wait for A to come in, for A to buy, push the price up, and then to sell at a higher price. For each of them, holding back (which is equivalent to not telling the truth) while the other places an order in the call leads to an excellent result. On the other hand, not holding back when the other does and going into the call alone leads to a bad result.

Consequently, as with the prisoners' dilemma, they both do that which is undesirable for both of them collectively – they both hold back from the opening call. The result? Both traders go to a market that is less liquid and wind up paying for their decisions in terms of higher market impact costs. Nevertheless, A's behavior is not irrational, and neither is B's. Each is basically following a self-interested, self-optimizing trading strategy given his or her expectations of what the other will do. But the outcome of their strategies is that book building is difficult.

What can we do about it? From the point of view of market design, how can we change a market's structure to avoid the undesirable Nash equilibrium? We focus on one solution in particular. We believe that an intermediary – an entity like a direct access broker, the classic exchange specialist, or an upstairs market maker – should (and does) take an active role in the book building process. We see the intermediary as a facilitator who animates the market. The animation process may involve providing capital, not to supply liquidity per se, but to get big buyers and sellers to step forward in a way that enables them to supply liquidity to each other.

On behalf of my co-authors Archishman and Bob, along with John Nash and Russell Crowe, I thank you.

WOLF: Thanks to you, Mike. Puneet?

PUNEET HANDA: I will talk about a paper that I wrote with Bob and Ashish Tiwari, 'The Economic Value of a Trading Floor: Evidence from the American Stock Exchange,' published in the April issue of the *Journal of Business*.⁷ We had some interesting results that I would like to share with you.

⁷ Reprinted with permission from 'The Economic Value of a Trading Floor: Evidence from the American Stock Exchange,' Handa, P., Schwartz, R., and Tiwari, A., *Journal of Business*, 2004, vol.77, no. 2, pt. 1, pp 331-355, ©2004 by The University of Chicago. All rights reserved.

We looked at the American Stock Exchange (Amex) and asked ourselves, ‘Does the floor have any economic value?’ All around the world, we are seeing a move to electronic exchanges. The question is, is the traditional trading floor archaic? Is it time to close the floor down? Is it there only because it has always been there? Or does the floor have economic value?

We did our analysis using 2001 data, focusing on the American Stock Exchange. The Amex receives orders in two ways. Some orders (floor orders) come from the floor brokers, and some orders (system orders) come in over the Amex’s electronic order delivery system. We compared the execution costs of the floor and system orders. The floor brokers, of course, incur handling costs. The question is: Does their superior order handling save enough in execution costs to justify the handling costs? We conjecture that this is the case, but it is not something that we are able to show or to prove. Rather, we focus more modestly on whether or not floor brokers have a gross value added, on whether or not the shares that they handle incur lower execution costs.

We originally started our study with Amex data for October 1996. But by the time the paper was finished and got reviewed by the *Journal of Business*, the referee said, ‘Good job, but the data are too old. Please redo the tests.’ So we went back to the Amex and they provided us with data for 973 stocks for October of 2001. We retested everything with the new data. The results confirmed what we had previously found with the 1996 data. Thus, we have further confidence that our findings are robust.

Information about the share volume and number of trades, trade sizes, etcetera, are given in Exhibit 3.

Descriptive Statistics

	Share Volume	No. of Trades	Trade Size	Trade Time
Floor	110,489,600	49,940	2,212.45	26.64
PER	361,739,540	388,194	931.85	27.87
All Trades	472,229,140	438,134	1077.82	27.73

Exhibit 3. Descriptive Statistics

We examined over 472 million shares traded, of which roughly 110 million came from the floor. That is, roughly, over 23%. We examined over 438 thousand trades of which roughly 10% (49,940) were floor based. Floor trades account for over 23% total share volume but only 10% of the trades because the floor trade size is much bigger (2,212 shares) as opposed to the PER trade size (932 shares). Trade time reflects the time, on average, for 31 trades to occur (for each trade, we examine the 15 trades that precede it and the 15 trades that follow it).

Our research design is as follows. We classified each trade according to the order that triggered it. For instance, a trade triggered by a floor order to buy is classified as a 'buy trade' and as a 'floor trade.' In total, we considered four combinations of floor vs. system orders and buy vs. sell orders. For both buy and sell trades, we matched the sample of floor trades to a sample of non-floor trades. Trades had to be in the same stock; in

the same direction (buy or sell); the execution price of the PER trade had to be within 20% of the price of the floor trade; and, finally, the size of the PER trade had to be within 20% of the size of the floor trade. While satisfying these conditions, we were able to match 48,471 floor trades (which was 97.06 percent of our sample). We compared each matched trade in terms of the quoted half-spread, the effective half-spread, and the realized half-spread. The quoted half-spread is the spread (divided by 2) that you would measure when simply selling at the bid and buying at the offer (which is not very realistic). The effective half-spread is the difference between the price at which your order has executed and the mid-point of the quoted spread at the time of your trade. It is a reasonably good measure except that sometimes transaction prices move because of ‘permanent’ price changes. To get rid of that permanent change, we used the realized half-spread. The realized half-spread reflects the difference between a trade price and the mid-point of the bid-ask spread 15 trades later.

Values for the three spread measures are shown in Exhibit 4.

Matched Pair Results

(in <i>bps</i>)	Q ½ Spread	E ½ Spread	R ½ Spread
Floor	16.23	8.11	-3.06
PER	17.47	10.27	4.43
Difference	-1.24 **	2.16 **	-7.49 **

**Significant at the 1% level.

Exhibit 4. Matched Pair Results

The quoted half-spread for the floor trades averaged 16.23, and for electronic trading it is 17.47, a difference of -1.24. The difference is statistically significant. The floor brokers did better than the electronic trades by 1.24 basis points. The comparable values for the effective half-spread are 8.11 for the floor trades and 10.27 for the system trades, a difference of -2.16 basis points. Again, the difference is statistically significant. Finally, look at the realized half-spread. This measure is the most important, realistic, and appropriate of the three. Overall, trades handled by floor brokers have a significantly smaller realized half-spread than do PER trades (-3.06 bps vs. 4.43 bps), a difference of 7.49 bps. This is a statistically significant victory for the floor. Notice that the realized half-spread for the floor trades is actually a negative 3.06. What does it mean for it to be negative? It means that the floor delivered order was executed when the market was moving up for a buy order (or when the market was moving down for a sell order). If the market continued to move up (after a purchase) or down (after a sale), the order was turned into a trade at the strategically right time. It is the effective timing of the floor trades that resulted in the realized half-spreads, on average, being negative.

We performed some further econometric analyses, and I will give you a brief overview of the results. We found that larger orders were more likely to execute on the floor. We looked at a market imbalance variable (the imbalance between buy and sell orders), and the coefficient told us that, as market imbalance increases, floor trades are more likely to occur. Specifically, a floor trader is more apt to step forward and execute an order when the book thickens on the side of the market (buy or sell) that the order is on. Further, when price has moved up prior to an actual trade, a floor trader is less apt to step forth with a buy order. Similarly, if price has moved down, a floor trader is less apt to step forward and execute a sell order. In other words, following a price change, you do not get as many floor orders. You tend to get system orders instead. We also looked at the time of day. Floor trades are more likely (relative to system trades) in the morning and in the late afternoon at the approach of the close. Finally, we found that floor trades are more likely for low volume stocks. That is, the mid-caps and the small-caps are more likely to be traded on the floor.

Here are the major conclusions presented in the paper:

1. Trades handled by floor brokers have significantly lower execution costs. I know this will shake up some people, but it is a fact.
2. The floor trading mechanism is preferred for larger size trades, on occasions when the book is thick on the side of the order initiating the trade, but not following a recent price change. The floor trading

mechanism is also preferred after the start of trading, near the market close, and for less liquid stocks.

3. The Amex trading floor has economic value. In fact, we measured this economic value based on our estimates. The Amex trading floor resulted in a total savings of \$4.36 million in the month of October 2001. That is our estimate of the amount of gross value that the floor added.
4. Floor traders exhibit strategic behavior. They become more aggressive in response to a thickening of the book on their side of the market, and they become more patient following large price changes that, if chased, could result in costly executions. In contrast, system orders are more apt to chase recent price changes.

WOLF: Interesting, indeed. Thank you, Puneet. Jim, please. It is time to hear from a practitioner.

JAMES ROSS: I must say that it is interesting for me to be on this panel with the professors. I figure, in the infinite wisdom of Bob Schwartz, that he is taking the opportunity to juxtapose the practical against the academic.

Most of my career has been in the crossing area, and I am still trying to understand Bob Schwartz's 1986 paper on call auction trading. As Bob has pointed out, for the past 15 to 20 years, we have been implementing new technologies. So, where are we today? What have we actually implemented? We are still having issues of volatility. We are still having issues with finding size. In many ways, things have gotten worse, even as we have seen heightened competition between the various ECNs and now between the New York Stock Exchange and the various ECNs.

A couple of years ago, Bob put up a slide on the first half-hour of trading in Cisco.⁸ That slide showed that, if you count the number of trades that occurred in the first half-hour of trading (almost 10,000 trades that went up in the first 30 minutes), and then divide the number of trades by 1,800 seconds, you see a whole host of trades (over five) going up in any given second. Using an admittedly unscientific approach, I looked at the first half-hour of trading for Cisco yesterday. 14,000 trades went up in the first 30 minutes (7.8 trades per second), for about nine million shares, and with an average trade size of 600 shares.

⁸ The data on the first half-hour of trading for Cisco are for January 22, 2001. They are presented in Robert Schwartz and Reto Francioni, *Equity Markets in Action: The Fundamentals of Liquidity, Market Structure and Trading*, John Wiley & Sons, 2004, page 133.

With technology, we have made everything far more efficient. We have reaped a lot of the benefits of that efficiency. It has helped us to lower costs, generally across the board. But at the same time, we are still plagued with some real big issues about getting size done and about dealing with volatility. As we go forward, we need to consider the use of time. Now that we are in a decimalized, sub-second environment, we need to get back to reality. We must look at the basic model that we are operating our market structure on. It is not so much about the speed of getting there, but what is happening with the orders once they are there.

One of the things that I have always liked about the call auction trading concept is that it is a different kind of animal compared to the continuous market. The call provides some interesting dynamics in contrast to a continuous market. I stress that the call is not a replacement for continuous trading. Some people feel that there is this desire just to take the liquidity, run an auction, and be done with it. I do not agree.

There are obvious benefits to aggregating liquidity at specific moments in time by running an auction at the open and another one at the close. If you look at the issues between electronic trading and floor trading, you realize that the centralization of orders is good. Whether you do it by connectivity in the ECN environment, or you do it by saying that you have to be at this or that particular place, there is a great benefit to getting orders together so that the orders can find each other. Taking this one step further, benefits are realized when you aggregate orders at specific, pre-determined moments in time. That is what crossing does.

I joined Instinet in the late '80s, a time when ITG and Instinet were both developing their crosses. It was really tough getting institutions to start using the crossing systems. It was not even a question of getting them to be at a place where they would trade – it was difficult just getting them to start considering it.

Nevertheless, the investing institutions in the late '80s and early '90s were very supportive of new ways of doing things. They were much more willing to try new ideas, to innovate, and even to support a new system. That obviously helped Instinet and ITG. Through the 90's, we had a rash of innovations that came and went with varying degrees of success. Some of them were ahead of their time. Now I wonder if institutions are just overwhelmed with the technology and the past innovations. Right now, they just want to deal with growing their businesses. They do not have much of a desire to take on yet another new model. But we need the institutions to support innovation. We haven't actually had a lot lately except for the advent of NASDAQ's auction and Archipelago's auction.

The spirit of innovation is going to be critical to the evolution of the markets.

WOLF: Thank you, Jim. You have given us more food for thought. Now it is time to open this up for discussion. Are there any questions from the audience?

UNIDENTIFIED SPEAKER [From the Floor]: I would like to know how the prisoners' dilemma applies to the setting where you have more than two players. In reality, there are many buyers and many sellers, but in the prisoners' dilemma you have only two, like a duopoly.

PAGANO: What we showed you here is a Reader's Digest version of the paper and the model behind it. The analysis generalizes to multiple players. You can think of it as many large buyers and many large sellers, and they know they can possibly move the market with their big orders, so they are going to hold back. It really does not matter if it is one person or 2,000 people in that kind of a situation.

WOLF: Puneet, did you address accentuated volatility in your paper?

HANDA: No.

WOLF: You did not address it at all?

HANDA: No.

WOLF: Okay. Thank you.

PAUL DAVIS (TIAA-CREF) [From the Floor]: I have a question for Puneet. Commissions tend to be a lot more expensive when you give the order to a broker who then gives it to the floor. It is roughly a five to one ratio. Let's say that the commission when you trade on the floor would be a nickel a share, versus trading electronically at a penny a share. That is four cents a share of savings, which, for 100,000,000 shares, is roughly \$4 million. So it looks like the value-added for the people doing the trading has just gone away. Could you address that issue? What happens when you take commissions into account?

HANDA: The way we looked at it, for larger orders, it could be economical to go to the floor. For smaller orders it may not be because of the commissions, because of the order handling costs.

SCHWARTZ [From the Floor]: Let me add to that. We are asserting that there is value in the discretionary handling of orders. Whether that value is enough to justify the costs is an issue that I would not begin to touch. But what you are saying, Paul, is that, on average, the incremental benefits and costs are quite similar. Isn't it interesting how markets can equilibrate? It means that traders know when to go to the floor and when

not to go. For some of the trades, the value added by the floor is probably more than the incremental commission costs, and for others trades the value added is less. Does that help, Paul?

DAVIS: Yes.

ERIC BARRET (CIBC) [From the Floor]: October 2001 data might be outdated due to new algorithmic trading tools and smart order routing tools provided by the direct access providers. Have you taken that into account in maybe a newer study?

HANDA: No, right now we have not. We would like to if we can get the data from the Amex. Things keep changing and one could certainly update the study.

WOLF: Jim, you wanted to make a comment?

ROSS: Yes. In Mike's prisoners' dilemma, two institutions are trying to find each other. What is critical in book building is that it is not always just two big institutions with two large orders. A lot of times – and I have certainly found this in my crossing experiences – you have an index arb guy versus a large active manager, or it could be a quantitative trader against a specialist, or it could be a market maker who is reducing risk versus an indexer. There is a tendency with each of today's electronic matching systems to cater to a particular constituency. These systems, which include Liquidnet and ITG, either exclude broker dealers outright or else through prohibitive pricing. Also, these systems sometimes focus on a select group of institutions, which have OMS technologies or specific investment strategies. I firmly believe that we now need new electronic matching systems, which are more inclusive of the various constituencies, from the buy-side to the sell-side. We need systems that respond to active and passive strategies in small-cap through large cap stocks.

One of the critical aspects of building a good, broad book is getting multiple parties with different trading horizons and different investment strategies to participate. It is a win/win situation when you can bring together someone committing capital and someone who is investing, and have them both get a trade off where they both feel that they have benefited. Maybe one has a short-term strategy and one has a longer-term strategy. This gets back to the structure of the system, and to how it permits many people with divergent trading strategies to come together and find each other. Unfortunately, it seems that the market structure that we have sometimes forces people apart as they adjust their strategies to get the results that they are ultimately looking for.

ROBERT WOOD (University of Memphis) [From the Floor]: I am curious about the realized spreads and about how the floor brokers are able

to systematically have a negative realized spread. In essence, this means either that they are able to time their trades extremely well, or that they are trading systematically with uninformed traders. Could you comment on that?

HANDA: We believe that they are able to time their trades well. Now, a negative average does not mean that every number is negative. I mean, overwhelmingly large realized spreads are negative. So they are (on average) executing when the price is moving in an upward direction for a buy, or in a downward direction for a sell. Hence, the floor brokers are able to time their executions extremely well. The floor brokers are sitting there, watching the way things are going. If the book thickens on their side of the market and the price starts to move, that is when they trade.

WOOD: I worry about the extent to which the floor is about doing favors. I have heard a situation described where you have a good floor broker, you want to buy 50,000 shares of GE, and the floor broker ‘knows’ that someone is working off an order of 300,000 shares. So your broker waits until that is done and then gets you a better price. In essence, you cannot do a favor for one person without hurting somebody else. If that was my 300,000-share order, I would say that you were fading my order – you were fading the market ahead of it. If you can do that systematically, you are going to be able to get, on average, a negative realized spread. You cannot do a favor for one person without hurting somebody else on the floor. Comments?

HANDA: That is a possibility. We did not have a chance to investigate that kind of a thing with our data, but it is an alternative explanation of what may be going on.

SCHWARTZ [From the Floor]: Perhaps our paper should come with a surgeon general's warning that it should be read properly and in context. When you examine a large body of data like this, you see that the floor brokers are responding to signals that we can capture. We have captured two major signals – the imbalance that is on the book and market direction. We have not captured knowledge that there is a big order in somebody's pocket. We only know about the orders that are on the book.

If I want to buy and there are a lot of buy orders on the book and the sells have thinned out, I do not wait to be a liquidity provider. Instead, I move forward and execute. We are finding very significant responses to variables that we can measure. When we see the positive correlations that we get, and when we see the contrasts, I think it is insightful. It suggests that the floor brokers are doing something of positive value. They are timing their orders. We can discuss further whether this justifies all of the

costs, as Paul Davis just pointed out, and whether there are other things going on. But it is nice to see some evidence that there are positives as well.

My last comment is, hey, we are academicians. This is an academic institution. We are like Fox News, fair and balanced.

WOLF: I'm sorry we have to end this session. I would like to thank the panel for their presentations and discussion, and move on to the next session.



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