

# **TRADING AND EXCHANGES: Market Microstructure for Practitioners**

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March 5, 2002 Draft

Forthcoming  
Oxford University Press  
Fall 2002



This book is dedicated to  
the memory of  
the victims of the September 11, 2001 terrorist acts in  
New York, Virginia, and Pennsylvania  
and to  
the honor of  
those people whose heroic actions  
on that day saved so many lives.



## Acknowledgements

Many people contributed to the success of this project with their encouragement, advice, knowledge, and expertise. I would not have started this project without their interest, and I would not have completed it without their support. The book is much better for their contributions.

I received my first encouragement as a graduate student at the University of Chicago, long before I knew anything about market microstructure. Professor Arnold Zellner advised me to publish a book based on lectures I would give when I became a professor. Although it seemed unimaginable to me at the time, I never forgot his advice or his confidence in me. I look forward to the time when I will read a book written by one of my students.

Several publishers suggested that I write this book. I particularly appreciate the interest shown by editors Mike Junior, Randall Adams, Maureen Riopelle, Kenneth MacLeod, and Paul Donnelly. I have no doubt that they all would have been very helpful in the development of this book. I regret that I could not work with them all. Their encouragement, enthusiasm, and vision helped kindle and sustain my interest.

This book would not have been possible without the many insights that I learned from my academic colleagues. I especially appreciate the lessons that they taught me, and the strong expressions of interest and valuable constructive criticism that they have given me. I wish to acknowledge the following colleagues by name:

Anat Admati	Bill Freund	Ruben Lee
Yacob Amihud	Stuart Gabriel	Charles Lee
Jim Angel	Ann Gillette	Bruce Lehmann
Gail Belonsky	Tom Gilligan	Ken Lehn
Hank Bessembinder	Larry Glosten	Marc Lipson
Bruno Biais	Charles Goodhart	Andy Lo
Fischer Black	Sandy Grossman	Francis Longstaff
Bernie Black	Joe Grundfest	Bob Lucas
Marshall Blume	Eitan Gurel	Craig MacKinlay
Michael Brennan	Yasushi Hamano	Ananth Madhavan
Corinne Bronfman	Puneet Handa	Steve Manaster
Mark Carhart	Joel Hasbrouck	Terry Marsh
Henry Cheeseman	Kaj Hedvall	Tom McInish
Kal Cohen	Pierre Hillion	Haim Mendelson
Harry DeAngelo	Craig Holden	Morris Mendelson
Linda DeAngelo	Kose John	Bob Miller
Ian Domowitz	Charles Jones	Mert Miller
Rob Engle	Avner Kalay	David Modest
Wayne Ferson	Eugene Kandel	Dale Morse
Mendy Fygenon	Jon Karpoff	Belinda Mucklow
Steve Figlewski	Don Keim	Harold Mulherin
Margaret Forster	Laura Kodres	Rob Neal
Doug Foster	Pete Kyle	Anthony Neuberger
Jennie France	Josef Lakonishok	Maureen O'Hara

J. Peake	Bob Schwartz	Avanidhar Subrahmanyam
André Perold	Bill Schwert	Sheridan Titman
Mitch Petersen	Duane Seppi	Walt Torous
Paul Pflleiderer	Kuldeep Shastri	Anand Vijn
Avri Ravid	Alan Shapiro	S. Viswanathan
Mark Ready	Eric Sirri	Dan Weaver
Jay Ritter	Sy Smidt	Mark Weinstein
Kevin Rock	Vernon Smith	Ivo Welch
Ailsa Roell	Chester Spatt	Ingrid Werner
Tavy Ronen	Sanjay Srivastava	Randy Westerfield
Ehud Ronn	Jim Stancill	Bob Whaley
Mark Rubinstein	Laura Starks	David Whitcomb
Tony Saunders	Dave Stewart	Joe Williams
Myron Scholes	Hans Stoll	Bob Wood
Eduardo Schwartz	René Stulz	

This book would not have been creditable were it not for the many practitioners and regulators who have shared their time with me to explain what they do. I particularly appreciate the generosity and encouragement that following individuals have extended to me:

Stanley Abel	Stuart Fraser	Rich Lindsey
Howard Baker	Dean Furbush	Evelyn Liszka
Frank Baxter	Jim Gallagher	Bob Litterman
Brandon Becker	Gary Gastineau	Bill Lupien
Gil Beebower	Brian Geary	Bernie Madoff
Jeff Benton	Steven Giacomini	Peter Madoff
Dale Berman	Jim Gilmore	Steven Malin
Charles Black	Phil Ginsberg	David Malmquist
David Booth	Gary Ginter	Tim McCormick
Harold Bradley	Keith Goggin	Dick McDonald
Kurt Bradshaw	Wendy Gramm	Dick Michaud
Pearce Bunting	Dick Grasso	Mark Minister
Richard Cangelosi	Bob Greber	Nate Most
Jim Cochrane	Leo Guzman	Annette Nazareth
David Colker	Spence Hilton	Gene Noser
Cromwell Coulson	Dave Hirschfeld	Bill Pratt
Larry Cuneo	Blair Hull	Eddie Rabin
David Cushing	Billy Johnson	Murali Ramaswami
Harry Davidow	Rick Ketchum	Bill Ryan
Pina DeSantis	Rick Kilcollin	Henry Sasser
Mike Edleson	Ray Killian	Evan Schulman
Tom Fay	Howard Kramer	Andy Schwarz
Jim Farrell	Ken Kramer	Christina Sciotto
Gene Finn	Arthur Leavitt	Jim Scott
Ed Fleischman	Charlie Lebens	Jim Shapiro
Russ Fogler	Marty Leibowitz	David Shaw
Gifford Fong	Dave Leinweber	Katy Sherrerd

Fred Siesel  
Deborah Soesbee  
George Sofianos  
Eric Sorensen  
Olof Stenhammar

Rob Telsar  
Artie Tolendini  
Jack Treynor  
Wayne Wagner  
Jeffery Wecker

Genie Williams  
Steve Wallman  
Steve Wunsch  
Steve Youngren  
Dorit Zeevi

Four people particularly influenced the development of this book. Wayne Wagner thoroughly reviewed an early draft of the manuscript. His suggestions greatly improved every part of the book. Craig Holden used early drafts of the text in his trading course at Indiana University. I am especially indebted to him for the confidence and vision he expressed to various publishers. Ananth Madhavan commented on early drafts of the book and supplied many bibliographic references. I have greatly appreciated having him as a colleague at USC. Finally, Jack Treynor was instrumental in helping me appreciate the importance of the zero-sum game in trading. Most principles of market microstructure somehow involve properties of zero-sum games.

Several generous sponsors provided financial support for this project. I received “angel financing” from the New York Stock Exchange (Dick Grasso, Billy Johnston, Jim Cochrane, and George Sofianos), the Jefferies Group (Frank Baxter), Mellon Capital Management Corporation (Bill Fouse and Tom Loeb), Bernard L. Madoff Investment Securities (Bernie and Peter Madoff), First Canada Securities International (Jim Medlock), Cantor Fitzgerald (Stuart Fraser and Phil Ginsberg), and First Quadrant (Rob Arnott). Their early support allowed me to take time off from my teaching to start this project. I am also grateful to Oxford University Press who provided a developmental grant with which I was able to pay research assistants.

I appreciate the support provided to me by the USC Marshall School of Business through the Fred V. Keenan Chair in Finance. The generosity of our donors has been instrumental to the remarkable development of our faculty, School, and University over the last ten years under the leadership of Marshall School deans Jack Borsting and Randolph Westerfield and USC president Steven B. Sample. Our most important accomplishments appear in the largely unseen influences that we have upon our students, and upon the policymakers and business executives who rely upon our research when making significant decisions. Our work rarely provides us with suitable opportunities to thank everyone who makes it possible. I am grateful for this opportunity to thank our donors for their confidence, vision, and support. I am especially pleased to recognize Fred Keenan, whose loyalty and generous support to the University have been an inspiration to us all.

Many people at USC helped me with the preparation of the manuscript. I am grateful both for their contributions to this book and for teaching me to write better. I gratefully thank my research assistants, Namrata Aggarwal, Chris Bandouveris, Claire Yu Cui, Shane Enete, Cynthia Lee, Jeff Lin, Jennifer Ly, Anna Nguyen, Venky Panchapagesan, and Jia Ye; and my departmental assistants Deborah Jacobs, Marilyn Johnson, Terry Lichvar, and Helen Pitts. I am particularly pleased to recognize Cynthia Lee for her very extensive assistance with grammar, style, and proofreading.

Several people were notably helpful with proofreading early drafts. I thank Jennifer Chang, Abby Harris, Naftali Harris, Hai Lu, and Joey Engelberg for the careful attention that they paid to the manuscript.

My family and friends also contributed to the successful completion of this book in more ways that would be appropriate to list here. I particularly appreciate the support given to me by Alex Baskin, Jack Birns, Brian Greene, Bernard Harris, Devera Harris, Sam Jason, and Alissa Rimon. My wife and children were especially supportive. Without their support, I would not have attempted or completed this project.

My editors at Oxford University Press, Paul Donnelly and <<copy editor>> ...

Finally, I am indebted to the many students at USC who studied with me in my *Trading and Exchanges* course. Their interest in trading encouraged me to first offer the course in 1991. This book grew out the lectures that developed to present the course to them. The lessons that I learned from my students while teaching *Trading and Exchanges* greatly influenced the organization and presentation of the topics that appear in this book. I believe that I have learned more from my students than from anyone else.

I have inevitably failed to acknowledge many people who richly deserve it. Regrettably, the ability to easily remember names is not one of the many gifts that I enjoy. Please forgive me for my oversight.

Thank you to everyone who has helped make this project successful.



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# Chapter 1

## Introduction

Markets are fascinating. They change constantly as prices adjust to new information, as winning traders replace losing traders, and as new technologies evolve.

Highly skilled professional traders employ clever strategies in their search for trading profits. They ultimately profit from investors, gamblers, and foolish traders.

The stakes in some markets are very high. Traders may arrange multimillion-dollar trades in seconds. They sometimes make or lose fortunes overnight.

The prices that traders negotiate ultimately determine how market-based economies allocate their scarce resources. Free economies owe much of their wealth to their well functioning markets.

### 1.1 Scope of the Book

This book is about trading, the people who trade securities and contracts, the marketplaces where they trade, and the rules that govern trading. You will learn about investors, brokers, dealers, arbitrageurs, retail traders, day traders, rogue traders, and gamblers; exchanges, boards of trade, dealer networks, ECNs (electronic communications networks), crossing markets, and pink sheets; single price auctions, open outcry auctions, and brokered markets; limit orders, market orders, and stop orders; program trades, block trades, and short trades; price priority, time precedence, public order precedence, and display precedence; insider trading, scalping, and bluffing; and investing, speculating, and gambling. This book will teach you the origins of liquidity, transaction costs, volatility, informative prices, and trader profits.

This book is not about the securities and contracts that people trade. We will not consider how to value them, who should trade them, how to design them, or how to issue them. Books about investments and corporate finance examine these questions.

*Market microstructure* is the branch of financial economics that investigates trading and the organization of markets. This field of study has substantially grown in size and importance since the October 1987 stock market crash.

This book presents the economics of market microstructure in simple English prose. Although some simple mathematics and graphics appear in a few supplementary examples, I fully explain all essential concepts in the main text.

### 1.2 Objectives

This book will help you understand how markets work, and how governments and exchanges regulate them. You will learn how prices come to reflect information about fundamental values, who makes markets liquid, and why some traders consistently profit from trading while others lose. You will be able to predict how various trading rules affect price efficiency, liquidity, and trading profits. Finally, you will understand the forces that govern regulatory processes.

With this knowledge, you can improve your trading strategies, and you can better manage the brokers who work for you. If you are—or aspire to be—a regulator or an exchange official, this knowledge will help you design better markets.

The primary objectives of this book are to understand the origins of the following characteristics of market quality:

- **Liquidity.** Traders and regulators often talk about liquidity, but they are rarely careful about what they mean. This book explains what liquidity is, and where it comes from. If you intend to offer or take liquidity, you must understand liquidity.
- **Transaction costs.** Traders must effectively manage their transaction costs to trade successfully. This book explains how to measure and manage transaction costs. If you trade actively, you must understand transaction costs.
- **Informative prices.** Speculators must understand how and when prices become informative to trade successfully. Informative prices are essential to the wealth of our economy. This book explains the processes by which prices become informative. If you intend to speculate, you must understand price efficiency.
- **Volatility.** Traders care about volatility because it can have a significant impact on their wealth. This book explains how prices become volatile, and how regulators try to control volatility. If risk scares you, you must understand volatility.
- **Trading profits.** Trading is a zero-sum game in which some traders win and others lose. Traders who do not expect to win should refrain from trading. This book explains why some traders consistently win while other traders consistently lose. If trading profits interest you—whether you manage your trading yourself or have someone manage it for you—you must understand what determines trading profits.

The secondary objective of this book is to understand how market structure—trading rules and information systems—affect each of these five market characteristics.

### 1.3 Instruments and Markets

Market microstructure examines organized trading in instruments. *Instruments* include common stocks, preferred stocks, bonds, convertible bonds, warrants, options, futures contracts, forward contracts, foreign exchange contracts, swaps, reinsurance contracts, commodities, pollution credits, water rights, and even many betting contracts. Most ideas discussed in this book apply equally well to trading in all these instruments.

Legislatures and judges have created numerous legal definitions of the term “security.” These definitions often distinguish between instruments that represent ownership of assets like stocks and bonds (usually called securities) and instruments that derive their values from commodities or from other security values (derivative contracts). They also universally exclude betting contracts. We will pay attention to these distinctions only when they affect the markets through the regulatory process.

A *market* is the place where traders gather to trade instruments. That place may be a physical trading floor, or it may be an electronic system in which traders can easily communicate with each other. The New York Stock Exchange, the Chicago Mercantile Exchange, and the EuroNext Amsterdam Options Exchange are examples of markets where traders meet on trading floors. Nasdaq, the Euronext, the Hong Kong Futures Exchange, and the interbank foreign exchange market are examples of electronically linked markets. This book considers how trading markets are organized, and how their rules affect traders.

## 1.4 A Brief Overview of Trading and Exchanges

This section provides a brief overview of some main points introduced in this book. It provides you with an outline of what you can expect to learn from this book. Do not be alarmed if you do not understand it all now. The remainder of the book explains everything in detail.

Trading is a search problem. Buyers must find sellers, and sellers must find buyers. Every trader wants to trade at a good price. Sellers seek buyers willing to pay high prices. Buyers seek sellers willing to sell at low prices. Traders also must find traders who are willing to trade the *quantities*, or *sizes*, they desire. Traders who want to trade large quantities may have to find many willing traders to complete their trades.

Dealers and brokers help people trade. *Dealers* trade with their clients when their clients want to trade. The prices at which a dealer will buy and sell are the dealers' *bid* and *ask* prices. After they trade with their clients, dealers then try to trade out at a profit by selling what they have bought or by buying back what they have sold. In effect, clients pay dealers to take their trading problems. The dealers then try to solve them at a profit. Dealers profit by buying low and selling high. Successful dealers must be excellent traders.

*Brokers* are agents that arrange trades for their clients. They help their clients find traders who are willing to trade with them. They profit by charging commissions.

Patient traders obtain better prices than impatient traders do because they are willing to search longer and harder to arrange their trades at favorable terms. Impatient traders pay for the privilege of trading when they want to trade.

Traders who offer to trade give other people options to trade. These options sometimes are quite valuable. Traders who expose their offers can lose to clever traders who use various front-running trading strategies to extract these option values. Traders therefore must expose their offers very carefully. They should expose only to traders who are most likely to trade with them.

Traders who trade only to accommodate other traders risk trading with, and losing to, well-informed speculators. *Speculators* are traders who trade to profit from information they have about future prices. *Well-informed speculators* can predict futures prices better than other traders can. They then choose to buy or sell based upon which side they expect will be profitable. Dealers lose to well-informed speculators because they end up being on the wrong side of the trade. Prices tend to move against their positions before they can trade out of them. All traders try to avoid trading with well-informed speculators.

Dealers recover their losses to informed speculators by widening the spread between the bid and ask prices at which they will buy and sell. Uninformed traders therefore pay more for their trades when dealers lose a lot to informed traders. In effect, uninformed traders lose to well-informed traders through the intermediation of dealers.

Traders who can estimate fundamental values cause prices to reflect their value estimates. They buy when price is below their value estimates and sell when price is above. Their buying pushes prices up, and their selling pulls prices down. They do not trade if they believe that prices reflect values. Well-informed traders make prices informative.

Bluffers can sometimes fool uninformed traders into trading unwisely. In general, they can profit if the price impacts of their buying and selling are not exactly opposite to each other.

Since dealers may trade when bluffers want them to trade, dealers must be highly disciplined to avoid losing to bluffers.

Trading is a zero-sum game when gains and losses are measured relative to the market average. In a *zero-sum game*, someone can win only if somebody else loses. On average, well-informed speculators and bluffers win, and poorly informed traders and foolish traders lose. Informed traders can only profit to the extent that less informed traders are willing to lose to them.

Poorly informed traders trade for many reasons. *Investors* use the markets to move money from the present to the future. *Borrowers* do the opposite. *Hedgers* trade to manage financial risks they face. *Asset exchangers* trade one asset for another they value more. *Gamblers* trade to entertain themselves.

Exchanges and brokerages design markets to minimize the search costs of trading. They usually organize markets so that everyone who wants to trade gathers at the same place. A common gathering place helps traders find those traders who will offer the best prices.

Exchanges and brokerages once exclusively organized their markets on physical trading floors. Now they can organize their markets within computerized communications networks that allow buyers and sellers to arrange their trades remotely. Electronic marketplaces have rapidly expanded as the costs of electronic communications technologies have dropped.

Most traders want to trade in well-established markets because other traders trade there. When many traders trade in the same place, arranging trades is very easy. The attraction of traders to other traders makes it hard to start new markets.

Entrepreneurs create new markets when old markets do not adequately meet the needs of a significant set of traders. Since traders face a diversity of trading problems, no single market can best meet every trader's needs. Many diverse markets may form as exchanges and brokerages compete to attract traders.

*Arbitrageurs* ensure that prices do not vary much across markets. When prices diverge, they buy in cheaper markets and sell in more expensive markets. The effect of their trading is to connect sellers in cheaper markets to buyers in more expensive markets.

An exchange's trading rules affect the quality of its markets. They determine the balance of power between informed traders and uninformed traders, between public traders and professional traders, and between large traders and small traders. Trading rules are very important.

Markets work best when they trade fungible instruments. An instrument is *fungible* if one unit (a share, a bond, a contract, ...) of the instrument is economically indistinguishable from all other units. If so, buyers do not care which units they receive. Since all sellers offer identical units, buyers can buy from any seller who offers an attractive price. Sellers likewise can sell to any buyer. Fungible instruments therefore are easier to trade than are instruments that have idiosyncratic characteristics. In derivative markets, the benefits of fungible instruments cause trading to concentrate in just a few standardized contracts.

### **1.5 Key Recurrent Themes**

A number of important issues repeatedly appear throughout this book. This section identifies these issues. Watch for them as you read this book.

**Information asymmetries.** Traders who know more about values and traders who know more about what other traders intend to do have a great advantage over those who do not. Well-informed traders profit at the expense of less informed traders. Less informed traders therefore try to avoid well-informed traders. Pay attention to who is well informed and to how traders learn about values.

**Options.** The option to trade is valuable. People who write limit orders give free trading options to other traders. Clever traders can extract the value of these options. Pay attention to when traders create trading options and to how they prevent other traders from extracting their values.

**Externalities.** People create *positive externalities* when they do something that benefits other people without compensation. People create *negative externalities* when they do something that harms other people without penalty. The most important externality in market microstructure is the *order flow externality*. Traders who offer to trade give other traders valuable options to trade for which they are not compensated. The order flow externality attracts and binds traders to markets because traders want to benefit from free trading options. Pay close attention to when, why, and how traders offer to trade. Pay attention also to how markets, brokerages, and dealers benefit from the order flow externality.

**Market structure.** *Market structure* consists of the trading rules, the physical layout, the information presentation systems, and the information communication systems of a market. Market structure determines what traders can do, and what they can know. It therefore affects trader strategies, the power relationships among different types of traders, and ultimately trader profitability. Always consider what effects market structures have on trading strategies and on the balance of power between various types of traders.

**Competition with free entry and exit.** Traders compete in markets to make profits. Trading strategies that generate large profits attract traders who want to participate in those profits. Their entry lowers the profits that everyone makes, on average. Conversely, traders quit using trading strategies that are not profitable, which allows remaining traders to make more profits on average. Free entry and exit ensures that alternative trading strategies produce equal net profits, on average, after accounting for all costs. Wherever you see people competing, consider how the costs of entry and exit affect their ability to maintain profits or avoid losses. This principle will help you understand the determinants of bid/ask spreads, dealer profits, informed trader profits, and order submission strategies.

**Communications and computing technologies.** Markets are essentially information processing mechanisms. They process information about who wants to trade, how much, and at what prices. The resulting prices aggregate information about fundamental values. The growth in information technologies has changed and will continue to change how people trade. Pay attention to the role of information processing technologies in the markets.

**Price correlations.** Markets for similar instruments are closely related. They tend to have similar market conditions, and they often compete fiercely with each other for order flow. The order flow externality generally ensures that one market among a set of closely related markets will eventually dominate the others. Pay attention to markets that trade similar instruments and to the differences among them that make them unique. These issues affect how markets compete with each other.

**Principal-agent problems.** Principal-agent problems arise when agents do what they want to do rather than what their principals want them to do. The most important principal-agent problem in market microstructure involves brokers and their clients. Brokers do not always do what you want them to do, and they may not work as hard on your behalf as you would. Pay close attention to how traders control their brokers.

**Trustworthiness and creditworthiness.** People are *trustworthy* if they try to do what they say they will do. People are *creditworthy* if they can do what they say they will do. Since people often will not or cannot do what they promise, market institutions must be designed to effectively and inexpensively enforce contracts. Pay close attention to the mechanisms that ensure that traders will settle their trades. Attempts to solve trustworthiness and creditworthiness problems explain much of the structure of market institutions.

**The zero-sum game.** All trades involve two or more parties. The accounting gains made by one side must equal the accounting losses suffered by the other side. Understanding the origins of trading profits therefore requires that we understand both sides of a trade. We must understand why traders on one side expect to profit, and why traders on other side either are willing to lose or do not understand that they should expect to lose.

## 1.6 Outline of the Book

The book is organized into seven parts. Part I examines the structure of trading. Several chapters describe how markets are organized and regulated, and how traders trade in them. Although much of the information is descriptive, the text also analyzes how various market structures affect trading strategies.

Part II considers what benefits markets produce for traders and for the wider economy. We must address these questions to judge whether the markets are working well. The first of the two chapters in this part of the book considers why people trade. The other chapter explains how markets benefit the whole economy. This chapter concludes with my opinion about what markets should do and for whom. Your opinion may differ from mine.

To understand how trading rules affect traders, you must first understand how traders behave. The book therefore next devotes many chapters to understanding what various traders do. These chapters should be especially interesting to readers who want to become traders and to traders who want to improve their trading skills. Part III includes chapters that consider various speculative trading strategies. Part IV examines the traders who offer liquidity.

Part V contains two chapters that will help you to better understand the origins of liquidity and volatility. Both concepts are described in relation to the various trading strategies introduced in Parts III and IV.

We consider the problems of evaluating trader performance in Part VI. You must understand these issues if you intend to manage brokers, or if you want to know why index markets are so popular. These chapters lay the foundation for understanding who profits, and who loses, from trading. If you intend to trade for profit or invest your money with a money manager, the chapter on performance evaluation and prediction will be of great interest to you.

Finally, Part VII concludes with several chapters that consider the economics of various market structures. These chapters examine how markets are organized, how they compete with each other, and how they respond to extreme volatility. These chapters will obviously interest



regulators and exchange officials. They should also interest farsighted traders: Being able to predict how changes in rules, technologies, and competitive relationships affects markets distinguishes winning traders from losers.

Numerous text boxes appear throughout the book. These boxes contain examples, stories, and historical explanations that illustrate and illuminate points made in the text. They are useful as mnemonic devices for remembering jargon and concepts. I beg your indulgence for the puns, wordplays, lighthearted jabs, and unsolicited opinions that appear in them.

### **Bulls and Bears**

Traders call rising markets *bull markets* and falling markets *bear markets*. According to legend, these terms originated from morbid contests that promoters once staged between bulls and bears. Bulls fight by thrusting upward with their horns. In contrast, bears fight by striking downward with their claws. This image has generated a small cottage industry of artisans who create bull-fighting-bear sculptures that traders buy to adorn their offices and living rooms.

I took the examples that appear throughout the book from all types of markets and from many different countries. A disproportionate number, however, involve equity trading in the United States since these are the best-known markets in the world. As noted above, most principles that apply to these markets also apply to all other markets.

### **1.7 An Important Disclaimer**

Traders often encounter significant legal and tax issues. Some types of trades are illegal, many trades create significant tax liabilities, and many commercial relationships in trading create important legal liabilities. If you trade, you must know the legal consequences of your actions.

The purpose of this book is to examine economic issues in trading, not legal issues. The text addresses many legal issues because legal issues often have significant economic implications for the markets, and because economic issues often are the basis for legal regulation. This book will help you to better understand the economic implications of laws that regulate securities, contracts, traders, and exchanges. It will also help you understand the economic bases for many regulations. It is not an authority for what the law is nor for what laws you should pay attention to.

Do not rely upon this book for guidance on any legal issues. Your author is not a qualified legal advisor. Consult a qualified attorney when you must address legal questions.

### **1.8 Summary**

This book will help you understand the theory and practice of trading in exchange markets and dealer networks. When you master this subject, you will be able to trade more effectively, you will better appreciate the organization of our markets, and you will be able to form well-reasoned opinions about how the markets should be organized.

Markets have changed substantially during the last 100 years, and they will continue to change in the next 100 years. The current pace of change is fast and accelerating. By the time you read this, some specific descriptive information in this book will undoubtedly be dated. The

economic principles governing markets and the traders in them, however, will remain the same. These concepts will help you understand all markets—past, present, and future.

## Chapter 2

### Trading Stories

This chapter presents stories about how traders arrange routine trades in stocks, bonds, futures contracts, and currencies. If you are new to trading, you should read this chapter to help you appreciate the trading problems that people solve. If you are already quite familiar with trading, you also may want to read this chapter. Although these stories describe routine trades, they highlight difficult issues that traders confront when trading.

This chapter is full of institutional details. Do not worry if you do not understand every detail on your first reading. After you have finished reading this book, you will be able to understand these stories completely. For now, just read them to get a feel for what trading is about. The impressions that you form will help you appreciate the practical importance of the analyses that this book presents.

#### **2.1 A Retail Trade in a NYSE-listed Stock**

Jennifer wants to buy 200 shares of AT&T. She calls her retail broker with whom she has already established an account. (Jennifer could also have used her broker's Internet-based order entry system.) Jennifer's broker might work for a full service broker/dealer, such as Merrill Lynch, a national discount brokerage, such as Charles Schwab, or perhaps a local deep discount brokerage, such as Los Angeles-based Dreyfus Brokerage Services.

Jennifer provides the broker with her account number and identifies herself. She then asks for the current quotes for AT&T common stock. The broker looks at a screen on his desk that appears like the Bridge Information Systems quotation display in Figure 2-1. The screen shows the best bids and offers for AT&T that traders display in the Consolidated Quotation System. The quotes come from dealers at the New York Stock Exchange, from dealers at several regional exchanges, from some independent NASD (National Association of Securities Dealers) dealers, and from some electronic communications networks (ECNs) that display limit orders that their clients have placed with them. The broker responds by quoting the best current prices at which traders can immediately buy or sell AT&T (ticker symbol "T") shares. Given the information in Figure 2-1, the broker reports that the best (highest) bid for AT&T is for 19.83 dollars and the best (lowest) offer is at 19.85. The broker also tells Jennifer that the last trade in AT&T was at 19.84 dollars, which is down 0.10 from the previous day's close. Jennifer considers the quote. She then gives her broker instructions to buy the shares.

us;T		AT and T Corp *#				Common Stock			
+	19.84	DN	0.10	(N)	14.06	H	20	L	19.51 V 8,341,400
E/MM	TIME	-BID-	SIZE (H)		E/MM	TIME	-ASK-	SIZE (H)	
(N)	14.06	+	19.83	6 dq	MADF	14.06	19.85	50	
CAES	14.06		19.83	1	CAES	14.06	19.85	50	
(T)	14.06	+	19.83	1	(T)	14.06	19.85	50	
TRIM	14.06		19.83	1	(C)	14.06	19.85	1	
(B)	14.04	+	19.80	30	(N)	14.06	19.86	33 dq	
(M)	14.06	+	19.73	1	ARCA	14.06	19.89	5	
(P)	14.01	+	19.72	20	(B)	14.04	19.94	30	
MADF	14.06		19.70	5	(M)	14.06	19.96	1	
(C)	14.06	-	19.70	1	(P)	14.01	19.98	20	
SBSH	14.00		19.69	1	TRIM	14.06	19.99	2	
(X)	14.06	+	19.58	1	NYD	12.24	20	500	
NYD	12.24		19.50	500	(X)	14.06	20.11	1	
SWST	9.42		9	1	SBSH	14.00	20.14	1	
ARCA	14.06		0.01	1	SWST	9.42	24.99	1	
OI BUY : LEHM FBCO GSCO NATW MLCO SBSH MONT									
OI SELL : PRUS UBSS NATW DLJP SALB RSSF MONT									
T/q		04-Oct-01 14:06 NYC							(c) BRIDGE

**Figure 2-1.** A Quotation Montage for NYSE-listed AT&T Common Stock

Source: Bridge Information Systems

The first line shows that this quotation montage provided by Bridge Information Systems is for US ticker symbol T, which corresponds to AT&T Corp common stock. The plus at the beginning of the second line shows that this price is higher than the last different trade price. AT&T last traded at 19.84, down 0.10 from the previous day's closing price. The trade took place at the NYSE (N) at 14:06 Eastern Time (2:06 PM). The highest price of the day so far was 20 and the lowest was 19.51. The total trading volume so far was 8,341,400 shares.

The table that follows consists of a two sets of four columns each for bid and ask quotes. The first column of each set identifies the quote maker. Exchanges have one and three letter symbols. Dealer-brokers and electronic communications networks have four letter symbols. The exchanges listed here are the New York (N and NYD), Boston (B), Pacific (P), Cincinnati (C), Philadelphia (X), and Chicago (M) Stock Exchanges. The symbol (T) refers to the best quote from an NASD over-the-counter dealer. The next three columns show the time when the quote was made, the price, and the number of shares (in hundred lots) for which it is firm. The dealer-brokers that appear on this list are Bernard L. Madoff Investment Securities, Inc. (MADF), Salomon Smith Barney, Inc. (SBSH), Southwest Securities, Inc. (SWST), and Trimark Securities, Inc. (TRIM). The electronic communications networks are Archipelago (ARCA) and the Nasdaq Computer Assisted Execution System (CAES).

The rows on the bid side are sorted so that the bids with the highest prices are at the top. Bids that have the same price are sorted so that bids with larger sizes are above bids with smaller sizes. Bids that have the same price and size are sorted so that bids made earlier appear above bids made later. The rows on the ask side are sorted so that the asks with the lowest prices are at the top. Otherwise, the sort order is the same as that for the bids.

The first line on the bid side shows that the NYSE specialist indicated that at 14:06, buyers there indicated that they were willing to buy at least a total of 600 shares for 19.83. This interest may come from traders on the floor of the exchange, from the specialist's limit order book, or from the specialist himself. The plus sign next to the time indicates that this bid was higher than the last different bid price. The "dq" next to the NYSE bid size indicates that the NYSE has also distributed a depth quote. The symbol NYD identifies the NYSE depth quotes. Traders at the NYSE are willing to buy at least 50,000 shares for 19.50.

The NYSE ask quote is not the lowest price ask in the market. The Madoff offer for 5,000 shares and the Cincinnati Stock Exchange offer for 100 shares are one penny lower. The Madoff offer generated the lines that start with T and CAES.

The two rows near the bottom of the screen present order indications (OI) that brokers and dealers have asked Bridge to display to Bridge clients. The first order indication on the buy side is from Lehman Brothers, Inc. (LEHM). The first indication on the sell side is from Prudential Securities, Inc. (PRUS).

The first item on the last line of this screen shows the command that requested this display. (Sometimes this line also shows the command that Bridge expects you will next want to enter.) The first part of the command, "T," indicates the ticker symbol. The next part "/q" requests Bridge's quote montage. The Bridge server filled this request on October 4, 2001 at 14:06 New York City time.

To convey her intentions, Jennifer will use either a market order or a limit order. A *market order* instructs the broker to buy at the best price available. A *limit order* instructs the broker to buy at the best price possible, but in no event pay more than a *limit price* that Jennifer specifies. If Jennifer uses a limit order, she will also specify when she wants the order to expire. For example, a *day order* will expire when the trading session ends.

Jennifer decides to submit a day limit order to buy 200 shares of AT&T, ticker symbol “T,” for no more than 19.80 dollars per share. The broker enters Jennifer’s order into his computerized order entry system. The system then confirms that Jennifer is authorized to make the trade. Next, the broker reads back the order to ensure that it is exactly what Jennifer intended. (The brokerage firm records the telephone calls in case a dispute arises about what they said.) After Jennifer confirms the order, the broker releases it, and the order entry system sends it to an exchange or to a dealer.

Although AT&T primarily trades at the New York Stock Exchange, Jennifer’s brokerage house might not send her order there. As Figure 2-1 demonstrates, many other exchanges and dealers also trade AT&T. The brokerage might send the order to a regional exchange or to a NASD dealer. Where the brokerage order system sends the order may depend on the prices the various markets quote. It may also depend on cash payments and other nonmonetary inducements that dealers offer brokerages to obtain their order flow.

The brokerage’s order entry system sends Jennifer’s order to the NYSE by transferring it to the NYSE’s SuperDot order routing system. SuperDot then presents the order to the specialist who manages AT&T trading on the floor of the exchange. The specialist will act as the floor broker for Jennifer’s order. Jennifer’s order appears on a workstation screen that the specialist rents from the exchange.

The AT&T specialist is a trader who works for a member firm of the New York Stock Exchange. He sometimes trades as a dealer for his firm’s account and sometimes as a broker for his clients. The Exchange gives the specialist some special privileges and special responsibilities. The specialist receives all of the SuperDot order flow in AT&T. He organizes the AT&T trading to ensure that it is orderly, and he represents all orders entrusted to him. In exchange, the Exchange requires that he trade for his own account to fill customer market orders if no one else is willing to do so.

Since Jennifer’s order is a limit order, the specialist first sees if anyone is interested in filling it immediately. No sellers are presently interested because other traders are bidding higher prices. The specialist then places her order in his electronic limit order book. Jennifer’s order will stand in the book until the specialist can match it with someone who wants to sell at or below its limit price, until the order expires, or until Jennifer tells her broker to cancel it.

(If Jennifer submitted a market order instead of a limit order, the specialist would conduct an auction to find the trader willing to sell at the lowest price. A trader on the floor, a standing limit order in the order book, or the specialist himself might offer that price. If no one wants to fill the market order, the specialist would fill it himself by selling some of his own shares in AT&T to Jennifer.)

A few minutes after Jennifer entered her order, a large seller sends a market order through SuperDot. The specialist uses his computer to match this order with several orders including

## **Part I**

### **The Structure of Trading**

The chapters in this part of this book describe how traders arrange their trades. We start in Chapter 3 with a quick introduction to the trading industry. This chapter provides you with some background information about who trades, what they trade, where they trade, and how their trading is regulated. You can safely skip reading this chapter if you are already familiar with the industry.

Chapter 4 describes how traders communicate their orders to the brokers, dealers, and exchanges that arrange their trades. We describe the orders that traders use and examine the properties of those orders. We also establish important concepts about the origins of liquidity in this chapter.

In Chapter 5, we consider how market structures vary. The differences in how markets organize their trading are important because they affect the profitability of different types of traders. We start to consider the relative advantages of various trading systems in this chapter.

Chapter 6 describes how exchanges use order-driven market mechanisms to arrange trades. The discussion introduces important issues that affect how traders formulate optimal order submission strategies.

Chapter 7 discusses how brokers serve their clients. We carefully describe their roles as trade negotiators and as clearing and settlement agents. You may find this chapter most interesting for its discussions about how markets prevent traders from engaging in various types of fraudulent activities.

## Chapter 3

### The Trading Industry

This chapter provides a brief survey of the trading industry. If you are already familiar with the industry, you can safely skip this chapter. If you are new to trading, the discussions here will provide you with the “big picture” that will allow you to better understand the rest of this book. In particular, you will be better able to discriminate between issues of primary and secondary importance if you know the context in which traders solve their trading problems.

This chapter is full of financial jargon and institutional detail. Most of it is not necessary for understanding the remainder of this book. If you are interested only in understanding market structure, you need not master the details.

We first consider who trades. Then we characterize trading instruments and the markets where they trade. Finally, we examine how regulators oversee trading.

#### 3.1 Who Are the Players?

*Traders* are people who trade. They may arrange their own trades, they may have others arrange trades for them, or they may arrange trades for others. *Proprietary traders* trade for their own accounts while *brokers* arrange trades as agents for their clients. Brokers are also called *agency traders*, *commission traders*, or *commission merchants*. Proprietary traders engage in *proprietary trading*, and brokers engage in *agency trading*.

Traders have *long positions* when they own something. Traders with long positions profit when prices rise. They try to buy low and sell high.

Traders have *short positions* when they have sold something that they do not own. Traders with short positions hope that prices will fall so that they can repurchase at a lower price. When they repurchase, they *cover their positions*. *Short sellers* profit when they sell high and buy low.

The trading industry has a buy side and a sell side. The *buy side* consists of traders who buy exchange services. Liquidity is the most important of these services. *Liquidity* is the ability to trade when you want to trade. Traders on the *sell side* sell liquidity to the buy side. A substantial fraction of this book considers how interactions between buy side and sell side traders determine the price of liquidity.

(The buy- and sell sides of the trading industry have nothing to do with whether a trader is a buyer or seller of an instrument. Traders on both sides of the trading industry regularly buy and sell securities and contracts. The terms buy side and sell side refer to buyers and sellers of exchange services.)

##### 3.1.1 The Buy Side

The buy side of the trading industry includes individuals, funds, firms, and governments that use the markets to help solve various problems that they face. These problems typically originate outside of trading markets. For example, investors use securities markets to solve intertemporal cash flow problems: They have income today that they would like to have available in the future. They use the markets to buy stocks and bonds to move their income from the present to

the future. We discuss this problem and other buy side trading problems in Chapter 8 (Why People Trade).

Many buy side institutions are pension funds, mutual funds, trusts, endowments, and foundations that invest money. These institutions are known collectively as *investment sponsors*. Investment sponsors frequently employ *investment advisors* to manage their funds. Investment advisors are also called *investment counselors*, *investment managers*, or *portfolio managers*. Investment advisors often employ traders to implement their trading decisions. These traders are *buy side traders*. The people and institutions who will ultimately benefit from the funds that *investment sponsors* hold are *beneficiaries*. A summary of buy side traders appears in Table 3-1.

**Table 3-1.** The Buy Side of the Trading Industry

Trader type	Generic examples	Why they trade	Typical instruments
Investors	Individuals Corporate pension funds Insurance funds Charitable and legal trusts Endowments Mutual funds Money managers	To move wealth from the present to the future for themselves or for their clients.	Stocks Bonds
Borrowers	Homeowners Students Corporations	To move wealth from the future to the present.	Mortgages Bonds Notes
Hedgers	Farmers Manufacturers Miners Shippers Financial institutions	To reduce business operating risk.	Futures contracts Forward contracts Swaps
Asset exchangers	International corporations Manufacturers Travelers	To acquire an asset that they value more than the asset that they tender.	Currencies Commodities
Gamblers	Individuals	To entertain themselves.	Various

### 3.1.2 The Sell Side

The *sell side* of the trading industry includes dealers and brokers who provide exchange services to the buy side. Both types of traders help buy side traders trade when they want to trade.

*Dealers* accommodate trades that their clients want to make by trading with them when their clients want to trade. Dealers profit when they buy low and sell high. We discuss dealers in Chapter 13.

In contrast, *brokers* trade on behalf of their clients. Brokers arrange trades that their clients want to make by finding other traders who will trade with their clients. Brokers profit when their



clients pay them commissions for arranging trades with other traders. We discuss brokers in Chapter 7.

Many sell side firms employ traders who both deal and broker trades. These firms therefore are known as *broker-dealers* or *dual traders*.

### The Wire in Wirehouse

Traders often call large broker-dealers *wirehouses*. The word “wire” in wirehouse once referred to the telegraph. Following its invention, broker-dealers used the telegraph to collect orders from branch offices in distant cities. Those who quickly adopted it were able to expand their businesses substantially and thereby greatly increase their profits. The ability to communicate quickly was—and remains—very important in the trading industry.

The sell side exists only because the buy side will pay for its services. We therefore must understand why the buy side trades before we can understand when the sell side is profitable. We consider how and why both sides trade in subsequent chapters. Table 3-2 provides a summary of sell side of the trading industry.

**Table 3-2.** The Sell Side of the Trading Industry

Trader type	Generic examples	Well-known US examples	Why they trade
Dealers	Market makers Specialists Floor traders Locals Day traders Scalpers	Spear Leads & Kellogg LaBranche & Co., Inc. Bernard L. Madoff Investment Securities Knight Trading Group TimberHill LLC	To earn trading profits by supplying liquidity.
Brokers	Retail brokers Discount brokers Full-service brokers Institutional brokers Block brokers Futures commission merchants	Charles Schwab & Co. E*Trade Dreyfus Brokerage Services Abel/Noser Corp. XpressTrade Cargill Financial Markets Group	To earn commissions by arranging trades for clients.
Broker-dealers	Wirehouses	Goldman Sachs Merrill Lynch Salomon Smith Barney Morgan Stanley Dean Witter Credit Suisse First Boston	To earn trading profits and trading commissions.

### 3.2 Trade Facilitators

Many institutions help traders trade. We introduce exchanges, clearing and settlement agents, depositories, and custodians in this section.

## Chapter 4

### Orders and Order Properties

*Orders* are trade instructions. Orders specify what traders want to trade, whether to buy or sell, how much, when and how to trade, and most importantly, on what terms. Traders issue orders when they cannot personally negotiate their trades.

Orders are the fundamental building blocks of trading strategies. To trade effectively, you must specify exactly what you intend. Your order submission strategy is the most important determinant of your success as a trader. The proper order used at the right time can make the difference between a good trade, a costly trade, or no trade at all.

Many markets arrange all their trades by using a set of rules to match buy and sell orders that traders submit to them. To understand how these markets work and to use them effectively, you must understand how traders specify their orders.

Understanding orders will also allow you to see where liquidity comes from. *Liquidity* is the ability to trade when you want to trade. Some orders *offer liquidity* by presenting other traders with trading opportunities. Other orders take liquidity by seizing those opportunities. Trader decisions to offer or take liquidity therefore affect market quality. To understand liquidity, you must understand how traders form their order submission strategies.

This chapter will show you what orders are, how traders specify them, and most importantly, what properties they have. Traders choose orders that have properties that allow them to best solve their trading problems.

Familiarize yourself with the many trading terms introduced in this chapter. We will use them throughout the book. Traders use specialized words and phrases to communicate quickly and accurately with each other. Whether you intend to trade or simply want to learn about trading, you need to be familiar with market nomenclature.

Although order instructions have the same meanings in all markets, their properties differ depending on the type of market to which traders submit them. In this chapter, we will assume that traders submit their orders to a *continuous trading market* that arranges trades as orders arrive. Identical orders have slightly different properties in *call markets* that collect and process all orders at the same time. We examine call markets and the properties of orders submitted to them in Chapter 6 (Order-driven Markets).

#### **4.1 What Are Orders, and Why Do People Use Them?**

Orders are instructions that traders give to the brokers and exchanges that arrange their trades. The instructions explain how they want their trades to be arranged.

An *order* always specifies which instrument (or instruments) to trade, how much to trade, and whether to buy or sell. An order may also include conditions that a trade must satisfy. The most common conditions limit the prices that the trader will accept. Other conditions may specify for how long the order is valid, when the order can be executed, whether it is okay to partially fill the order, where to present the order, and how to search for the other side. Some orders even specify the traders with whom the trader is willing to trade.

**An Order Example**

Harry wants to sell 7,600 shares of Exxon Mobil (XOM) at no less than 41.05 dollars per share, but only if he can trade during the current trading session and only if he can trade the entire quantity at once. He would issue an all-or-nothing, day order to sell 7,600 shares of XON, limit 41.05 dollars.

Orders are necessary because most traders do not personally arrange their trades. Traders who arrange their own trades—typically dealers—do not use orders. They decide on the spot what they want to do and how to do it. All other traders must carefully express their intentions ahead of time.

For many small traders, it is not economical to continuously monitor the market. These traders use orders to represent their interests when they are not paying close attention to the market.

Traders who arrange their own trades have an advantage over traders who use orders to express their intentions. The former can respond to market conditions as they change. The latter must anticipate such changes and write contingencies into their orders to deal with them. Carefully written orders will adequately represent traders' interests even when conditions change. When orders do not do so, traders must cancel them and resubmit new instructions. During the time it takes to cancel and resubmit orders, traders can lose because their old orders trade before they can cancel them, or because they cannot submit new orders in time to take advantage of the changing market conditions. Traders therefore must carefully specify their intentions when they use orders to trade.

In general, traders who can respond most quickly to changes in market conditions have an advantage over slower traders. Traders who submit and cancel orders manually are slower than traders who use computers to monitor and adjust their orders. Where speed is of the essence, floor traders and computerized traders are the most successful traders.

Clear and efficient communication is essential when trading in fast markets. Brokers must understand exactly what traders intend. Otherwise, extremely costly errors may occur. To avoid mistakes, most traders use standard orders to decrease the probability that they will misunderstand each other when communicating quickly. All traders recognize and understand these orders.

This chapter introduces the standard orders and describes their properties. We must define some basic terms first.

**4.2 Some Important Terms**

Traders indicate that they are willing to buy or sell by making *bids* and *offers*. Traders *quote* their bids and offers when they arrange their own trades. Otherwise, they use orders to convey their bids and offers to the brokers or automated trading systems that arrange their trades. Bids and offers usually include information about the prices and quantities that traders will accept. Traders call these prices *bid* and *offer prices*. They also use the terms *bidding price*, *offering price*, *asking price*, or simply *bid* and *ask*. They refer to the quantities as *sizes*.

Prices are *firm* when traders can demand to trade at those prices. Prices are *soft* if the traders who offer them can revise them before trading. Orders generally have firm prices.

The highest bid price in a market is the *best bid*. The lowest offer price is the *best offer* (or equivalently, the *best ask*). Traders also call them the *market bid* and the *market offer* (or *market ask*) because they are the best prices available in the market. A *market quotation* reports the best bid and best offer in a market. A market quotation is often called the *BBO*, which is the acronym for *Best Bid and Offer*. Many markets continuously publicize their *market quotations*. The best bid and offer anywhere in the United States is the *NBBO*—*National Best Bid and Offer*.

The difference between the best ask and the best bid is the *bid/ask spread*. Traders sometimes call it the *inside spread* because the space between the highest bid price and the lowest ask price is *inside the market*. The English often refer to the spread as the *touch*. In sports betting markets, bettors and bookies call it the *vigorish*.

An order *offers liquidity*—or equivalently *supplies liquidity*—if it gives other traders an opportunity to trade. For example, suppose Joe issues an order to buy 100 shares of IBM for no more than 100 dollars per share from the first person to contact him before trading closes today. Joe's bid offers liquidity because other traders now have the opportunity to sell IBM for 100 dollars per share. Joe's bid is a *day limit order* because it is only valid for the day, and because Joe limits the price that he will pay.

Buyers and sellers can both offer liquidity. Buyers offer liquidity when their bids give other traders opportunities to sell. Sellers offer liquidity when their offers give other traders opportunities to buy.

The dual use of the word “offer” may seem confusing. It may refer to an offer of an item for sale, or to an offer of liquidity. If you think of liquidity—the ability to trade when you want to trade—as a service that you can buy or sell, the use of the word “offer” makes sense. This perspective leads to many useful insights. For example, dealers make money by selling liquidity to their clients.

*Standing orders* are open offers to trade. Joe's order will stand until someone sells to Joe at 100 dollars or less, the order expires at the end of the day, or Joe cancels it. Standing orders are also called *open orders*. Since standing orders allow other traders to trade when they want to trade, traders offer liquidity when they have orders outstanding.

Traders who want to trade quickly *demand liquidity*. Traders *take liquidity* when they accept offers—standing limit orders or quotes—that other traders made. If Sue is willing to sell 100 shares of IBM at 100 dollars, she can initiate a trade by taking Joe's offer.

Traders who demand to trade immediately demand *immediacy*. We show in Chapter 19 (Liquidity) that immediacy is one of several dimensions of liquidity.

A market is *liquid* when traders can trade without significant adverse effect on price. Markets with many standing limit orders and small bid/ask spreads are usually quite liquid.

The prices at which orders fill are *trade prices*. Buy orders that trade at high prices and sell orders that trade at low prices trade at *inferior prices*.

Markets and traders sometimes treat orders differently depending on whether they are agency orders or proprietary orders. *Agency orders* are orders that brokers represent as agents for their clients. *Proprietary orders* are orders that traders represent for their own accounts. In many organized markets, agency orders have precedence over proprietary orders at the same price.

## Chapter 5

### Market Structures

The trading rules and the trading systems used by a market define its *market structure*. They determine who can trade; what they can trade; and when, where, and how they can trade. They also determine what information traders can see about orders, quotations, and trades; when they can see it; and who can see it.

Market structure is extremely important because it determines what people can know and do in a market. Since power comes from knowledge and the ability to act on it, market structure helps determine power relations among various types of traders. These relationships greatly affect who will trade profitably.

To trade effectively, you need to know the structure of every market in which you trade. The trading strategies that are successful in one market often do not work well in markets with different structures. The best order submission strategy for a given trading problem generally depends on the structure of the market where the trader intends to solve the problem. Traders therefore behave differently in different markets.

You must understand market structure, and how it affects trader behavior, to understand the origins of market liquidity, price efficiency, volatility, and trading profits. These variables all depend on trader behavior. Since market structure affects trader behavior, it helps determine whether markets will be liquid, whether prices will be informative, and which traders will trade profitably.

We will introduce and describe a framework for classifying market structures. This classification scheme will help you recognize how markets are similar and dissimilar to each other. Being able to classify market structures will be useful to you since trading problems have similar solutions in similar markets. If you understand how to trade in one market, you should be able to apply your knowledge and experience to other similar markets. We will use this classification system throughout the rest of this book.

We will start by discussing the different types of trading sessions that exchanges, brokerages, and dealers organize. We then will discuss the various execution systems that traders use to arrange their trades. Finally, we will describe the information processing systems that transmit orders into and out of markets, present market information to traders and to the public, and store open orders.

#### 5.1 Overview

Trading takes place in *trading sessions*. The two types of trading sessions are continuous trading sessions and call market sessions. In *continuous trading*, traders can attempt to arrange their trades whenever the market is open. In *call markets*, all trades take place only when the market is called.

*Trading forums* are the places where traders arrange their trades. In *physically convened markets*, traders must be on a *trading floor* to negotiate their trades. Physically convened futures markets trade in *trading pits*. Physically convened stock markets trade at *posts*. In *distributed*

*access markets*, traders use telephones or screen-based trading systems to arrange their trades from their offices.

### Physically Convened Screen-based Markets

Although screen-based trading systems are ideally suited for distributed access markets, many Asian exchanges with screen-based trading systems once required their traders to be on their trading floors to use their electronic systems. This arrangement made it easier for exchanges to regulate their traders. It also allowed them to construct reliable communications networks, which was once an important issue in countries with poor telecommunications infrastructures.

Many traders like to trade in physically convened markets because they enjoy the society of other traders. Now that exchange regulations no longer require them to be there, many traders have stayed on the exchange floor.

Some countries require that traders arrange all trades in a given instrument at a particular exchange. For example, with few exceptions, it is illegal to arrange trades in a Chicago Board of Trade corn futures contract outside of the corn futures trading pit on the CBOT floor. These restrictions are common in many futures markets and in the equities markets of some Asian and Eastern European countries.

Traders and exchanges use various *execution systems* to arrange trades. In *quote-driven systems*, dealers arrange most trades when they trade with their customers. In *order-driven systems*, all trades are arranged by using *order precedence rules* to match buyers to sellers and *trade pricing rules* to determine the prices of the resulting trades. In *brokered trading systems*, brokers arrange trades by helping buyers and sellers find each other.

Various information systems move information in and out of the market, present it, and store it. *Order routing systems* send orders from customers to brokers, from brokers to dealers, from brokers to markets, and from markets to markets. These systems also send reports of filled orders back to customers. *Order presentation systems* present orders to traders so that they can act upon them. The systems may use *screen-based*, *open-outcry*, or *hand-signaling* technologies. *Order books* store open orders. *Market data systems* report trades and quotes to the public.

In most markets, traders can only use prices that are an integer multiple of a specified *minimum price increment*. The size of the increment, measured as a fraction of price, varies considerably across markets. In Chapter 11 (Order Anticipators), we show that the increment is an extremely important determinant of market quality in many markets.

### Price Clustering

Traders do not use all possible prices equally. Instead, their usage clusters on round numbers. In markets with fractional prices, they use whole numbers more often than halves, halves more often than odd quarters, quarters more often than odd eighths, and eighths more often than odd sixteenths. In markets with decimal prices, prices that are integer multiples of 1.00, 0.50, 0.25, 0.20, 0.10, and 0.05 are likewise most common. The clustering of prices is most pronounced when the minimum price increment is a small fraction of price, the market is highly volatile, and the instrument is thinly traded.

Clever traders often consider the clustering of limit order prices when they place limit orders. They frequently place their orders just above or just below a round number to take advantage of the fact that many other traders may place their prices at the round number.

## 5.2 Trading Sessions

Markets have *trading sessions* during which trades are arranged. The two types of trading sessions are continuous market sessions and call market sessions.

### 5.2.1 Continuous Markets

In *continuous markets*, traders may trade anytime while the market is open. Trading is continuous in the sense that traders may continuously attempt to arrange their trades. In practice, they usually trade only when a trader demands liquidity.

Continuous trading markets are very common. Almost all major stock, bond, futures, options, and foreign exchange markets have continuous trading sessions.

### 5.2.2 Call Markets

In *call markets*, all traders trade at the same time when the market is called. The market may call all securities simultaneously, or it may call the securities one at a time, in a *rotation*. Markets that call in rotation may complete only one rotation per trading session, or as many rotations as their trading hours permit. Markets that call in rotation were once very common. Now only in the stock markets of a few small countries call in rotation.

Many continuous order-driven exchanges open their trading sessions with call market auctions and then switch over to continuous trading. These markets also use calls to restart their trading after a trading halt. Open-outcry futures exchanges, however, start continuous trading immediately when they open.

Call markets are used as the exclusive market mechanism for many instruments. Most governments sell their bonds, notes, and bills in call market auctions. Some stock markets also use calls to trade their least active securities. The Deutsche Börse and Euronext Paris Bourse are examples of such markets.

### Call Market Betting at the Horse Races

US horse racetracks offer *pari-mutuel betting* to their betting clients. In pari-mutuel betting, bettors receive a share of the total money bet on all horses—less a fixed percentage for the track and the state—if their horse wins. Bettors can place their bets anytime until betting closes a few moments after the start of the race. The track *totalizator* system displays the projected winnings for each bet while the bettors place their bets.

Pari-mutuel betting is a call market auction in which the totalizator simultaneously prices all bets on a race. (The price of each bet is the amount bettors must bet to receive a dollar if their horse wins.) The call occurs when betting closes. Since the system only allows market orders, many traders wait until the last moment to bet so that they can see what the prices will be.

## Chapter 6

### Order-driven Markets

*Order-driven markets* use trading rules to arrange their trades. These markets include oral auctions, single price auctions, continuous electronic auctions, and crossing networks. You will learn how these markets work, and how trading strategies depend on market structure.

Order-driven markets are quite common. Almost all of the most important exchanges in the world are order-driven markets. Most newly organized trading systems choose electronic order-driven market structures.

Despite the great variation in how order-driven markets operate, their trading rules are all quite similar. All order-driven markets use *order precedence rules* to match buyers to sellers and *trade pricing rules* to price the resulting trades.

Variations in trading rules distinguish order-driven markets from each other. The trading strategies that work best in one market may work poorly in markets with different rules. Traders therefore need to know how trading rules affect optimal trading strategies.

If you trade in order-driven markets, the principles introduced in this chapter will be of immediate and obvious value to you. These principles will also help you understand front-running and block trading strategies that we will consider in later chapters.

The topics in this chapter should also interest you if you are interested in market structures. Most recent innovations in trading technologies involve order-driven market structures. To evaluate new trading technologies, you must thoroughly understand how they work.

We will first discuss how oral auctions work. In these order-driven markets, traders arrange trades by negotiating on a trading floor. Since many readers may already be acquainted with these markets, they provide us with a familiar context for introducing various trading rules. We then will turn our attention to rule-based order-matching systems. These systems include single price auctions, continuous order book auctions, and crossing networks.

#### 6.1 Oral Auctions

Many futures, options, and stock exchanges use continuous bilateral oral auctions to trade their contracts and securities. The largest oral auction market is the US Government Long Treasury Bond futures market. This market, which the Chicago Board of Trade organizes, regularly attracts 500 floor traders. It may be the most liquid market in the world. The smallest oral auctions may include only two traders.

In an *oral auction*, traders arrange their trades face-to-face on an exchange trading floor. Some traders cry out their bids and offers to attract other traders. Other traders listen for bids and offers that they are willing to accept. Most traders do both. Trades occur when a buyer accepts a seller's offer, or when a seller accepts a buyer's bid. In the former case, the buyer will call out "take it" to accept the offer. In the latter case, the seller will call out "sold" to accept the bid. Buyers and sellers often take turns bidding and offering until they agree on a price and quantity to trade. Traders *offer liquidity* when they make bids or offers to trade. Traders *take liquidity* when they accept bids or offers.



The traders must obey the market trading rules. These rules organize trading to ensure fairness for all traders and to provide for the efficient exchange of information necessary to arrange trades. The trading rules also help protect brokerage customers from dishonest brokers.

The first rule of an oral auction is the *open-outcry rule*. Traders must publicly express all bids and offers so that all traders can act on them. This requirement ensures that all traders can fairly participate in the market. In most oral auctions, any trader can accept another trader's bid or offer, even if they are not actively negotiating with that trader. The first trader to accept a bid or offer generally gets to trade. The open-outcry rule also requires traders to express their acceptances publicly so that all traders are aware of the trades that they arrange. This information helps traders evaluate market conditions. It also protects customers from dishonest brokers who might try to arrange trades privately to benefit their friends instead of their clients.

### 6.1.1 Order Precedence Rules

The *order precedence rules* of an oral auction determine who can bid or offer, and whose bids and offers traders can accept. In oral auctions, the primary order precedence rule is always *price priority*. The secondary precedence rules depend on the market. Futures markets use *time precedence*. US stock exchanges use *public order precedence* and then time precedence.

#### 6.1.1.1 Price priority

The *price priority rule* gives precedence to the traders who bid and offer the best prices. Traders cannot accept bids or offers at any inferior price. Buyers can accept only the lowest priced offers and sellers can accept only the highest priced bids.

Price priority is a *self-enforcing rule* because honest traders naturally search for the best prices. Exchanges therefore do not have to adopt special procedures to enforce it. They keep the rule on their books so that they can prosecute dishonest brokers.

Most oral auctions do not allow traders to bid below the best bid or offer above the best offer. Since only the best bid and offer interest traders, bids and offers behind the market only create confusion and noise.

Traders acquire price priority by bidding or offering prices that improve the current best bid or offer. Any trader may improve the best bid or offer at any time.

#### 6.1.1.2 Time Precedence

The *time precedence rule* used in most oral auctions gives precedence to the traders whose bid or offer first improves the current best bid or offer. While they have time precedence, no other traders may bid or offer at the new best bid or offer.

Traders retain their time precedence as long as they maintain their bid or offer, or until another trader accepts it. Afterwards, anyone may bid or offer at the new price and all traders at that price will have equal standing.

In oral auction markets, bids and offers generally are good only for a moment. Traders say, "A quote is good only as long as the breath is warm." In practice, traders who do not honor their quotes for a reasonable period find that nobody wants to trade with them. Traders maintain their

precedence by repeating their quotes as often as is necessary to show that they remain interested in trading. Traders may repeat their quotes continuously in large, very active markets.

The time precedence rule encourages traders to improve prices aggressively. Traders who want to trade ahead of a trader who has time precedence must improve the price. Time precedence rewards aggressive traders by giving them the exclusive right to trade first at the improved price. The time precedence rule thus encourages price competition among traders.

### **Leapfrog**

The orange juice concentrate futures market is currently 103.10 cents bid, offered at 103.25 cents. (Traders quote prices per pound for 15,000 pound contracts.) Guy is the bidder at 103.10. He has time precedence at that price, and he is defending it. If you want to buy at 103.10, you must wait until Guy trades. If you want precedence, you must improve the bid to 103.15. You then would have price priority over his bid and time precedence over all subsequent bids at 103.15. If Guy then wants to reclaim his precedence, he would have to improve the market again by bidding 103.20. Time precedence encourages traders to play leapfrog by jumping over each other's prices with improved prices.

Good traders carefully consider their leapfrog strategies. For example, if you are willing to bid 103.20 and you are confident that Guy will bid 103.20 if you bid 103.15, you may want to skip over 103.15 and bid first at 103.20. If you bid 103.20 and Guy still wants to trade first, he will take the offer at 103.25. In which case, he will trade immediately and you will still have time precedence at 103.20. Of course, if you are quite impatient to trade, your best strategy may be to immediately take the offer at 103.25.

Time precedence is only meaningful when the minimum price increment is not trivially small. The *minimum price increment*, or *tick*, is the smallest amount by which a trader may improve prices. It is the incremental price that traders must pay to acquire precedence, through price priority, when they do not have time precedence. If it is very small, the time precedence rule gives little privilege to the traders who improve price.

The effect of the tick on price competition varies by tick size. If the tick is too small, it decreases price competition by weakening the time precedence rule. If this tick is too large, traders are reluctant to improve prices because of the expense. Since the minimum price increment significantly affects market quality, exchanges and regulators pay close attention to it.

### **The Common Cents Stock Pricing Act of 1997**

In March of 1997, Republican Representative Mike Oxley and others introduced a bill to require that US stock markets trade on dollars and cents rather than on dollars and fractions of a dollar. The bill had wide popular support because most people find decimal pricing simpler to understand than fractional pricing. The bill never passed. Instead, the exchanges decided to switch to decimals by themselves.

The bill was somewhat remarkable because it represented an attempt by the US Congress to micromanage trading rules in the stock markets. The exchanges probably decimalized at least in part to prevent the passage of this bill.

## Chapter 7

### Brokers

*Brokers* are agents who arrange trades for their clients. Unlike dealers, who trade with their clients, brokers trade their clients' orders. Clients usually pay brokers *commissions* for their services.

Many brokers are also *financial advisors* who advise their clients about their investments or their financial plans. They may also provide their clients with investment information. In these capacities, they often influence the trading decisions that their clients make.

Unless you arrange your own trades, you will use the services of a broker when you implement your trading strategies. You therefore must understand what brokers can do for you—and to you—to trade effectively. This chapter describes what brokers do and the problems that traders may have with lazy or dishonest brokers.

You also need to know what brokers do if you want to be a broker yourself. The discussions in chapter will allow you to better understand how brokers compete with each other for business, and how the best brokers win these competitions.

You must understand what brokers do to predict when electronic order matching systems will be successful. Automated order-driven execution systems are essentially electronic brokers. Since traditional brokers and electronic order matching systems both match buyers to sellers, they compete with each other. To fully understand either system, you must understand the economics of both trading systems.

Finally, you must understand what brokers do if you are interested in the distinctions that regulators make between automated order-driven execution systems and traditional brokers. Some automated order-driven execution systems are regulated as exchanges whereas other nearly identical systems are regulated as brokers. If you are interested in these distinctions, you must ask how the order matching done by traditional brokers differs from the order matching done by automated systems.

We begin this chapter by considering how brokers serve their clients, how they organize their operations, and what determines their profits. We then discuss how the most important management problem—the principal-agent problem—affects brokers and their clients. The chapter closes with a discussion about problems that traders can have with dishonest brokers, and how traders can prevent these problems.

#### 7.1 What Brokers Do

Brokers arrange trades for their clients. They search for traders who are willing to trade with their clients; they represent their clients at exchanges; they arrange for dealers to fill their clients' orders, they introduce their clients to electronic trading systems; and they match their clients' buy and sell orders.

Brokers conduct these activities in various types of markets. In *order flow markets*, brokers take orders that their clients give them and match them with orders and quotes made by other traders. Exchanges, dealers, or the brokers themselves may operate these markets. Brokers generally search for the best price only among traders who are willing to display their limit orders and

quotes in these markets. In *block markets*, brokers take large client orders and try to find other traders to fill them. Brokers often must search among traders who have not expressed interest in trading to discover those traders who are willing to trade. In *offering markets*, brokers distribute new issues and seasoned issues to traders. Brokers must often market these securities to generate buyer interest. Finally, in *merger and acquisition markets*, brokers help firms buy other firms. Brokerage firms that engage in large capital transactions are called *investment banks*. Table 7-1 summarizes the different types of brokered transactions.

**Table 7-1.** Types of Brokered Transactions

Market type	Trades	Market structure	Brokerage role
Order flow	Small to medium sizes in seasoned securities and contracts.	Order-driven or quote-driven	Brokers receive orders and match them with orders and quotes made by other traders.
Block	Large sizes in seasoned securities and contracts.	Brokered	Brokers receive an order on one side and must search for traders who will take the other side. Brokers occasionally identify both sides.
New and seasoned offerings	Large size offered by an issuer or one or more large holders.	Brokered	Brokers sell securities to buyers on behalf of issuers and large holders.
Mergers and acquisitions	Company to company.	Brokered	Brokers find one or both parties.

Only the largest investment banks operate in all types of markets. Most brokerage firms specialize in only one or two of these markets.

In all markets, brokers are their clients' agents. Their clients tell them what trades they want to make, and under what terms they will trade. The brokers then try to arrange the best trades that they can subject to the constraints imposed upon them. Generally, clients expect that brokers will seek the lowest possible prices when buying and the highest possible prices when selling.

Clients use brokers to arrange their trades because brokers usually can arrange trades at a much lower cost than can their clients. The following reasons explain why brokers are low cost traders:

- Brokers can solve clearing and settlement problems at a lower cost than their clients can.
- Brokers can access exchanges and dealers that their clients cannot access.
- Brokers generally know better than their clients who might be willing to trade.
- Brokers are often better negotiators than their clients are.
- Brokers can represent orders for their clients when their clients are unavailable to represent them themselves.

We examine these points in the remainder of this section.

### 7.1.1 Clearing and Settlement among Traders

The most important, but perhaps least appreciated, reason why traders use brokers to arrange their trades involves clearing and settlement. Clearing and settlement problems can arise whenever traders do not settle their trades immediately after they negotiate them. During the time between arrangement and final settlement, traders risk that their counterparts may not acknowledge their trades, may refuse to settle their trades, or may be financially unable to settle their trades. Traders therefore are reluctant to trade with people who they do not know are trustworthy and creditworthy.

Without the assistance of brokers, traders would have to check the credit of every trader with whom they trade. Brokers assist traders by helping them avoid this expensive problem.

Brokers solve clearance problems by clearing their clients' trades. If a client fails to acknowledge a trade, the broker must resolve the problem with the client. The broker thus protects the trader on the other side of the trade.

Brokers solve the settlement problem either by guaranteeing that their clients will settle their trades, or by staking their business reputations on whether their clients will settle their trades. When brokers guarantee their clients' trades, the brokers settle trades that their clients will not. When the brokers simply vouch for their clients, they risk losing future business if they acquire a reputation for representing clients who do not settle their trades. In both cases, brokers must ensure that they only represent trustworthy and creditworthy clients. Otherwise, undesirable clients will impose significant costs upon them. The credit function that brokers provide is especially important in order-driven markets since such markets generally arrange trades among total strangers.

#### **Multiplying Credit Checks**

When traders arrange trades that they intend to settle in the future, they must be confident that their counterparts can and will perform. Traders routinely perform *credit checks* to determine whether their counterparts are creditworthy.

In a market with no brokers, each trader must be prepared to check the credit of every other trader. If exactly one million traders trade in such a market, the total number of potential credit relationships is 999,999,000,000, or slightly less than one quad-trillion. In such markets, traders will only check the credit of traders with whom they intend to trade. They will naturally prefer to arrange trades only with traders whose credit they have already checked.

Now suppose that this market has brokers who guarantee their clients' trades. Three types of credit relationships are present in this economy:

1. Brokers must check the credit of their clients to protect themselves.
2. The clients must check the credit of their brokers to ensure that they can trust them. These credit checks may be perfunctory if everyone knows that a broker is creditworthy.
3. Each broker must check the credit of every other broker with whom he or she arranges trades.

## **Part II**

### **The Benefits of Trade**

The two chapters in this part discuss how trading benefits individual traders and the entire economy. Chapter 8 explains why traders trade. We introduce 32 different types of traders and identify the benefits that they each obtain from trading. Remarkably, traders often do not clearly understand why they trade. They therefore often trade when they should not or fail to trade when they should. Traders who understand why they trade will generally trade more effectively.

In Chapter 9, we consider how well functioning markets benefit the entire economy. The primary benefits come from informative prices and from market liquidity. We explain how well functioning markets help market-based economies use their resources most efficiently. We also consider a framework for evaluating public policy.

## Chapter 8

### Why People Trade

People trade to invest, to borrow, to exchange assets, to hedge risks, to distribute risks, to gamble, to speculate, and to deal. We consider each of these objectives in this chapter and explain how markets help traders achieve them.

You must understand why people trade to use markets effectively. Markets provide many valuable opportunities. To take advantage of them, you must first recognize them.

By considering why people trade, you will better understand why you trade and whether you should trade. Many traders do not fully recognize the reasons why they trade. Consequently, either they pursue inappropriate trading strategies, or they trade when trading is counterproductive to their true interests. The optimal trading strategy for a given trading problem depends on the problem. You cannot trade well if you do not know why you want to trade.

Knowing why people trade may also help you determine whether other traders understand why they are trading. This skill is very important because you can usually distinguish a good money manager from a poor one by whether they understand well why they trade. It is also important because traders who do not fully understand why they trade often trade foolishly. If you can identify such traders, you may be able to profit from their foolishness.

If you engage in any trading strategy that depends on the volume of trade, you must understand why people trade to interpret volumes properly. Many factors cause people to trade. If your trading strategy depends on one of these factors, you will want to examine volumes carefully. However, you must be careful to recognize when other factors may cause people to trade. Otherwise, you may misinterpret volumes and trade when you should not.

Markets are successful only when people trade in them. If you want to design new markets, or if your business depends on trading in a successful market, you must understand why—and how—people trade.

Trading is a zero-sum game in an important accounting sense. In a *zero-sum game*, the total gains of the winners are exactly equal to the total losses of the losers. Trading is a zero-sum game because the combined gains and losses of buyers and sellers always sum to zero. If a buyer profits from a trade, the seller loses the opportunity to profit by the same amount. Likewise, if a buyer loses from a trade, the seller avoids an identical loss.

Successful traders must understand the implications of the zero-sum game. To trade profitably, traders must trade with people who will lose. Profit-motivated traders therefore must understand why losers trade to know when they should trade.

Finally, you must understand why people trade to form well-reasoned opinions about market structures. Different structures favor different trader types. If you intend to influence a decision about market structure, you should consider first how the decision affects various traders. The benefits that traders obtain from markets depend on why they trade. Regulators and other interested parties must therefore understand these reasons.

This chapter identifies the main reasons why people trade. We will refer to them throughout the rest of the book. Pay close attention to the distinctions between investing, speculating, and gambling. When traders confuse these important concepts, they often trade poorly. When regulators confuse them, they often adopt policies that hurt the markets. Consider also why liquid markets benefit most traders. When you understand why people trade, you will appreciate why all market participants care about liquidity.

For expository clarity, we will associate a stylized trader with each reason for trading, and we will assume that that stylized trader trades only for that reason. In practice, traders often trade for many reasons. The complexity of their motives explains why many traders get confused and fail to fully recognize why they trade. By considering stylized traders, we simplify our discussions and ultimately make it easier for you to identify the different reasons why people trade.

### Multiple Identities

Many traders simultaneously invest, speculate, and gamble. They invest when they need to move money from the present to the future. They speculate when they try to use information about future security prospects to obtain a better return on their investments. They gamble when they focus more attention on favorable outcomes than on losing outcomes.

Their multiplicity of interests often compromises their judgment. Investors often speculate without thinking about whether they would be good speculators, and speculators often gamble without considering whether their emotional needs have influenced their judgment.

Our stylized traders are profit-motivated traders, utilitarian traders, or futile traders. *Profit-motivated traders* trade only because they rationally expect to profit from their trades. Speculators and dealers are profit-motivated traders. *Utilitarian traders* trade because they expect to obtain some benefit from trading besides trading profits. Investors, borrowers, asset exchangers, hedgers, and gamblers are utilitarian traders. *Futile traders* believe that they are profit-motivated traders. Although they expect to trade profitably, their expectations are not rational. They have no advantages that would allow them to be profitable traders. Utilitarian traders and futile traders lose on average to profit-motivated traders because trading is a zero-sum game.

Traders are either informed traders or uninformed traders. *Informed traders* can form reliable opinions about whether instruments are fundamentally undervalued or overvalued. The *fundamental value* of an instrument is the value that all traders would agree upon if they knew all available information about the instrument and if they could properly analyze this information. An instrument is *undervalued* when its market price is below its fundamental value. It is *overvalued* when its price is above fundamental value. Since nobody actually knows fundamental values, traders must estimate them. Informed traders typically form their opinions from insightful analyses of publicly available information or from simple analyses of information that is not widely known. Informed traders speculate on their information by buying undervalued instruments and selling overvalued instruments. Informed traders are therefore profit-motivated traders. *Uninformed traders* do not know whether instruments are fundamentally undervalued or overvalued. Either they cannot form reliable opinions about values, or they choose not to. Uninformed traders include utilitarian traders, futile traders, and some types of profit-motivated traders.



Our discussion starts with and primarily focuses on utilitarian traders. At the end of the chapter, we will introduce the profit-motivated traders and the futile traders. Detailed discussions of how they behave appear in subsequent chapters devoted exclusively to their various styles.

## 8.1 Utilitarian Traders

Utilitarian traders trade to obtain some benefit besides trading profits. Investors and borrowers trade to move money forward or backward through time. Asset exchangers trade to exchange one asset for another asset of greater value to them. Hedgers trade to exchange risks. Gamblers trade for entertainment. Fledglings trade to learn how to trade. Cross-subsidizers trade to transfer wealth to other people. Tax-avoiders trade to minimize their taxes by exploiting tax loopholes. We will consider each of these traders in turn.

### 8.1.1 Investors and Borrowers

People often need to move money from one point in time to another. Workers need to move their current earnings from the present to the future to finance their retirements. Students need to move their future earnings to the present to pay tuition. Young couples need to move their future earnings to the present to buy houses.

These problems are all examples of intertemporal cash flow timing problems. People face *intertemporal cash flow timing problems* when their incomes and expenses do not always coincide. When their incomes are more than their expenses, they *invest* money to move money into the future, or they *repay* money that they borrowed from the past. When their incomes are less than their expenses, they *borrow* money from the future, or they *liquidate* investments that they made in the past. People invest, borrow, liquidate, and repay to move money forward or backward through time.

Corporations and governments also face intertemporal cash flow problems. The most common problem that corporations face is inadequate current cash flow to pay for investments that will generate future revenues. To solve this problem, they borrow money from the future by selling bonds or stock shares. Governments most commonly borrow against their future tax revenues to finance current spending. They may use the money to fund projects that will produce benefits in the future, to fund current services, or to enrich poor people, disabled people, retirees, immigrants, and in many cases, farmers and manufacturers.

Although people, corporations, and governments invest and borrow to move money through time, in aggregate, no money actually moves through time. Instead, for every dollar invested, someone must borrow a dollar. The assets that investors use to move money from the present to the future therefore are the same assets that borrowers use to move money from the future to the present. Traders buy assets when they want to move money to the future, or when they repay money that they previously moved from the present to the past. They sell assets when they want to move money from the future to the present, or when they redeem money that they have moved from the past to the present.

Investors use various financial and real assets to move money forward through time. *Financial assets* include stocks, bonds, mutual funds, insurance policies, certificates of deposit, demand deposits, and currencies. *Real assets* include real estate, machinery, commodities, precious metals, and going business concerns. Those investors who cannot, or who would rather not,

## Chapter 9

### Good Markets

Market structures have changed significantly in the last few years, and many more changes are under consideration. Throughout the world, people actively debate the following questions:

- Should regulators consolidate all orders into a central limit order book?
- Should markets use quote-driven or order-driven systems?
- Should regulators allow internalization and preferencing?
- Should regulators impose price limits or trading halts on trading?
- Should trading use floor-based or screen-based systems?
- Should dealers yield to their customers?
- Should regulators require that markets be linked electronically? How fast should those links be?
- What trading hours should markets adopt?
- Who should be able to see the limit order book?
- Who owns market data?
- What securities and contracts should regulators allow exchanges to trade?

The markets have wrestled with these and many other issues in recent years. They undoubtedly will continue to do so.

Virtually any change in market structure will have significant economic effects on our markets. Trading rules, trading systems, and information protocols all affect liquidity, transaction costs, volatility, the quality of prices, and the distribution of trader profits. We therefore must carefully consider whether proposed changes in market structure are desirable. This chapter introduces a paradigm for how we should make these decisions.

Everyone has an economic interest in how markets should be organized since everyone—whether they trade or not—benefits from having well-functioning markets. Not surprisingly, opinions about market structure vary widely.

Many people try to influence market structure:

- Legislators pass laws that dictate structures.
- Regulators interpret those laws, propose new ones, and selectively enforce them.
- Government administrators propose laws, veto laws, and use their influence in a myriad of ways to promote their interests. In some countries, they also write the laws.
- Judges interpret laws and write new case law.
- Exchanges, brokers, clearing agencies, and information providers freely create any market structures that the legal system permits. They also frequently propose—and sometimes even implement—structures that laws and regulations do not currently permit.
- Issuers influence market structure through the decisions they make about where to list their securities.

- Traders likewise influence market structure through the decisions they make about where to trade.
- Investors and the general public influence market structure by voting for politicians that favor their interests and by lobbying those politicians.
- Finally, the leaders of trade organizations, public interest groups, and watchdog agencies often lobby on behalf of their constituents.

These people all discuss market structure with those who have power to promote or frustrate their interests.

Debate generally is most productive when conducted within a framework for making decisions. Welfare economics provides such a framework. *Welfare economics* is the branch of economics that considers how we should organize our economy. In this chapter, we consider principals by which we should organize our markets.

How markets should be organized is completely subjective. Everyone is entitled to his or her own opinion. Many people think that markets should do well whatever it is that they do. Accordingly, we will closely consider the benefits that markets produce for our economy. At the end of this chapter, I provide a set of weak objectives that I believe regulators should use when evaluating alternative market structures. You may have your own opinion about what are good markets.

If you agree that markets should be organized to maximize the benefits that they produce for the economy, then you must be familiar with these benefits so that you can consider them when you evaluate alternative policies. If you believe that markets should be organized to promote other objectives, you should at least be aware of the costs to the economy of the policies that your objectives favor.

Even if you have no interest in influencing market structures, you should find these discussions interesting. Well-functioning markets are largely responsible for the tremendous wealth that free market-based economies have generated and continue to generate. This chapter helps explain why some countries are rich while other countries are poor.

We start our discussion with a brief introduction to welfare economics. The discussion then turns to the benefits that markets produce for individuals and for the wider economy. If your only interest in this book is to become a better trader, you can safely skip this chapter.

## **9.1 Welfare Economics**

Welfare economics involves positive and normative economic analyses. In *positive economic analyses*, analysts use theories and empirical evidence to predict the consequences of various economic policies. Positive economics is objective in the sense that analysts who use the same assumptions and the same data should obtain the same results. In *normative economic analyses*, analysts argue for specific economic policies. Normative economics is highly subjective. Everyone is entitled to his or her own opinion about what should be.

Normative analysts arrive at their conclusions by finding the policy that maximizes a subjective measure of social welfare. The conclusions may flow from formal mathematical models based on rigorous statistical analyses or from simple heuristic arguments based on best guesses. Either way, a proper normative argument has four parts:

1. An identification of all reasonable alternative policies.
2. A specification of subjective criteria for evaluating the alternative policies. The criteria describe a *social welfare function* that measures the value of each policy. If the social welfare function is based on multiple criteria, it must specify the acceptable trade-offs among the various criteria.
3. A positive economic analysis that evaluates the social welfare of each alternative policy.
4. An identification of the policy that produces the greatest social welfare.

All normative analysts should follow this procedure. In practice, most follow it implicitly rather than explicitly. This procedure provides a valuable framework for debate because it clearly identifies the criteria upon which analysts base their conclusions. Without this discipline, proponents of a policy often argue for it as though it were the objective rather than the path to some commonly agreed upon objective. When policy becomes the objective rather than the means to the objective, poor results often follow.

### **Do Economists Disagree Much?**

The public widely believes that economists rarely agree with each other. Consider the popular joke, “Put two economists in a room, and you get three opinions.”

Economists actually agree more than they disagree. They appear to disagree a lot because people remember controversies more than agreements. Since economic controversies interest us, economists often appear to disagree.

When economists disagree about positive analyses, they usually have based their analyses on different assumptions or different data. Since analysts must make many decisions about which assumptions and which data to incorporate into their studies, policymakers must be careful when interpreting economic analyses. They must ensure that the subjective biases of the analysts do not influence their results.

When economists disagree about assumptions and relevant data, we need a set of principles to evaluate the decisions that underlie their analyses. The norms of economic science provide us with these principles: We should evaluate assumptions by how well they represent the essential reality of the problem at hand rather than whether we like their policy implications. Likewise, we should evaluate data by how well they characterize relevant past experience rather than by whether we like their policy implications.

When economists disagree about normative analyses, they usually have employed different social welfare functions. Economists—like everyone else—have different opinions as to what is good and valuable. Policymakers must consider whether they agree with the analyst’s values before accepting the conclusions of a normative analysis.

### **9.1.1 Market Welfare Economics**

To decide public policy in the markets, we need an objective by which we can measure the merits of alternative policies. Many people believe that we should design markets to do well whatever it is that they do. Whether you subscribe to this objective or not, you must understand what markets do to responsibly evaluate public policy.

## **Part III**

# **Speculators**

We now turn our attention to the three main types of profit-motivated speculators.

We consider informed traders in the Chapter 10. Informed traders are well informed about fundamental values. Their trading makes prices more informative.

We study order anticipators in Chapter 11. Order anticipators are well informed about what other traders intend do. They front run other traders and thereby reduce their profits. Their trading often makes prices less informative.

In Chapter 12, we examine bluffers. Bluffers try to fool other traders into believing that they have information about future price changes. Their trading usually makes prices less informative.

## Chapter 10

### Informed Traders and Market Efficiency

*Informed traders* are speculators who acquire and act on information about fundamental values. They buy when prices are below their estimates of fundamental value and sell when prices are above their estimates. Informed traders include *value traders*, *news traders*, *information-oriented technical traders*, and *arbitrageurs*.

In this chapter, we will consider how informed traders trade, and how their trading makes prices informative. We will pay special attention to why some informed traders make money while others do not. We also will explain why prices cannot be completely informative. This chapter will help you understand how informed traders make money, when they make money, and the limits to how much money they can make.

Informed trading may interest you for at least three reasons. First, you may be an informed trader yourself. If your trading decisions depend in any way on opinions you form about fundamental values, you are an informed trader. Unfortunately, most traders who believe that they are informed traders do not trade profitably because they are not truly well informed. The principles we will discuss in this chapter should improve your trading by helping you predict when you will trade profitably.

Second, you must understand informed trading to understand the risks that traders face when they offer liquidity. In Chapter 13 (Dealers), we show that dealers and other traders who supply liquidity lose to well-informed traders. The profitability of dealer operations therefore depends critically on how dealers cope with informed traders. If you intend to be a dealer, if you intend to trade with them, or if you intend to offer liquidity yourself, you must understand informed trading.

Finally, you must understand informed trading to see how prices become informative. A price is *informative* when it is near its corresponding fundamental value. Informative prices are extremely valuable to the economy because they help us allocate resources efficiently. To fully appreciate how market-orientated economies work, you must understand how informed traders make prices informative.

#### 10.1 Fundamental Values

To discuss informed trading, we must distinguish between market values and fundamental values. The *market value* of an instrument is the price at which traders can buy or sell the instrument. The *fundamental value* (or *intrinsic value*) is the “true value” of the instrument. In financial terms, fundamental value is the expected present value of all present and future benefits and costs associated with holding the instrument. Everyone would agree upon this value if they all knew everything known about the instrument, if they all used the proper analyses to predict and discount all uncertain future cash flows, and if they all perceived the benefits and costs of holding the instrument equally. Since these conditions never occur, traders often differ in their opinions about fundamental values. This chapter examines how informed traders estimate fundamental values, and how they trade upon their estimates.

Fundamental values are not perfect foresight values. Fundamental values depend only on information that is currently available to traders. *Perfect foresight values* depend on all current

and future information about values. Fundamental values are the best estimates of perfect foresight values.

Prices are completely *informative* when they equal fundamental values. *Efficient markets* produce prices that are very informative. The difference between fundamental value and market value (price) is *noise*. Informed traders try to identify the noise in prices by estimating fundamental values. Since we do not observe fundamental values, we cannot easily determine whether prices are informative or noisy.

### **Fischer Black on Noise**

Fischer Black was a mathematician who made many seminal contributions to the development of financial theory. Perhaps most notably, he helped develop option-pricing theory, for which Myron Scholes and Robert Merton received the 1997 Nobel Prize in Economic Science. Had Fischer not died two years before the Prize was awarded, he undoubtedly also would have been a Nobel laureate.

In his 1985 presidential address to the American Finance Association, Black offered a now famous opinion about noise. He believed that we should consider stock prices to be informative if they are between one-half and twice their fundamental values! Most economists believe that the prices of actively traded securities are well within these extreme bounds, but no one can know for sure.

Source: Fischer Black, 1986, "Noise," *Journal of Finance* 41(3), 529-543.

Changes in fundamental values are completely unpredictable. Since fundamental values reflect all available information, they change only when traders learn unexpected new fundamental information. If fundamental value changes were predictable, current fundamental values would not fully reflect the information upon which the predictions are based. Fundamental value changes therefore must be unpredictable. Since prices are very close to fundamental values in efficient markets, price changes in efficient markets are quite unpredictable.

When traders cannot predict future price changes, statisticians say that prices follow a *random walk*. Plots of random walks through time look like paths that wander up or down at random because random walks are completely unpredictable.

## **10.2 Informed Traders**

Informed traders estimate fundamental values. They may base their estimates on *private information* that only they have, or on *public information* that any trader can obtain. Informed traders compare their value estimates with the corresponding market prices. They consider instruments to be *undervalued* if prices are less than their estimates of fundamental value, and *overvalued* if prices are greater.

Informed traders buy instruments that they believe are significantly undervalued and sell instruments that they believe are significantly overvalued. They hope to profit when the prices of their purchases rise, and when the prices of their sales fall. Informed traders naturally hope that these price changes will occur quickly.

Informed traders lose money when they estimate fundamental values poorly. When their value estimates are wrong, they pay too much for instruments they have overvalued, and they sell too

cheaply those instruments that they have undervalued. Informed traders who consistently estimate values poorly usually quit trading when they have lost more money than they can tolerate or when bankruptcy forces them out of the markets.

Informed traders also can lose money even if they accurately estimate fundamental values. This happens when prices move away from fundamental values rather than towards them. These losses, however, tend to be short-term losses. In the long run, prices usually revert toward their fundamental values so that well-informed traders ultimately profit.

Even if prices never adjust to their fundamental values, well-informed traders who have correctly estimated values still can profit from their trades if they are patient. When they buy an undervalued instrument, they acquire the rights of ownership for less than their aggregate value. By holding the instrument, they will eventually receive the benefits of these rights—typically interest, dividends, royalties, capital repayments, or liquidating distributions—at a lower price than they could otherwise obtain them. When they sell overvalued instruments, they can invest the proceeds in instruments with higher expected rates of return.

### **10.3 Informed Traders Make Prices Informative**

Informed traders, like all other traders, often significantly impact prices when they trade. Their buying tends to push prices up, and their selling tends to push prices down. Since they buy when price is below their estimates of fundamental value and sell otherwise, the effect of their trading is to move prices toward their estimates of fundamental value. Their trading therefore causes prices to reflect their estimates of fundamental value. When informed traders accurately estimate values, their trading makes prices more informative.

Informed traders generally differ in their estimates of value. This often happens when they base their estimates on different data. Informed traders often trade with each other so that the price impacts of their trading tend to cancel. The net impact of their trading is a market price that reflects an average of their different value estimates. This price usually is more informative than are any of the individual value estimates. Markets aggregate data from many sources to produce prices that typically estimate fundamental values more accurately than can any individual trader.

#### **An Algebraic Illustration**

This box presents an algebraic illustration of how markets aggregate information. If you are not comfortable with algebra and symbolic notation, skip it. The exercise only illustrates points made in the text.

Suppose that  $N$  traders each produce a different forecast of the true value of a security. Let  $f_i$  be the forecast of the  $i^{\text{th}}$  trader and assume that it is an unbiased estimate of  $V$ , the true fundamental value. We can represent the forecast as  $f_i = V + e_i$  where  $e_i$  is the error in the  $i^{\text{th}}$  trader's forecast. The expected forecast error is zero because the forecasts are unbiased. The individual forecast errors might be quite large in absolute value, however.

Let each trader's desired position in the security,  $D_i$ , be proportional to the difference between her forecast of value and the market price, i.e.,  $D_i = a(f_i - P)$  where  $a$  is some constant of proportionality, and  $P$  is the market price. This assumption ensures that trader  $i$  will want a long position if her forecast is greater than the market price and a short position otherwise. It also



## Chapter 11

### Order Anticipators

*Order anticipators* are speculators who try to profit by trading before other traders trade. They make money when they correctly anticipate how other traders will affect prices or when they can extract option values from the orders that other traders offer to the market.

Order anticipators include front runners, sentiment-oriented technical traders, and squeezers.

*Front runners* collect information about trades that other traders have decided to arrange.

*Sentiment-oriented technical traders* try to predict trades that uninformed traders will decide to make. *Squeezers* try to exploit traders who must trade by cornering the market.

Order anticipators are *parasitic traders*. They profit only when they can prey on other traders. They do not make prices more informative, and they do not make markets more liquid. To trade profitably, you must avoid these traders. You therefore must understand how they trade.

Large traders are especially vulnerable to order anticipators. You must be familiar with parasitic traders to understand how large traders expose their orders.

Some front runners obtain their information about trader intentions from brokers. If you trade with brokers, if you are a broker, if you are interested in becoming a broker, or if you regulate brokers, you must know how brokers occasionally unwittingly or intentionally expose orders.

Trading by order anticipators often makes prices more volatile and markets less efficient. If volatility and price efficiency interest you, you must consider how order anticipators affect the markets.

Uninformed traders sometimes significantly affect prices. Traders who can predict what uninformed traders will do therefore can sometimes profit from that knowledge. If you have these skills, how sentiment-oriented technical traders trade should interest you.

Even if you cannot predict what uninformed traders will do, you may be able to identify what uninformed traders have done after the fact. Although you cannot profit directly from this information, you can use it to better understand why your trading strategies worked or failed. Understanding how sentiment-oriented technical traders collect and process information will help you to better understand uninformed traders.

In markets that enforce time precedence, order anticipators must improve price by at least the minimum price increment to trade ahead of other traders. The size of the price increment therefore greatly affects the profitability of order anticipator strategies in such markets. You must be familiar with how order anticipation trading strategies to form reasonable opinions about the proper size of the minimum price increment.

#### 11.1 Front Runners

*Front runners* collect information about trades that other traders have decided to arrange. They then try to trade before those traders complete their trades. Front runners may obtain their information from public sources, from the traders they front run, or from brokers. Practitioners call them front runners because they hurry (run) to trade before (in front of) other traders.

Front-running strategies differ according to the type of trader that they front run. Front runners may trade in front of aggressive traders or passive traders. *Aggressive traders* demand liquidity while *passive traders* offer liquidity.

### 11.1.1 Front Running Aggressive Traders

Aggressive traders usually issue market orders. Their demands often push prices up when they buy and push prices down when they sell. Front runners who trade ahead of aggressive traders profit from the price impact of the aggressive traders' trades.

In most markets, front running is illegal when the front runner improperly obtains information about the incoming order. Front runners obtain information improperly when they violate a confidential brokerage relationship or when they eavesdrop on confidential communications. These violations may take place at any point between the receipt of the order by the broker and its final execution.

#### **An Illegal Front-running Scheme Involving a Violation of Confidentiality**

Rob is a runner who works for a large brokerage house on the floor of a futures exchange. Rob's job is to carry orders from his firm's telephone booth on the perimeter of the exchange floor to his firm's brokers in various trading pits.

Nate trades commodity futures for his own account in one of those pits. He and Rob have arranged a set of signals by which Rob can surreptitiously tell Nate that he is carrying a large buy or sell order. They may convey their signal by a glance at a clock, by the hand in which Rob carries the order, by the placement of a pen in a pocket or behind an ear, or by some other means. Rob and Nate employ a variety of signals to make it difficult for anyone to detect what they are doing.

When Nate sees the signal for a large buy order, he immediately buys contracts for his own account. After Rob delivers the order to his firm's broker, the broker buys contracts to fill it. Nate profits as the broker pushes the price up to fill the order. Nate sometimes even sells his newly acquired contracts to the broker. Afterwards, Nate and Rob split the profits.

Their profits come at the expense of the broker's customers. The customers pay higher prices when buying and obtain lower prices when selling because Nate takes liquidity that they otherwise would have taken.

This scheme is very difficult to detect in actively traded markets. To prevent it, brokerage firms, their customers, and exchanges must carefully watch how prices change before and after orders arrive. They must try to remember who traded before large orders arrived so that they can identify systematic patterns that might suggest a front-running problem.

Brokers also must secure their communications to prevent these schemes. At several exchanges, new wireless electronic order delivery systems eliminate the need for floor runners and thereby remove potential for fraud in that link of the order transmission chain.

Not all front running is illegal. Observant traders on the floor of an exchange can often infer an order from how a broker handles it. Brokers must be especially careful to avoid revealing their orders inadvertently.

**Legal Front Running by an Observant Trader**

Rifka and Jon have both traded on the same options floor for years. Although they are not friends, their close proximity to each other has allowed them to become very well acquainted. Rifka trades for her own account. Jon is a floor broker for a large firm.

Rifka has noticed that Jon behaves slightly differently when he receives a large order than a small order. The differences are very subtle; Rifka cannot even articulate what she sees. She just knows from experience when Jon has a large order.

Jon's behavior does not reveal whether the order is a buy or sell order. Rifka often guesses correctly since she has noticed that Jon tends to buy after he has bought and sell after he has sold. At least one of Jon's clients probably splits his or her large orders.

When Rifka suspects that Jon has received a large order, she will try to front run it. If she feels confident about the side of the order, she may try to beat Jon to the market. Otherwise, she will wait to see which side Jon needs to trade. She may then better his price and hope to make a profit when Jon's client returns to the market.

Rifka's trading is legal. Her profits come from recognizing Jon's shortcomings as a broker and from noting that Jon's clients tend to split their orders. She is a profitable trader because she is observant and because she acts quickly on her information.

Front runners sometimes also obtain information about orders when brokers call them to arrange trades. Brokers who want to arrange a large trade must call traders who they think might be willing to take the other side. They often reveal their orders in these calls. Although front runners may legally exploit this information, those who do risk harming their relationships with these brokers. Brokers must be very careful to expose orders only to those traders who will most likely take the other side. They must avoid exposing their orders to traders who would front run their clients.

**Shop the Block**

Brokers *shop the block* when they expose large orders. Not surprisingly, prices tend to rise when they widely shop a large block buy order, and fall when they widely shop a large block sell order.

Front runners capture the benefits of price discrimination that large traders would otherwise obtain. In continuous auctions, large traders typically split their orders so that they can discriminate among the traders who offer them liquidity. They want to trade first with those traders offering the best prices and then, if necessary, with traders offering inferior prices. Splitting their orders thus produces a better average price than they would obtain if they had to fill their entire order at a single price. Front runners appropriate the benefits of price discrimination by taking liquidity from the traders offering the best prices. They then offer this liquidity back to the large traders at inferior prices. The effect of a successful front-running strategy is to force large traders to pay more uniform prices to fill their orders.

Under some very limited circumstances, front runners can be valuable to large traders. If front runners can find liquidity more cheaply than can large traders, the front runners may lower the costs of trading large sizes. To be of value to large traders, front runners must consolidate the

## Chapter 12

### Bluffers and Market Manipulation

*Bluffers* are profit-motivated traders who try to fool other traders into trading unwisely. The bluffers then profit from those foolish traders. To trade profitably, you must avoid trading with bluffers.

Bluffers use two techniques to fool their victims. *Rumormongers* spread information that they hope will encourage people to trade as the bluffers want them to trade. The information may be false information, or it may be true information presented in a manner or under circumstances that would cause traders to misinterpret it. *Price manipulators* arrange trades at prices, volumes, and times that they hope will change people's opinions about instrument values. The trades may be real market trades properly arranged at arm's length, or they may be *wash trades* that they arrange with confederates to create artificial market activity. Both bluffing techniques present the bluffers' victims with information that the bluffers hope will cause them to make false inferences about values. In both cases, bluffers try to convince other traders that they are well-informed traders.

#### Painting the Markets

Traders say that price manipulators *paint the tape* when they trade to influence other traders. Traders coined this term when automated telegraph printers reported trades to off-floor traders. These printers—called *tickers* because of the sounds that they made—produced long paper ribbons called *ticker tapes*. Traders who paint the tape cause the price record to appear differently than it otherwise would appear.

Traders also say that price manipulators *paint a picture* when they produce information that does not reflect true market conditions. Manipulators hope that other traders will mistake their pictures for reality.

*Market manipulation* occurs when bluffers or their victims cause prices to change from what they would be if the bluffers did not pursue their bluffing strategies. Market manipulation is illegal in the United States and many other countries. It is very difficult to catch, however. If the bluffers do not openly fabricate information or arrange wash trades with conspirators, they often can easily defend themselves by claiming that they were engaged in legitimate trading strategies.

Traders who offer liquidity to other traders must be especially careful not to offer liquidity to bluffers. To avoid losing to bluffers, liquidity suppliers must be very careful when they make inferences about values from prices and volumes. If they make these inferences poorly, bluffers may manipulate their trading and thereby profit. To fully understand how traders supply liquidity, you must understand how bluffers discipline liquidity suppliers.

This chapter starts with an illustration of a bluff. We then formally characterize bluffing. We discuss how bluffs work, why they sometime fail, and why regulators cannot easily enforce laws against market manipulation. The chapter concludes with a discussion of the implications of bluffing for traders who offer liquidity.

### 12.1 A Long Side Bluff

Bluffing is best introduced with an example. In the following invented example, Bill undertakes a long side bluff. In a *long side bluff*, a bluffer tries to profit by buying at low prices and selling later at higher prices. Our example has two endings. In the first ending, Bill successfully completes his bluff and makes great profits. In the second ending, value traders call Bill's bluff, and he loses heavily.

After some careful research, Bill decides that the stock of a small firm named Bubbles Never Burst (BNB) is a good candidate for his bluff. BNB is a young firm that has developed a new emulsifier with potentially valuable applications ranging from bathtub soaps to industrial foams. The stock is followed by many investors who are excited by its growth prospects. Most of them know little or nothing about the underlying chemistry. BNB currently has no earnings and is trading for 5 dollars a share. The firm has 8 million common shares outstanding of which management holds 70 percent.

Bill starts his bluff by buying BNB shares as quietly as he can. Using limit orders, he patiently waits for the market to come to him. Because other traders also occasionally want to buy the stock, the price starts to rise. Over the next 40 trading days, Bill buys 200,000 shares at prices ranging from 5 dollars to 7 dollars. His average trade price is 6 dollars.

On the 31<sup>st</sup> trading day, and continuing thereafter, Bill starts to praise the stock extensively in messages he posts to various Internet message boards. He describes BNB's technology in substantial detail as though he fully understood it. He also provides very optimistic cash flow projections for applications of the technology. His messages draw heavily on information presented in BNB's most recent 10-Q and 10-K reports. He posts these messages using several different usernames so that it appears that the stock is widely followed. He even has his various usernames spar with each other on the message boards to strengthen the impression that they represent different people. Of course, his pessimistic usernames eventually concede winning points to his optimistic usernames.

On the morning of the 41<sup>st</sup> trading day, BNB independently issues a press release that announces that it will be producing its new emulsifiers in China. The news is not surprising to anyone who read BNB's last 10-Q report in which BNB provided a positive status report of its efforts to produce in China. Several electronic news services receive electronic copies of the press release. Most news service editors run the story by publishing an exact or slightly edited copy of BNB's press release.

Bill sees the news immediately because he subscribes to a real time information service that he has programmed to alert him whenever stories about BNB appear. Although the announcement has no particular fundamental value, Bill quickly decides that it represents the opportunity for which he has been waiting. Bill immediately submits market orders to buy 50,000 shares of BNB stock. He divides the orders into several parts and submits them to different brokers without telling them about the other parts. When the orders converge on the market, the price rapidly rises. In 20 minutes, the price rises from 7 dollars to 10 dollars as Bill buys 50,000 shares at an average price of 8.5 dollars. At the end of the hour, several news services are reporting that BNB is up substantially for the day on unusually large volume. BNB also appears on various electronic intraday lists of the largest daily price gainers.

Bill also starts posting notes to the Internet bulletin boards about the importance of the China information. His notes now project price targets of 20 and 25 dollars per share, with the possibility of more than 50 dollars a share by the time the new plant comes on line.

### 12.1.1 The Successful Ending: Bill Profits

Some traders who follow BNB closely see the price change. They immediately query their electronic information retrieval services to determine why the stock is moving, and when it started to move. They find the story about producing in China and see that the price increase immediately followed its publication.

Although the news has no particular fundamental value, many traders infer more from the story than they should because of the large positive price change that followed the announcement. They mistakenly conclude that other traders believe that the story is extremely good news. They foolishly ask themselves, "Why else would the market have gone up?" They convince themselves that someone obviously thinks that the stock is a good value. In light of this information, they then reevaluate their opinions about BNB. BNB's technology now seems more promising, and the firm's prospects look much brighter than when they last thought about the company. They say to themselves, "Because I certainly am among the first to see this news, I probably can still profit by buying BNB stock. If I wait too long, price will continue to rise, and I will have lost my opportunity." These traders then buy the stock. Since they are afraid that others may soon come to the same conclusion that they have, they submit market orders to trade quickly.

Traders who buy when the market is rising and sell when it is falling are *momentum traders*. They are particularly susceptible to bluffs.

These momentum traders primarily buy their stock from Bill! Bill lets the stock continue to rise to close at 12 as he sells 100,000 shares at an average price of 11 dollars.

By late afternoon, the stock exchange has contacted the CFO of BNB about the price rise. She reports that management is completely mystified by the events. The firm considers issuing a second press release stating that they have no idea why their stock price is rising. BNB's attorney, however, advises against doing so for fear of exposing the firm to lawsuits. When news service reporters call, management declines to comment stating that they have a policy of not commenting on market fluctuations.

By the next day (Day 42), many other traders have seen the price rise. Some believe that it indicates that the stock may do very well in the future. Others have read Bill's notes on the various Internet bulletin boards and now agree that the stock probably is undervalued. These traders also may have seen news stories reporting that BNB declined to comment on the burst in market activity. They interpret the refusal as a further indication that something is happening. These foolish traders try to buy the stock.

Other traders believe that the stock may be overvalued, but most are not willing to act on their opinion since they are not sure whether other, more significant, fundamental information might account for the large price rise. Still others think that the stock is overvalued, but are unwilling to sell it because they expect that it will rise further.

Bill sells heavily throughout the day, along with a few value traders. The stock peaks at 13 dollars and then drops to 8 dollars on very high volume. Bill sells his remaining 150,000 shares

## **Part IV**

### **Liquidity Suppliers**

This part of the book examines how and why traders supply liquidity to other traders. We start in Chapter 13 by discussing dealers. Dealers make markets. They allow other traders to quickly trade small size. Dealers tend to be high frequency traders who do not know much about with whom they trade or the fundamental values of the instruments that they trade.

Chapter 14 then examines bid/ask spreads in dealer markets and in order-driven markets. The discussions in this chapter will help you to better understand the determinants of transaction costs.

Chapter 15 considers how block traders arrange large trades. Block traders find liquidity for traders who want to trade large sizes. Block traders generally know their clients well.

We consider value traders in Chapter 16. They are the ultimate suppliers of liquidity. These highly informed traders often supply great depth when they believe that prices do not reflect fundamental values.

We introduce arbitrageurs in Chapter 17. Arbitrageurs are informed traders who move liquidity from one market to the other. You must understand their trading strategies well to appreciate the economic effects of competition among market centers for order flows.

Chapter 18 considers how public traders create order submission strategies. These decisions determine whether they supply liquidity or take liquidity. When public traders are willing to supply liquidity, they can often displace dealers.

## Chapter 13

### Dealers

Dealers are merchants who make money by buying low and selling high. What you already know about merchants will help you understand how dealers in the financial markets trade profitably.

Merchants may be dealers or distributors. *Dealers* buy from, and sell to, their clients. *Distributors* buy from their suppliers and sell to their clients. (In practice, many distributors are also commonly known as dealers. Consider, for example, new car dealers.) Traders act as dealers when they make a market in seasoned securities or in contracts. They act as distributors when they help firms sell new securities or when they help a client sell a large block of securities.

All dealers face the same problems regardless of what they trade. They must set prices, they must market their services to acquire clients, they must manage their inventories, and they must be careful that they do not trade with better-informed traders. The relative importance of these problems varies by what the dealers trade.

Dealers in the financial markets supply liquidity to their clients who want to buy and sell trading instruments. They allow people to trade when they want to trade. They buy when their clients want to sell, and they sell when their clients want to buy.

Dealers make money by buying at low prices and selling at high prices. They lose money when market conditions force them to sell at low prices or buy at high prices. These losses often occur after they trade with informed traders.

When dealers purchase something, they usually do not know to whom they will sell it or at what price they will sell it. If the price drops before they can sell the item, they lose money. Likewise, when they sell something, they usually do not know the price that they will pay to repurchase it. These unknowns make being a dealer challenging, exciting, and very risky. Dealers assume significant risks when they trade.

Dealers are passive traders. *Passive traders* trade when other traders want to trade. Since passive traders do not control the timing of their trades, they must be very careful about how they offer to trade and to whom they offer to trade. They must ensure that when they do trade, their trades benefit them and not just their clients. Dealers must be especially vigilant to avoid losing to informed traders and bluffers.

In this chapter, we will examine the principles by which dealers conduct their businesses. You will learn how dealers set their quotes, how they manage their inventories, how they respond to informed traders, and how they learn about the values of the instruments that they trade. The principles that we will discuss apply to all dealers whether they trade securities, commodities, or retail goods. If you are—or intend to be—a dealer, understanding these principles will help you maximize your trading profits.

Even if you have no interest in being a dealer, you must understand how dealers behave to trade successfully in financial markets. Whether you trade with dealers or compete with them to offer liquidity, their trading decisions affect you. In particular, you must consider how dealers trade when you decide whether to take or offer liquidity.



In markets where dealers are the primary suppliers of liquidity, the cost of liquidity depends on the factors that determine dealer profits. If you are interested in market liquidity, you must understand how dealers trade, and when they are profitable.

We start this chapter with introductory discussions about who dealers are, how traders negotiate with dealers, and how dealers attract order flow. We then consider how dealers control their inventories, and how they set their prices. The chapter closes by examining how dealers relate to value traders and to bluffers.

### 13.1 Who Are Dealers?

*Dealers* are profit-motivated traders who allow other traders to trade when they want to trade. The liquidity service they sell—immediacy—is valuable to impatient traders. Dealers profit when they buy from impatient sellers at low prices and sell to impatient buyers at high prices. The difference in prices compensates them for providing immediacy.

Many dealers are professional traders who work on the floors of exchanges or in the offices of trading firms. These professionals sometimes use computer systems to support their dealing or to implement their trading strategies.

Other dealers are individuals who access the markets through their brokers, often via Internet order entry systems. Such traders generally supply immediacy by issuing limit orders. These individuals often do not recognize that they are acting as dealers. They consequently do not always fully appreciate the risks that they face and the circumstances under which they will lose or profit.

Many markets officially register some traders as dealers. In exchange for some special privileges, these markets may require that their registered dealers supply liquidity. We discuss these arrangements in Chapter 24 (Specialists).

Dealers often are known by other names. At futures exchanges, dealers are often called *scalpers*, *day traders*, *locals*, or *market makers*. At many stock exchanges and options exchanges, they are known as *specialists* or *market makers*.

Many dealers are also brokers. We discuss brokers and the dual trading problem that broker-dealers present in Chapter 7 (Brokers).

In addition to offering liquidity to other traders, many dealers also speculate. Dealers sometimes can predict future price changes by inferring the reasons why traders demand to trade. They also can use quote-matching strategies to capture the option values of limit orders that they see. In many actively traded markets, competition among dealers may be so intense that dealers cannot profit only by providing liquidity to customers. In such markets, dealers must speculate successfully to stay in business. Dealers who must speculate to stay in business are sometimes called *position traders* as opposed to spread traders. *Spread traders* profit exclusively from buying at the bid and selling at the ask.

In this chapter, we consider only how dealers supply liquidity. Although we discuss how dealers infer information from the order flow, and how they react to it, we do not consider how they may speculate on it. Chapters 10 (Informed Trading) and 11 (Order Anticipators) examine the speculative trading strategies that dealers most often employ.

Because dealing can be quite risky, successful dealers tend to be traders who tolerate risks well. They generally do not enjoy bearing them, however. The risks of dealing are serious and scary. Many dealers have gone bankrupt because they assumed risks that did not work out. Dealers constantly think about the risks that they bear and how to avoid them. Since bearing risk is unpleasant, dealers demand appropriate compensation when forced to bear large risks.

### 13.2 Dealer Quotations

The prices at which dealers are willing to buy and sell are their *bid* and *ask* prices. Dealers usually quote these prices to their clients before they trade. Dealers bid to buy at their bid prices and offer to sell at their ask prices. Sellers receive bid prices when they sell to dealers, and buyers pay ask prices when they buy from dealers. Ask prices are also known as *offering prices*.

Traders who want to buy from a trader who is offering to sell *take the offer*. Traders who want to sell to a trader who is offering to buy *hit the bid*.

Dealers always set their ask prices above their bid prices. The difference between the ask and the bid is the *bid/ask spread*. When the ask is close to the bid, the spread is *narrow*, or *tight*. When the ask is much higher than the bid, the spread is *wide*.

Dealers make money by buying low at their bid prices and selling high at their ask prices. This strategy is profitable if dealers can fill orders on both sides of the market without changing their prices. In practice, this strategy is quite difficult to implement profitably because dealers rarely receive buy and sell orders in equal volumes, and because unforeseen price changes are very common.

The realized spreads that dealers earn are often smaller than their quoted spreads. The *realized spread* is the difference between the prices at which dealers actually buy and sell. Realized spreads are usually smaller than quoted spreads because dealers occasionally trade at better prices than they quote and because dealers often adjust their bid and ask prices between trades.

#### Example of a Small Realized Spread

Dell is a dealer who is bidding 35.0 and offering 35.3 for a security. A client arrives and sells at Dell's bid of 35.0. Dell now needs to sell the security to restore her former position.

Bad news about the fundamental value of the security subsequently arrives. To avoid buying from well-informed traders, Dell must lower her bid to 34.6. To encourage traders to buy from her so that she can sell the security, she must lower her ask to 34.9.

A buyer arrives and buys from Dell at 34.9. Although Dell's quoted bid/ask spread before both trades was 0.3, the realized spread for her roundtrip buy and sell was  $-0.1 = 34.9 - 35.0$ . Dell lost money because she was holding the stock when its value dropped.

Dealers who quote both bid and ask prices quote a *two-sided market*. Their quotes *make a market*. Those who quote only one side quote a *one-sided market*. Although most dealers will quote a two-sided market, they usually aggressively price only the side on which they would prefer to trade. For example, dealers who want to buy usually quote high (aggressive) bid prices to encourage sellers to sell to them. They also quote high uncompetitive ask prices to discourage buyers from buying from them. Dealers who want to sell likewise quote low bid and ask prices.

## Chapter 14

### Bid/Ask Spreads

The bid/ask spread is the price impatient traders pay for immediacy. Impatient traders buy at the ask price and sell at the bid price. The spread is the compensation dealers and limit order traders receive for offering immediacy.

The spread is the most important factor that traders consider when they decide whether to submit limit orders or market orders. When the spread is wide, immediacy is expensive, market order executions are costly, and limit order submission strategies are attractive. When the spread is narrow, immediacy is cheap, and market order strategies are attractive. If you are interested in optimizing your order submission strategies, you must understand what determines bid/ask spreads so that you can judge whether they are wide or narrow, given current market conditions.

The spread is also the most important factor that dealers consider when they decide whether to offer liquidity in a market. If the spread is too narrow, dealing may not be profitable, and dealers may quit trading. If it is wide, dealing will be profitable, and other dealers may enter the market. If you are interested in dealer profitability, you must understand the factors that determine bid/ask spreads.

In this chapter, we will consider what determines bid/ask spreads in dealer markets and in order-driven markets. We will discuss when immediacy is expensive, when it is cheap, and why. The most important factors that determine spreads are adverse selection due to well-informed traders, volatility, and market activity. We will closely examine these factors and many others.

The most important lesson you may learn from this book appears in this chapter. You will learn why uninformed traders lose to well-informed traders whether they submit limit orders or market orders. Uninformed traders lose simply because they trade. If you are an uninformed trader and do not want to lose, you should minimize your trading.

#### 14.1 Dealer Bid/Ask Spreads

Dealers set their spreads to maximize their profits. Their spreads must be wide enough to allow them to recover their costs of doing business. Otherwise, they will not be profitable, and they will quit dealing. Their spreads cannot be so wide, however, that no one would trade with them. Their revenues then would not cover their expenses.

Dealers profit when their revenues exceed their expenses. Dealer revenues depend on the effective spreads they earn on their roundtrip trades, on how often they can turn their inventory, and on how much they lose to informed traders. Dealer business expenses reduce their profits. Dealer expenses include financing costs for their inventories, wages for their staff, exchange membership dues, and expenditures for telecommunications, research, trading system development, clearing and settlement, accounting, office space, utilities, and other such items.

##### 14.1.1 Monopoly Dealers

When dealers face little competition, they may quote wide spreads to maximize their profits. The optimal monopoly spread depends on the demand for their services. If clients are willing to

trade regardless of the spread, spreads will be wide. If clients are sensitive to their transaction costs, spreads will be low.

Monopoly dealers set their spreads so that the additional revenue from a slight decrease in spread is just equal to the additional cost of providing the additional liquidity that traders will demand at the slightly lower spread. A similar result appears in all introductory economics textbooks. We will not explain it here because dealers can rarely behave as monopolists in financial or commodity markets.

Monopolies are successful only when monopolists can prevent other competitors from entering their markets. In most security and contract markets, the barriers to entry that dealers face are low. Dealers always look for markets in which they can make money. If dealing profits are excessively high in some market, they will enter that market and try to participate in the excess profits. Their entry tends to lower spreads and thereby the profits of all dealers in the market. The threat of entry therefore may prevent a dealer from behaving as a monopolist even when no other dealers are in the market.

In many markets, dealers also face competition from public limit order traders. Limit orders are essentially the same as dealer quotes. Both are offers to trade that other traders may take when they want to trade. Dealers who compete with aggressive public limit order traders cannot earn large effective spreads because the limit order traders will undercut their quotes.

#### **One Dealer Does Not Necessarily a Monopolist Make**

The specialists at the New York Stock Exchange are the unique dealers in their specialty stocks. Although their unique positions may give them some market power on the floor of the Exchange, they are hardly monopolists. They face competition from public limit order traders and from dealers at other exchanges that trade the same securities.

#### **14.1.2 Spreads in Competitive Dealer Markets**

In competitive dealer markets, dealer spreads ultimately depend on the costs that dealers incur running their business. The free entry and exit of dealers ensures that spreads will adjust so that dealers just earn normal profits for providing their liquidity services. When spreads are too high so that incumbent dealers earn excessive profits, new dealers will enter the market. Their competition for order flow will cause spreads to fall. As the spreads fall, so will the excess profits. If spreads are too low so that dealers are losing money, some will eventually quit since nobody can lose money forever. With less competition, the remaining dealers will be able to raise their spreads and thereby decrease their losses. Only when spreads are set so that dealers earn normal profits will dealers neither enter nor leave the market.

Dealers earn normal profits when their revenues just cover their total economic costs of doing business. These costs include all costs described above, a fair rate of return on their invested capital, and fair compensation for their entrepreneurial efforts. Economists call the difference between revenues and the total economic costs of doing business *economic profit*. When dealers earn normal profits, economic profits are just zero. Firms that make normal profits have accounting profits that just cover the value of the entrepreneurs' time and the rental of their capital.

## 14.2 Spread Components

For analytic purposes, economists break the bid/ask spread into two components. The decomposition makes it easier to understand what factors determine bid/ask spreads.

The *transaction cost spread component* is that part of the bid/ask spread that compensates dealers for their normal costs of doing business. We enumerated these costs above. This component also funds any monopoly profits that the dealer may make and any risk premium that dealers may require for bearing inventory risk.

The *adverse selection spread component* is that part of the bid/ask spread that compensates dealers for the losses that they suffer when trading with well-informed traders. This component allows dealers to earn from uninformed traders what they lose to informed traders. We also discuss this component in Chapter 13 (Dealers) when we consider how dealers learn about values from the order flow. There we examine the component from an information perspective. Here we examine it from an accounting perspective. Although the two perspectives are quite different, remarkably, both perspectives imply the same sized adverse selection spread component.

The two components taken together constitute the total spread. Dealers never separately quote both components. They simply quote their bid and ask prices. To actually estimate the two spread components, analysts must use econometric methods.

### 14.2.1 The Transaction Cost Component

If all traders knew instrument values with complete certainty, the transaction cost component would constitute the entire spread. Prices would simply bounce back and forth between bid prices, which would be set slightly below instrument values, and ask prices, which would be set slightly above instrument values. Competition among dealers would cause the spread to equal the normal costs of doing business. If dealers had monopoly power, they would set wider spreads.

Economists also call the transaction cost spread component the *transitory spread component* because price changes associated with this component are transitory. *Transitory* price changes regularly reverse. Price changes caused by a jump from the bid to the ask most frequently follow price changes caused by a jump from the ask to the bid. Such price changes occur when the order flow includes a mix of buyers and sellers.

Traders call the bouncing back and forth between bid and ask prices *bid/ask bounce*. Bid/ask bounce is a minor form of price volatility caused by impatient traders who demand immediacy. The transitory spread component is responsible for bid/ask bounce.

### 14.2.2 The Adverse Selection Spread Component

Since dealers do not know fundamental values well, they expose themselves to adverse selection from better-informed traders when they offer liquidity. The better-informed traders choose which side of the market on which to trade, and the dealers end up losing money to them. When some traders are better informed than are other traders, traders are *asymmetrically informed*.

If dealers set their spreads to reflect only their normal costs of doing business, their losses to well-informed traders would eventually force them out of business. Dealers must widen their spreads further to cover their losses to informed traders. This additional widening of the spread

## Chapter 15

### Block Traders

*Block trades* result from orders that are too large to fill easily using standard trading procedures. Such orders generally demand more liquidity than is normally available at exchanges or in dealer networks. Traders who wish to trade large blocks therefore must look elsewhere for liquidity. They usually turn to block traders to arrange their trades.

*Block traders* include block dealers and block brokers. *Block dealers* arrange block trades when they fill their clients' large orders. *Block brokers* arrange block trades when they find other traders who are willing to fill their clients' orders. Both types of block traders usually arrange their trades by telephone in the *upstairs block market*. The traders who initiate large trades are *block initiators*. We will call the traders who fill their orders *block liquidity suppliers*. Block liquidity suppliers include dealers and large buy side traders.

Although block trades represent a small fraction of all trades in most markets, they often account for much of the total trading volume due to their large sizes. Block traders arrange most block trades on behalf of large institutions and very wealthy individuals.

Large traders often have a significant impact on prices. They therefore must very carefully arrange their trades to control their transaction costs. Block traders must especially consider how they expose their orders to avoid losing to front runners and quote matchers.

Since block trades significantly affect volumes and prices, traders must understand block trading to interpret volumes and prices. If you intend to extract information from volumes and prices, you must understand block trading.

In this chapter, you will learn how large traders expose their orders, and how block traders arrange their trades. You will learn that block dealers and block brokers only want to serve uninformed clients who honestly tell them the true sizes of their orders. Block initiators—whether they are uninformed or informed, honest or deceitful—therefore must convince block liquidity suppliers that they are uninformed and honest. We therefore will consider how traders convince others that they are uninformed and honest.

#### 15.1 Statistical Definitions of Block Trades

For our purposes, a *block trade* is any trade that results from an order that is too large to fill easily using normal trading procedures. Such orders typically represent more than a day's normal trading volume. In thinly traded instruments, these orders may only represent a few thousand shares or tens of contracts. In actively traded instruments, such orders are many times larger. Most block traders think of a block as exceeding a quarter of a day's average trading volume in an actively traded stock.

For statistical purposes, exchanges often arbitrarily designate trades as block trades if they exceed some fixed size. These classification schemes vary by exchange. The New York Stock Exchange defines a block trade as 10,000 shares or more, regardless of trading activity or price level. Traders, however, routinely arrange such trades on the Exchange floor in actively traded stocks and in low priced stocks. Although officially classified as block trades, these trades are normal trades in all other respects. In thinly traded stocks, or in very high priced stocks like

Berkshire Hathaway (priced as of this writing above 70,000 dollars per share), trades smaller than 10,000 shares often cannot easily be arranged on the floor of the Exchange.

### A Humble Suggestion

Block trading statistics would be more useful if block trades were classified by whether they exceed some fraction of average daily volume rather than by whether they exceed some fixed size.

## 15.2 Block Trading Problems

Block initiators face four problems when they attempt to arrange their traders. The *latent demand problem* makes it hard to find block liquidity suppliers who are not in the market. The *order exposure problem* makes block initiators reluctant to advertise for liquidity for fear driving the market away from them. The *price discrimination problem* makes liquidity suppliers reluctant to trade with large traders because they fear that more size will follow. The *asymmetric information problem* makes liquidity suppliers reluctant to trade with block initiators because they fear that the block initiators are well informed.

### 15.2.1 The Latent Demand Problem

The most obvious problem that large traders face is finding traders to with whom to trade. Many block liquidity suppliers are unwilling to expose their interest. Many more might trade if asked, but they have not yet issued orders to trade. Block traders must find these traders to complete their trades.

Traders who would be willing to trade if asked, but who have not yet issued trading orders, have *latent trading demands*. They may not issue orders because writing orders is costly, or because they simply do not realize that they are willing to trade.

When the probability of trading is small, traders often do not issue orders because they are costly to manage. For example, a trader may be a willing buyer of hundreds of different stocks at prices 5 percent below their current market prices. If he creates and submits orders for each stock, he risks buying all the stocks should the market as a whole drop significantly. Since he cannot afford to buy all the stocks, he cannot allow so many orders to stand at once. Moreover, if all stocks drop together, he may not be a willing buyer in any stock. He therefore waits to see which stocks drop. He has latent trading demands for many stocks, but block traders must discover them before he will trade.

Other traders simply do not know that they are willing to trade. Forming opinions about thousands of securities is costly. Instead, they often wait until events force them to think about trading opportunities. When presented with an attractive opportunity, they may then decide to trade.

Traders who are willing to trade but who do not initiate their trades are *responsive traders*. They respond to demands for liquidity. Most traders who supply liquidity are responsive traders.

Block traders must discover the latent demands of responsive traders when they cannot find adequate liquidity in the market. They find liquidity primarily by calling traders who they think would be willing trade.

Block traders also often move prices significantly to discover the latent demands of responsive traders. Buyers bid prices up, and sellers offer prices down to encourage responsive traders to pay attention and respond. Block initiators give *price concessions* to block liquidity suppliers to encourage them to trade.

Good block traders know where to look for traders willing to provide liquidity at the lowest cost. They keep track of who is interested in various securities, and who has traded those securities in the past. They also try to know what instruments will appeal to different traders so that they can predict who will be most willing to trade when presented with attractive trading opportunities.

### **Hard Work Pays**

Suppose that brokers can develop and maintain one buy side trader client for each hour per week that he works. A broker who works only 20 hours per week has 190 ways to arrange trades among pairs of his 20 clients. If the broker works an additional 20 hours a week, he has 780 ways to arrange trades. If he works 60 hours a week, he can arrange trades 1,770 ways.

This illustration shows that well organized brokers become more productive the harder they work. Hard working brokers benefit from the network externality.

Most large traders do not know as much about latent demands as do professional block traders who specialize in collecting this information. Large traders therefore often contract with block traders to arrange their trades.

Large traders do not initiate all block trades. Sometimes *sales traders* in large wire houses broker block trades by identifying latent trading demands on both sides of the trade.

### **Block Traders Play Concentration Well**

Block traders play a game similar to the card game “concentration” in which players take turns uncovering cards two at a time and attempt to match them. To match buyers to sellers, block traders must remember who was, who is, and—most importantly—who would be interested in trading hundreds of securities.

Unlike card players, block traders can take notes, and they obviously do not have to take turns when playing. Not surprisingly, good block traders spend most of their time on the telephone. Many enter copious notes into electronic contract management systems.

## **15.2.2 The Order Exposure Problem**

When looking for liquidity, block traders must be very careful about to whom they expose their orders. Traders who know about impending blocks often use that information when trading to the disadvantage of the block traders. Some traders create orders expressly to front run pending blocks. Other traders who intend to trade on the same side as the block accelerate their trading to avoid the price impact of the block. Traders who intend to trade on the opposite side retard their trading to capitalize on the price impact of the block. These strategies accelerate the price impact of the block by demanding liquidity in front of the block, or by withholding liquidity from the block. Block traders then ultimately obtain less favorable prices for their blocks. To



## Chapter 16

### Value Traders

*Value traders* are speculators who form opinions about instrument values using all information available to them. They buy instruments that they believe are undervalued and sell instruments that they believe are overvalued. We describe their speculative trading strategies in Chapter 10 where we discuss informed traders.

Value traders are also liquidity providers, though they often do not see themselves this way. This chapter explains how and when value traders offer liquidity. We shall see that they are the ultimate suppliers of market liquidity. They trade when no one else will. We therefore must understand this aspect of value trading to fully understand who makes markets liquid.

Value traders who understand that they liquidity supply will trade more successfully than will those who do not realize that they are liquidity suppliers. By considering the implications of their roles as liquidity suppliers, value traders will make better decisions about when to trade and at what price to trade. If you are interested in being a value trader, the principles discussed in this chapter will be of particular interest to you.

Dealers often trade with value traders when they want to restore their target inventories. Dealers therefore have mixed feelings about value traders. On the one hand, they compete with them to provide liquidity. On the other hand, they depend upon them for liquidity when they are unwilling to carry large inventory positions. If you are a dealer or if you are interested in being a dealer, you need to thoroughly understand how dealers relate to value traders.

Value traders must confront an economic problem called the winner's curse to trade successfully. Traders suffer the *winner's curse* when they win an auction and subsequently regret that they traded because they paid too much or sold for too little. Everyone who competes with others to buy or sell items faces the winner's curse. You need to know about the winner's curse when you buy a house, when you trade on eBay, and when you bid on a job. Even if you do not intend to trade securities or contracts, you should find this chapter useful.

#### 16.1 Value Traders Supply Liquidity

Although value traders trade to make speculative profits, the effect of their trading is to provide liquidity to the market. This characterization of their trading is apparent when you consider when they trade profitably.

Value trading is profitable only when price differs from fundamental value. Price can differ from fundamental value two ways:

- When new information causes fundamental value to change and thereby deviate from price, or
- When uninformed traders push price away from fundamental value.

In the first case, news traders profit because—by definition—they are the first to receive new information. Their trading tends to push price to the new fundamental value. (Chapter 10 discusses information flow trading.) In the second case, value traders profit. Through their research, they are able to determine that price no longer reflects fundamental value. Their

trading tends to push price back to its fundamental value. Value trading therefore is profitable only when value traders trade in response to demands for liquidity made by uninformed traders.

In the following discussion, we will need to refer frequently to “the uninformed traders whose demands for liquidity cause prices to change.” To simplify our discussion, we will simply call them the *uninformed liquidity demanders*. The uninformed liquidity demanders may be one or more large traders, or they may be numerous small traders who all want to trade on the same side of the market. They cause prices to change as they try to fill their orders.

### 16.1.1 Uninformed Traders Cause Prices to Deviate from Fundamental Values

Price deviates from fundamental value when uninformed traders demand liquidity, and when the traders who offer them liquidity do not realize that they are uninformed. This situation often happens when dealers do not know their clients well. To protect themselves from adverse selection losses to informed traders, dealers must make inferences from their order flow. If uninformed traders dominate the order flow on the same side of the market, dealers will mistake those traders for informed traders and adjust prices accordingly. These price adjustments cause price to deviate from fundamental value.

Dealers also may adjust prices even when they know that their clients are uninformed. When dealers supply liquidity only on one side of the market, their inventories diverge from their target levels. The resulting off-target inventories expose them to substantial inventory risks. If their uninformed clients demand more liquidity than dealers are willing to supply, dealers will demand substantial price concessions to bear the resulting inventory risk. These price adjustments will be especially large when dealers fear that they will not easily find traders on the other side of the market.

Uninformed traders may also cause prices to deviate from fundamental values in order-driven markets that do not have dealers. In such markets, prices change when traders demand liquidity on one side of the market and exhaust the liquidity supplied there.

### 16.1.2 How Value Traders Respond

Value traders may trade directly with the uninformed liquidity demanders, or they may trade indirectly with them through the intermediation of dealers and other traders who employ dealing strategies. Value traders trade directly with them when value traders offer limit orders that the uninformed liquidity demanders take, or when block brokers ask value traders to fill orders for their uninformed liquidity demanding clients. In these situations, value traders supply immediacy to the uninformed liquidity demanders because they allow them to trade when they want to trade.

Value traders also indirectly supply liquidity to the uninformed liquidity demanders. We can best introduce this situation with an example.

Suppose that uninformed liquidity demanders want to sell stock in a hurry. They sell to dealers who offer them immediacy. The dealers accumulate large long positions as they buy the inventory. Since they do not know their clients very well, they suspect that the uninformed liquidity demanders may be informed traders. The dealers therefore adjust their prices accordingly. They also adjust their prices because they fear that they will not easily find traders on the other side of the market, in which case they will be exposed to more inventory risk than

they would like to bear. These adjustments cause price to fall below fundamental value so that value trading becomes profitable. To restore their target inventories, the dealers lower their quotes. Value traders buy from the dealers at their ask prices when they see that they can buy substantial size at discounted prices.

The dealers solicit liquidity from the value traders by lowering their asking prices. When the value traders respond, they take liquidity from the dealers in the form of immediacy, but simultaneously supply liquidity to the dealers in the form of size or *depth*. In effect, the value traders indirectly supply liquidity to the uninformed liquidity suppliers through the intermediation of the dealers.

Even though the dealers lay off their inventory on the value traders, both sets of traders may profit. The dealers will profit if they sell their inventories at prices above the prices that they paid to the uninformed liquidity demanders. The value traders will profit when prices return to fundamental values.

### 16.1.3 Market Resiliency

When uninformed traders cannot change prices substantially, the market is *resilient* to their trading. Value traders make markets resilient by standing ready to trade when prices move away from fundamental values.

Dealers will take larger positions when trading with their uninformed clients in resilient markets than in markets that lack resiliency. In resilient markets, dealers know that they can rely upon value traders to restore their target inventories if their order flows remain unbalanced.

## 16.2 The Outside Spread and its Determinants

The prices at which a value trader is willing to trade define the value trader's *outside spread*. Since value traders are well-informed traders, they rarely quote these prices. They do not want to reveal their value estimates, and they do not want to give free trading options to the market.

The spreads of value traders depend on the risks and costs of their business. When they are large, their spreads will be large. This section considers what determines the outside spread.

### 16.2.1 The Risks of Value Trading

Value traders face two serious risks when they trade. These are adverse selection and the winner's curse. Like dealers, value traders face adverse selection when they supply liquidity to better-informed traders. They face the winner's curse when they have misestimated instrument values.

The two risks are closely related. Both arise when value traders are not fully informed. When they suffer adverse selection, they lack information that better-informed traders have. When they suffer the winner's curse, they have mistakenly valued their instruments.

### 16.2.2 The Adverse Selection Risk

Value traders are subject to adverse selection risk because they offer liquidity in response to other traders who demand it. They must be particularly careful that they do not trade with news traders who have new information that the value traders do not have.

## Chapter 17

### Arbitrage

*Arbitrageurs* are speculators who trade on information about relative values. They buy instruments that seem relatively cheap and sell those that seem relatively expensive. Arbitrageurs profit when prices converge so that their purchases appreciate relative to their sales.

We introduced arbitrage trading strategies when we examined informed traders in Chapter 10. There we described how arbitrageurs acquire information about relative values, how the price impacts of their trades cause prices to converge, and how they thereby unwittingly enforce the law of one price. This price characterization of arbitrage helps us understand how arbitrageurs trade as informed traders.

This chapter continues our study of arbitrageurs. Besides being informed traders, we shall see that arbitrageurs also supply liquidity, move liquidity, and produce financial products. This quantity characterization of arbitrage helps explain why arbitrage opportunities arise.

Successful arbitrageurs must understand both the price and quantity characterizations of arbitrage. Although many arbitrageurs can trade successfully merely by responding to arbitrage opportunities as they arise, arbitrage is more profitable when arbitrageurs also can predict when and where those opportunities will arise. Arbitrageurs who consider the quantity characteristics of their arbitrages will make better decisions about when and at what prices to trade.

This chapter characterizes different types of arbitrages and discusses the risks that arbitrageurs face. If you intend to be an arbitrageur or if you trade with arbitrageurs, this discussion should greatly interest you.

We shall see that arbitrageurs sometimes compete with dealers to offer liquidity. Dealers also often lose to arbitrageurs because arbitrageurs usually are better-informed traders. If you intend to be a dealer, you must understand how arbitrageurs can hurt your business. If you merely wish to understand the origins of market liquidity, you also must understand what arbitrageurs do.

In Chapter 26 (Competition within and among Markets), we show that arbitrage is one of three processes that keep fragmented markets together. If you are interested in how markets compete with each other to trade similar or identical instruments, you must thoroughly understand why arbitrageurs trade. You must particularly understand arbitrage to estimate the costs of competition among marketplaces.

Commentators sometimes blame arbitrageurs when markets crash. For example, some people believe that index arbitrageurs were at least partly responsible for the 1987 Stock Market Crash. To understand how traders transmit volatility among markets, you must consider what arbitrageurs do.

Complaints about arbitrage have led to restrictions upon arbitrage trading strategies in some markets. These restrictions can be costly because arbitrage trading benefits more than just arbitrageurs. It also benefits other traders and the economy as a whole. To estimate the sometimes-significant costs of arbitrage restrictions, you must appreciate the quantity characteristics of arbitrage.

Our presentation starts with some definitions. We then characterize arbitrage so that we can understand it in light of trading strategies that we have already discussed. Next, we introduce and discuss various types of arbitrages. We follow this section with discussions about the risks of arbitrage and about how arbitrageurs control these risks. We conclude the chapter with discussions about the quantity characteristics of arbitrage and about how dealers and arbitrageurs relate to each other.

### 17.1 Definitions

*Arbitrageurs* trade instruments whose prices are correlated. *Correlated prices* tend to rise or fall together. Instruments typically have correlated prices when their values depend on common fundamental factors. They also may have correlated prices when the demands of uninformed traders to buy or sell the instruments are correlated.

Arbitrageurs form opinions about the normal relations among correlated instruments. An *arbitrage opportunity* arises when the prices of correlated instruments diverge from their normal relations. Arbitrageurs then buy those instruments that have become relatively cheap and sell those that have become relatively expensive. The strategy is profitable if the prices of the instruments return to their normal relations. When that happens, the prices have *converged*. Arbitrageurs profit from *price convergence*.

#### Barter, Arbitrage, and Relative Values

Modern economies use money as a *medium of exchange*. Almost all trades involve money. The buyer pays it, and the seller receives it. When a trader wants to dispose of one item and acquire another, the trader usually sells the first and buys the second. The nice thing about money is that it allows us to buy and sell from different people.

*Barter* involves the exchange of two (or more) items without the use of money. Barter is not common because both traders must be interested in both items. Traders who want to exchange apples for oranges often cannot easily find traders willing to exchange oranges for apples.

Trades involving money can be considered special cases of barter in which one of the traded items is money. This characterization of trading reminds us that all trades are relative value trades. People buy things when they value the item more than the money they exchange for it. They sell things when they value the money more than the item. In a sense, all trades are arbitrages since all trades are relative value trades.

When arbitrageurs take arbitrage positions, they *put on the arbitrage*. When they close their positions, they *unwind* their positions or *take off the arbitrage*. Arbitrageurs usually unwind their positions when the arbitrage converges. Since prices may again diverge after they converge, arbitrageurs need to closely watch their positions so that they can close them at favorable prices.

The portfolios that arbitrageurs construct are their *hedge portfolios*. The various positions in the hedge portfolio are the *legs* of the arbitrage.

Hedge portfolios usually consist of one or more long positions and one or more short positions in various correlated instruments. Arbitrageurs generally construct hedge portfolios to minimize the total risk of the portfolio given some measure of its size.

(In some instances, hedge portfolios may consist only of short positions or only of long positions. Traders construct such hedge portfolios of instruments whose returns are inversely correlated. Such portfolios typically include put contracts. For example, a long position in a deep-in-the-money put contract is a good hedge for a long position in the underlying instrument.)

Traders usually identify one leg of the hedge portfolio as the *arbitrage numerator* or *reference instrument*. They use the numerator to measure the size of the portfolio. The arbitrage numerator is usually the security, contract, or commodity that traders most closely identify with the common risk factor that causes the correlations among the various instruments in the hedge portfolio. The arbitrage numerator for hedge portfolios involving a derivative contract and its underlying cash instrument is usually the cash instrument.

The ratios of holdings in other legs to holdings in the numerator are the portfolio *hedge ratios*. Traders choose their hedge ratios to minimize the total risk of the portfolio.

Arbitrageurs may have long or short positions in the hedge portfolio. They are *long the hedge portfolio* when they have a long position in the instrument that serves as the arbitrage numerator. Since hedge portfolios usually have both long and short positions, a long hedge portfolio will have one or more short positions. A short hedge portfolio will likewise have one or more long positions.

Hedge portfolios have carrying costs. *Carrying costs* are the costs of holding a hedge portfolio. Depending on the arbitrage, these costs may include interest paid or foregone to finance positions in the hedge portfolio, dividends paid on short positions, fees paid to physically store commodities, or depreciation incurred as commodities age and spoil. Carrying costs are sometimes offset by dividends, interest income, and lending fees earned on long positions, or by interest earned on the proceeds from short sales. Carrying costs can make some arbitrages very expensive.

The difference in prices between instruments in the hedge portfolio is the *basis*. The *fair value* of the basis is the basis that would result if all instruments were correctly priced relative to each other. Fair values depend on carrying costs. Arbitrageurs must estimate fair values because they usually are not common knowledge.

The *arbitrage spread* is the difference between the basis and the fair value of the basis. Arbitrageurs trade when the arbitrage spread is sufficiently large.

The values of the basis at which arbitrageurs are just willing to trade are called *arbitrage bounds*. The arbitrage bounds are on either side of fair value. Arbitrageurs generally put on their arbitrages only when the basis is outside of the arbitrage bounds.

Hedge portfolios generally are less risky than the positions in the individual instruments from which arbitrageurs construct them. The reduction in risk is due to the offsetting effects of having long and short positions in instruments whose values depend on the same factors. When changes in these factors cause instrument values to fall, gains in the short positions offset losses in the long positions. Likewise, when changes in these factors cause instrument values to rise, gains in the long positions offset losses in the short positions.

The risk that an arbitrage hedge portfolio will lose value is called *basis risk*. Analysts also call this risk *residual risk* because it remains after the common factor risks in the various portfolio instruments cancel each other. Basis risk arises because prices depend on instrument-specific factors as well as common factors. The specific factors may be fundamental valuation factors, or

## Chapter 18

### Buy Side Traders

Traders must pay close attention to their order submission strategies to trade effectively. Traders who optimize their trading strategies will have lower transaction costs and higher portfolio returns than those who do not carefully consider their trading problems.

Order submission strategy is the most important determinant of execution quality that traders control. Traders must decide when to submit market orders and when to submit limit orders. When they submit limit orders, they must know where to place their limit prices. If their limit orders do not execute, they must know when, and how, to resubmit their orders.

Large traders also must pay close attention to how they display their orders. Traders who display large orders often attract front runners and scare away liquidity suppliers. Large traders therefore must consider the following questions:

- Whether to actively look for the other side or to wait for it to come to them.
- Whether to show their full interest or to hide it.
- Whether to break up their orders and spread them over time or to bring their whole orders to market at once.
- Whether to employ a single broker or to use multiple brokers to hide their total interest.
- Whether to trade in one market or in many markets.

Display decisions are the most important trading decisions that large buy side traders make.

The decision to use limit orders versus market orders is related to the order display decision. Traders who want to display their trading interest often use limit orders to show that they are willing to trade. Those who do not want to show their interest often use market orders. Traders do not have to display their limit orders, however. They often can use the services of a confidential broker, or they can submit their orders to electronic trading systems that permit undisclosed limit orders.

The strategies that traders should use depend on their trading problems. Informed traders who have material information that will soon become public will trade very differently from value traders who can identify mispriced instruments. Both types of traders will trade differently from traders who need to raise cash before a deadline or index traders who need to rebalance their index portfolios in response to changes in the composition of their target indexes.

In this chapter, we examine the issues buy side traders weigh when deciding how to trade. We start by considering the decision to use market orders versus limit orders. We then analyze the benefits and costs of exposure and consider how traders can defend against parasitic trading strategies that order anticipators may exercise against them. Finally, we discuss how exchanges, brokers, and regulators can structure markets to promote the interests of buy side traders.

Although these issues obviously interest buy side traders, they also should interest anyone who wants to understand the origins of liquidity. Order submission strategies affect the supply and demand of liquidity. Traders demand liquidity when they submit market orders, and they supply

liquidity when they submit limit orders. We therefore must consider how traders choose their order submission strategies to fully understand liquidity.

Chapters 4 (Orders and Order Properties), 7 (Brokers), 11 (Order Anticipators), 12 (Bluffers and Market Manipulation), 14 (Bid/Ask Spreads), and 15 (Block Traders) introduce many of the issues discussed in this chapter. The value-added in this chapter comes from the discussion of these issues from the point of view of the buy side trader. To avoid unnecessary duplication, the text in this chapter assumes some familiarity with some of these issues. Readers who are not familiar with the markets may want to read these other chapters first.

### **18.1 Market versus Limit Orders**

The equilibrium spread model presented in Chapter 14 (Bid/Ask Spreads) shows that order submission strategy does not matter when all traders have identical needs. Bid/ask spreads simply adjust to ensure that traders are indifferent between using market orders and limit orders. In practice, however, traders are not identical. Some traders need to trade faster than do other traders. Impatient traders generally should use market orders while patient traders should use limit orders. Some traders are also more sensitive to order exposure issues than are other traders. Those who do not want to display often use market orders to avoid exposing limit orders.

In all cases, the decision to use limit orders or market orders depends critically on the bid/ask spread. When the spread is wide, taking liquidity is expensive and offering liquidity is attractive. When the spread is narrow, market orders are attractive relative to limit orders. Traders judge whether spreads are wide or narrow from their experience in the market. They can much better organize that experience by being familiar with the bid/ask spread determinants discussed in Chapter 14 (Bid/Ask Spreads).

#### **A Problem with Rules**

The rule to take liquidity when the spread is small and offer it when the spread is large is valid only when you do not know anything about value. For example, suppose that the market is 48 bid, offered at 50. If the spread normally is 10, market orders would appear to be extremely attractive relative to limit orders.

Now suppose that you knew that the true value of the instrument is 45. A market order sell order would execute at a great price relative to value, but a market buy order would execute at a poor price.

This situation often arises when an impatient limit order trader places an aggressively priced order in the market. For example, suppose that the market was 40 bid, offered at 50, before an aggressive buyer placed a limit buy order at 48. The limit order buyer improves the market substantially for market order sellers, but provides no benefit to market order buyers. Sellers who can recognize this situation should take liquidity.

The new bid also affects the decisions buyers make to offer or take liquidity. Since the new bid decreases the probability that limit orders placed below 48 will ultimately execute, limit order strategies that would otherwise place buy orders below 48 are less attractive. The new bid makes market orders more attractive to buyers, though not nearly as much as the abnormally narrow spread would suggest.



The rule is correct when traders know nothing about values. In our example, sellers benefit greatly if they use market orders rather than limit orders, and buyers may be slightly better off with market orders than limit orders. The narrow spread makes market orders more attractive than limit orders—on average—to uninformed traders.

The prices at which traders place their limit orders depend on how they value the tradeoff between execution price and execution probability. Aggressively priced orders will more likely execute than will less aggressively priced orders, but the execution prices will be inferior. Traders who are more concerned about price than about trading will more likely use limit orders. Traders who are more concerned about trading than price will more likely use market orders.

The decision to use market orders versus limit orders also depends on what will happen when limit orders do not execute. Traders who must fill their orders will trade at inferior prices when the market moves away from their limit orders. They can reduce their exposure to this risk by using market orders or by placing their limit orders close to the market to increase the probability that they will execute quickly. Traders who are not committed to trading only trade if they can obtain a good price. These traders—primarily traders who employ dealing strategies—often use limit orders or firm quotes to profit from the bid/ask spread. When their limit orders do not execute, they simply cancel them or replace them with orders placed at new prices.

To derive optimal trading strategies, traders must know how execution probabilities depend on limit order prices. The relation between these variables depends on market conditions. The most important factors include total limit order size at better prices, price volatility, and trader interest in the instrument.

Traders can acquire information about the relation between execution probabilities and limit order prices using formal econometric models. Numerous vendors sell access to optimized order generators that suggest order strategies based on current market conditions.

Traders also acquire information about the relation between execution probabilities and limit order prices through experience. Experienced traders who pay close attention to the market get a feel for what may happen. Buy side traders who give their brokers market-not-held orders give them timing discretion over their orders. They expect that their brokers will use their experience and knowledge of current market conditions to determine the best strategies for filling their orders and to continuously reevaluate those strategies as conditions change.

## **18.2 The Order Exposure Decision**

Traders expose their intentions many different ways. On one extreme, traders can publicize their trading interests by submitting limit orders to systems that widely display their orders. They then hope that other traders will trade with them. On the other extreme, traders can hide their interests until an exchange or a broker presents an acceptable opportunity to trade. Traders may also trade only through brokers and exchanges that settle their trades on an anonymous basis so that neither side knows with whom they traded. A multitude of order exposure strategies lies between these two extremes.

Traders decide to expose by weighing the benefits of display against the costs of display. The benefits are obvious. Buyers and sellers can find each other most easily when they both show that they want to trade. This simple observation helps explain why trading tends to consolidate

## **Part V**

### **Origins of Liquidity and Volatility**

In the next two chapters, we provide broad characterizations of liquidity and of volatility. These concepts mean different things to different people. Consequently, people often are confused when they discuss them. The discussions in these chapters should give you a much more complete understanding of the origins of liquidity and volatility, and of their many dimensions.

Chapter 19 explains that liquidity is the successful outcome of a bilateral search in which buyers look for sellers and sellers look for buyers. This characterization of liquidity explains why liquidity has multiple attributes. The chapter concludes by showing how various types of traders cooperate and compete with each other to supply liquidity.

Chapter 20 breaks total volatility into fundamental and transitory volatility components. Transitory volatility is closely related to the transaction costs that uninformed traders bear. Regulators therefore are quite interested in it. The chapter concludes with a discussion about how statisticians can discriminate between the two volatility components.

## Chapter 19

### Liquidity

*Liquidity* is the ability to trade large size quickly at low cost when you want to trade. It is the most important characteristic of well-functioning markets.

Everyone likes liquidity. Traders like liquidity because it allows them to cheaply implement their trading strategies. Exchanges like liquidity because it attracts traders to their markets. Regulators like liquidity because liquid markets are often less volatile than illiquid markets.

#### Market Frictions

Economists like liquid markets—security markets, contract markets, product markets, and labor markets—because their models work better when they do not have to consider how transaction costs affect economic decisions. When confronted with transaction costs, people trade less often. If the costs are high enough, they do not trade at all.

Transaction costs in an economic system therefore are like frictions in a mechanical system. They both slow things down and can ultimately stop all activity. Economists therefore call transaction costs *market frictions*.

Everyone in the markets has some affect on liquidity. Impatient traders take liquidity. Dealers, limit order traders, and some speculators offer liquidity. Brokers and exchanges organize liquidity.

Given its importance, you would expect that the term *liquidity* would be well defined and universally understood. In fact, liquidity means different things to different people. Traders and regulators talk about it all the time, but rarely are they clear about what they mean. Consequently, they often fail to communicate effectively about liquidity.

The confusion is due to the many dimensions of liquidity. When people think about liquidity, they may think about trading quickly, about trading large size, or about trading at low cost. Some dimensions of liquidity are more important to some people than to others. Unfortunately, people rarely distinguish among these dimensions when discussing liquidity.

In this chapter, you will see that liquidity—the ability to trade—is the object of a *bilateral search* in which buyers look for sellers and sellers look for buyers. The various liquidity dimensions are related to each other through the mechanics of this bilateral search. Traders must understand these relations to trade effectively.

Understanding liquidity is one of the primary objectives of this book. In this chapter, we will carefully define liquidity and its various dimensions. We then will identify the various types of traders who supply liquidity and discuss how they compete with each other.

These discussions will be especially useful to you if you are a trader who needs to know where to look for liquidity. They also will be useful to you if you intend to offer liquidity. In which case, you must understand with whom you will compete so that you can predict when you expect to be successful.

You also need to understand liquidity to measure it effectively. Many traders and regulators regularly measure liquidity. Traders measure liquidity to determine whether their trading strategies are sensible given the available liquidity. They also measure liquidity to evaluate the service they obtain from their brokers. Brokers likewise measure liquidity to evaluate the service they obtain from their dealers. Regulators measure liquidity to determine which market structures are best. No one can answer these questions, however, without clearly understanding what they are measuring. As a rule, you cannot measure something that you cannot define. The concepts presented in this chapter provide a basis for the measurement methods presented in Chapter 21 (Measuring Liquidity).

### **19.1 The Search for Liquidity**

Liquidity is the object of bilateral search. In a *bilateral search*, buyers search for sellers, and sellers search for buyers. When a buyer finds a seller who will trade at mutually acceptable terms, the buyer has found liquidity. Likewise, when a seller finds a buyer who will trade at mutually acceptable terms, the seller has found liquidity. To understand trading, you must understand the strategies traders use to conduct these bilateral searches.

#### **The Most Important Bilateral Search**

For many people, finding a life partner is the most important bilateral search problem that they encounter. For others, it is finding a job. Although this book is not about how people form life relationships and obtain jobs, all bilateral search problems have similar structures. What you learn about how people trade securities and contracts may help you understand how people find partners and jobs.

Bilateral searches are similar to—but more complicated than—unilateral searches. You will find bilateral search strategies easier to understand if you first understand unilateral search strategies.

#### **19.1.1 Unilateral Searches**

In a unilateral search, you actively search for a good match—a good price, for example. The main decision that you must make is when to stop the search. The general rule is to continue searching as long as the expected benefit from an additional inquiry is greater than the expected cost of the inquiry. The expected benefit depends on the probability that you will find a better match than you have already found. As the search proceeds, this probability declines as you find progressively better matches. The expected benefit also depends on how much better unfound matches might be than the best match you have already found. As the search proceeds, the possible improvement declines as you find progressively better matches. At some point, your expected benefit from an additional inquiry becomes less than the cost of the inquiry. You then stop the search and pick the best match that you found.

#### **A Unilateral Search for a 35mm Camera**

Fred wants to buy a specific camera model at a low price. His time is worth 30 dollars an hour.

Fred goes onto the Internet to search for the best price among mail order photography stores that offer the camera. After five minutes of searching at A1ePhoto's site, he discovers that they will sell the camera for 112 dollars. After another five minutes, he discovers that BNDPicture will

sell it for 109 dollars. He decides to search again. Six minutes later, he finds that CDBirD will sell it for 119 dollars. No bargain there.

Should Fred search more? He estimates that if he finds a lower price, it would be no lower than 99 dollars, i.e., no more than 10 dollars less than his current best price. He also estimates that the probability that he will find a price that low at less than 0.25. Fred's expected gain from searching again therefore is less than 2.50 dollars ( $10 \times 0.25$ ). Since it appears that each search takes at least five minutes, his expected cost of searching again is more than 2.50 dollars, given the 30-dollar value he places on an hour of his time. Since the expected cost is greater than the expected gain, Fred decides to stop searching. He buys the camera from BNDPicture for 109 dollars.

If searching is expensive, you will often stop before you have found the best possible match. You may later discover that you could have arranged a better match had you known more about the alternatives. An optimal search produces the best possible result only if you are lucky enough to find it.

### **The Economics of Divorce**

Some people divorce because they learn that they have arranged poor matches. They either learn that their relationships did not develop as they expected, or that their opportunities to form other relationships were better than they expected.

Other people divorce because they are not mature enough to accept that even when they search optimally, they generally will not arrange perfect matches. When they later see other matches that they believe would have been better for them, they forget that they stopped searching because it was too costly. They also forget that the search for a spouse is a bilateral search. In particular, they forget that they cannot arrange every match that they might want to arrange.

In either event, people who initiate divorces presumably believe that the benefits from searching again, or from being single, are greater than the substantial emotional, social, and financial costs of breaking their matches. Unfortunately, many subsequently learn that their expectations were poorly founded.

If you knew ahead of time where to find the best possible match, you would of course go there first. In which case, the costs of searching would be very low because you already know the outcome. In general, you will get a better outcome when your costs of searching are low.

### **Exchanges Are Search Engines**

A *search engine* is a system that collects information in which people may be interested. It allows people to search through that information at a low cost.

In the previous example, had Fred been able to use a search engine to locate the best price for his camera, he might have discovered that GR8 Film and Photo is offering the camera for 87 dollars. Search engines make markets more competitive by lowering the costs of searching.

Exchanges and electronic quotation services collect information about who wants to trade. They then organize it so that traders can easily find the best trading opportunities. They are search

## Chapter 20

### Volatility

*Volatility* is the tendency for prices to unexpectedly change. Prices change in response to new information about values and in response to the demands of impatient traders for liquidity.

Volatility itself changes through time. Sometimes prices are very volatile. Other times, prices are very stable and hardly change at all. Large price changes sometimes occur in short time intervals. Regulators and traders refer to episodes of such price changes as *episodic volatility*. Episodic volatility concerns many people because it can be quite scary.

Volatility, risk, and profit are closely related. Every drop in prices creates losses for traders who have long positions and profits for traders with short positions. Likewise, every price rise causes losses for traders with short positions and profits for traders with long positions. Traders therefore are very interested in volatility because it can have a significant impact on their wealth. If risk scares you or profits interest you, you need to know about volatility.

Volatility especially concerns options traders. Option contract values depend critically on the volatility of the underlying instrument. Options traders must be able to measure and predict volatilities to trade profitably. Both skills require that they understand well the origins of volatility.

Technical traders who try to interpret trading volumes also pay close attention to volatility because volumes and volatility are often correlated. The relation between the two variables is not simple, however. It depends on the origins of the volatility.

Volatility greatly concerns regulators. Excessive volatility may indicate that markets are not functioning well. Since accurate prices are extremely important in the economy, regulators pay close attention to the markets when prices are highly volatile. They are especially attentive when markets crash.

In this chapter, we identify the origins of volatility and distinguish between its two types. *Fundamental volatility* is due to unanticipated changes in instrument values while *transitory volatility* is due to trading activity by uninformed traders.

The distinction is important both for traders and for regulators. Traders must distinguish between the two volatility types to accurately predict future volatility, the profitability of dealing strategies, and transaction costs. Regulators must distinguish between them because they cannot have any lasting effect on fundamental volatility, but they often can substantially affect transitory volatility. Depending on the policies regulators adopt, they may decrease or increase transitory volatility.

We start this short chapter with discussions about the origins of the two types of volatility. We then finish by considering how to distinguish between them. Chapter 28 (Bubbles, Crashes, and Circuit Breakers) considers what regulators can do about volatility when it appears excessive to them.

## **20.1 Fundamental Volatility**

Since economies use prices to allocate resources, it is very important that prices reflect fundamental values. Values change when the fundamental factors that determine them change. Prices therefore should change when people learn that fundamental factors have unexpectedly changed. Such price changes contribute to fundamental volatility.

When new information about changes in fundamental values is common knowledge, prices may change without any trading. For example, suppose that an unexpected killer frost descends upon Florida overnight. The morning news will undoubtedly report the event. The next day, orange juice futures contracts will open at a much higher price than the last price of the previous trading day.

When only a few people know new information about changes in fundamental values, prices generally will change on high trading volumes. The well-informed traders will trade on their information. The pressures their trades put on prices will cause prices to change to reflect the new fundamental values.

Since informed traders generally hurt dealers, and since dealers generally do not know when they trade with informed traders, dealers try to infer information about fundamental values from their order flows. The inferences that they make contribute to the adverse selection spread component introduced in Chapter 13 (Dealers). Price changes due to the adverse selection spread component thus contribute to fundamental volatility.

### **20.1.1 Fundamental Volatility Factors**

Any factor that determines the value of a trading instrument can cause the price of that instrument to change. For a commodity, the most important factors are cash market supply and demand conditions. Other important factors are interest rates and storage costs. For a bond, the most important factors are interest rates and the credit quality of the issuer. For a stock, the most important factors are quality of management, the values of the company's resources and technologies, the supply and demand conditions in its product markets and in its input markets, and interest rates. For currencies, the important valuation factors include national inflation rates, macroeconomic policies, and trade and capital flows. Unexpected changes in any of these factors generate fundamental volatility in the instrument.

### **20.1.2 Predictability**

Expected changes in fundamental factors generally do not change prices. Informative prices usually fully incorporate all available information about future values. Since people base their expectations on existing information, fully informative prices will already incorporate expected changes in fundamental factors. When the expected event occurs, it is not surprising, and it therefore should not cause prices to change. Only unexpected events cause fundamental price volatility. Consequently, the identifying characteristic of fundamental volatility in fully informative prices is unpredictable price changes. An unpredictable price process is called a random walk. Chapter 10 (Informed Traders and Market Efficiency) provides a more complete explanation of the properties of fully informative prices.

The one exception to this rule involves price changes that are necessary to compensate instrument holders for their carrying costs and for bearing risk. For example, the prices of zero-

coupon bonds creep upwards over time as they approach maturity. Since they pay no interest, investors buy them at substantial discounts to their face values. The creep in prices compensates them for the interest payments that they otherwise would have received had they invested in a straight bond. These creeping price changes are fully predictable and therefore do not contribute to fundamental volatility. Note, however, that if interest rates unexpectedly fall, the prices of zero-coupon bonds will immediately rise to reflect the new interest rates. This unexpected price change would contribute to fundamental volatility.

### 20.1.3 Storage Costs

Commodities that are expensive to store are often quite volatile. The high storage costs ensure that producers and distributors generally will not hold large inventories. When demand exceeds supply, buyers can quickly deplete inventories. Prices then spike up until new production can relieve the shortage. Conversely, when inventories are large and new product will soon arrive, distributors may greatly discount the inventory to make room for the newly arrivals.

Price volatility in high storage cost commodities depends on the time it takes to adjust the flow of product from the producers to the consumers. If the production pipeline is quite long so that adjustments take a long time, prices may be quite volatile.

Price volatility in high-storage cost commodities also depends on demand variation. When demand is highly variable, inventory imbalances may often occur. The production and distribution may be unable to adjust as quickly as the demand changes. For low storage cost commodities, inventories generally buffer mismatches in the rates of production and consumption so that prices are more stable.

Finally, price volatility in high-storage cost commodities also depends on whether people can easily do without them. If the demand is highly *inelastic*, people will demand approximately the same quantities at any price. Such goods often experience sharp price spikes when shortages develop.

#### **Gasoline, Diesel Fuel and Heating Oil Volatility**

Gasoline, diesel fuel, and heating oil are expensive to store because they require very large tanks. The available producer storage in the United States amounts to only 9 days of consumption of gasoline and 18 days of distillate fuels (heating oil and diesel fuel). Since the demands for these fuels are highly inelastic, unexpected fluctuations in demand caused by weather, refinery accidents, or changes in the economy often cause substantial variation in the prices of these commodities.

Source: Year 2000 consumption and refinery working storage capacity data obtained from the Energy Information Administration, US Department of Energy at [www.eia.doe.gov](http://www.eia.doe.gov).

*Perishable goods* are goods that become worthless if they are not used before they expire. The prices of perishable goods are often especially volatile because they cannot be stored indefinitely. Where a surplus of soon-to-perish goods exists, prices fall very quickly as their owners try to avoid a complete loss. If a shortage of perishable goods develops, prices may rise very quickly.



## Part VI

### Evaluation and Prediction

In the next two chapters, we consider how traders measure and predict portfolio performance. Traders need to monitor their performance so that they can determine what they are doing well, and what they are doing poorly. They then can better manage their trading. As a rule, you cannot manage what you cannot measure.

How well a portfolio performs depends on the instruments that are in the portfolio and upon the costs of constructing and maintaining the portfolio. The problem of choosing the best instruments to maximize portfolio performance is the *portfolio selection/composition problem*. The problem of implementing portfolio composition decisions is the *portfolio implementation problem*. Traders must obtain good solutions to both problems to perform well.

In practice, few profit-motivated traders consistently outperform the market. Most active traders lose because they trade too much and because they pay too much to trade. The costs of trading eventually overwhelm any informational advantages that they may have. Traders therefore must understand their trading costs.

In Chapter 21, we focus first on measuring and predicting implementation performance. For most traders, the portfolio implementation problem is easier to solve than the selection/composition problem. Because most traders cannot consistently outperform the market, the implementation problem is their more important problem. In Chapter 22, we consider why superior selection/composition performance is difficult to achieve and even more difficult to predict.

## Chapter 21

### Liquidity and Transaction Cost Measurement

Traders pay attention to their transaction costs because transaction costs make implementation of their trading strategies expensive. Transaction costs are most important to traders who trade frequently or who trade large sizes. For most active traders, transaction costs are the most significant determinants of their total returns. Speculators who perform poorly usually do so because their transaction costs exceed the values of their trading strategies.

Traders measure their transaction costs to evaluate how well they and their brokers have implemented their trading strategies. Traders must evaluate implementation to manage it effectively. They must know whether they have been trading too aggressively—or not aggressively enough—to optimize their order submission strategies. They also must know how well their brokers work on their behalf to decide which brokers should receive their orders in the future.

Traders also estimate future transaction costs to predict the costs of implementing various trading strategies. Clever strategies may not be profitable if the costs of implementing them are too great. Transaction cost prediction especially concerns large traders in illiquid markets. Their strategies may be profitable if implemented in small size, but the price impacts of implementing them in large size may cause them to lose on net.

Transaction cost measurement also interests exchanges, brokers, regulators, and investment sponsors for the following reasons:

- Exchanges conduct transaction cost measurement studies to document the quality of their markets. They use the results in their marketing efforts. They may also use them to evaluate their brokers, dealers, and specialists.
- Brokers conduct transaction cost measurement studies to document their performance. They use the results to identify their shortcomings, to market their firm's services, and to confirm that they obtain best execution for their clients. The last purpose is especially important when dealers pay brokers to route orders to them. Government regulations, exchange regulations, and common law require that brokers ensure that payment for order flow arrangements do not hurt their clients. Brokers therefore must regularly and rigorously examine execution quality to ensure the most beneficial terms for their customers' orders.
- Investment sponsors must ensure that they obtain value for the commissions that their investment managers spend on their behalf. The US Department of Labor requires that pension funds covered by the Employee Retirement Income Security Act (ERISA) recognize that trading commissions are fund assets that they must conserve. Fund trustees therefore conduct transaction cost measurement studies to determine whether their funds obtain appropriate value for their commissions.
- Regulators often try to promote policies that lower transaction costs. Regulators therefore conduct transaction cost measurement studies to characterize the performance of various market structures. The US Securities and Exchange Commission now requires that all market centers—exchanges, ECNs, and dealers—collect and publish highly disaggregated

data that traders can use to evaluate average execution quality for various order types and sizes.

We consider how to measure liquidity in this chapter. We will examine both retrospective and prospective measures of transaction costs. We consider first retrospective measures of transaction costs. We then consider how traders use information about past transaction costs to predict future transaction costs.

## **21.1 Transaction Cost Components**

Defining and measuring exactly what we mean by the term “transaction costs” is difficult. This entire book is about understanding what transaction costs are, where they come from, and how to measure them. We explore these questions in detail throughout this book.

For our present purposes, *transaction costs* include all costs associated with trading. These costs include *explicit costs*, *implicit costs*, and *missed trade opportunity costs*.

*Explicit transaction costs* are all costs that a cost accountant would easily identify. These costs include commissions paid to brokers, fees paid to exchanges, and taxes paid to government. Explicit transaction costs also include any resources that traders devote to the trading process. For example, the costs of setting up, staffing, and running a buy side trading desk are all explicit costs of trading.

*Implicit transaction costs* are the costs of trading that arise because traders generally have an impact upon prices. For example, traders who buy at asking prices and sell at bid prices pay the bid/ask spread when trading. The spread is an obvious and important cost of trading. Likewise, when large buyers push prices up and large sellers push prices down, the price impacts of their trading are transaction costs.

*Missed trade opportunity costs* arise when traders fail to fill their orders or when they fail to fill their orders in a timely manner. Suppose that a speculator wants to buy 100 cotton futures contracts at the New York Board of Trade when the price is 65 cents per pound. In an effort to obtain a good price, the trader submits a buy limit order with a limit price of 64.95 cents. The price of cotton subsequently rises to 68 cents, and the order does not execute. Had the trader traded more aggressively and filled the order at an average price of 65.25 cents, he would have made 2.75 cents per pound, or 1,375 dollars for each 50,000-pound contract. Because the trader failed to trade aggressively, he lost the opportunity to make 137,500 dollars. Traders need to keep track of their opportunity costs so that they can determine whether they are trading aggressively enough.

Explicit transaction costs are the most easily measured of the three types of transaction costs. Measuring them is a simple cost accounting exercise in which the analyst identifies and sums up all commissions, fees, and explicit expenses associated with trade process.

Implicit transaction costs and missed trade opportunity costs are harder to measure because they require some benchmark against which to compare trade and no-trade prices. To measure the price impact of a completed trade, analysts must estimate what prices would have been had the trade not taken place. To measure the opportunity cost of an uncompleted trade, analysts must estimate the average prices at which the trade would have taken place had it been completed. These estimation problems make transaction cost measurement a difficult and imprecise science.

## 21.2 Implicit Transaction Cost Estimation Methods

Traders estimate implicit transaction costs using *specified price benchmark methods* and *econometric transaction cost estimation methods*. The price benchmark methods are the most commonly used methods. They are easier to implement than the econometric methods and generally more useful when traders need to evaluate transaction costs for specific trades. The econometric methods are most useful for estimating average transaction costs for a whole market.

Most traders measure transaction costs relative to specific price benchmarks. The price benchmark provides a basis for determining whether buyers paid, and sellers received, good or bad prices.

When traders use a specified price benchmark, they estimate the per unit transaction cost as the difference between the trade price and the benchmark price. For a purchase, the estimated cost is the excess of the trade price over the benchmark price. For a sale, it is the opposite. They then multiply this difference by the trade size to obtain the estimated transaction cost:

$$\text{Estimated Cost} = \text{TradeSize} \times \begin{cases} \text{TradePrice} - \text{BenchmarkPrice} & \text{for a purchase} \\ \text{BenchmarkPrice} - \text{TradePrice} & \text{for a sale} \end{cases}$$

Estimated transaction costs thus are high when buyers pay high prices, and when sellers receive low prices.

Note that the estimated transaction costs for all buyers and sellers in a trade exactly sum to zero. Transaction cost to one side is trading profit to the other side. Traders who demand liquidity tend to pay transaction costs while those who offer liquidity have negative transaction costs.

### The Flip Side

Transaction costs concern everyone in the trading industry. Sell side institutions—brokers, dealers, and exchanges—try to sell low cost transaction services. Buy side institutions try to obtain transaction services at low cost. To a casual observer, it would appear that everyone wants low transaction costs.

Not so. Transaction costs to the buy side are revenues to the sell side. Sell side institutions would like their revenues to be as high as possible. They only market low cost transaction services because they compete with each other for buy side business.

These comments suggest that sell side institutions benefit from high transaction costs. While this might be true in the short run, it has not been true in the long run. Decreases in transaction costs have caused buy side traders to greatly increase the volume of their trading. The increased volume, coupled with substantial decreases in the costs of providing transaction services, have increased sell side profits even as buy side transaction costs have fallen.

For convenience, the difference between the trade price and the benchmark price is often called the *signed difference*, where the sign of the difference is understood to be one if the trade is a purchase and minus one if the trade is a sale:

$$\text{Estimated Cost} = \text{TradeSize} \times \text{TradeSign} \times (\text{TradePrice} - \text{BenchmarkPrice})$$

## Chapter 22

### Performance Evaluation and Prediction

Many people trade because they want to speculate successfully. They hope to profit by buying securities and contracts that will rise in value and by selling those that will fall.

Unfortunately for those of us who would like to get rich quickly, predicting future prices is quite difficult. Some people can do it, but most cannot. Successful speculators must predict future prices well enough to beat the market on average. Unsuccessful speculators eventually lose money when trading. At best, they make less money than they would have made had they simply bought and held index funds. If they trade only because they want to earn speculative trading profits, they should stop trading.

In this chapter, we consider how to measure past performance and how to predict future performance. The two questions are closely related. Most people measure past performance primarily because they want to predict future performance. We shall see why predictions based only on past performance generally are quite unreliable. We can predict performance better using other information.

You must be able to predict performance if you intend to speculate. Speculators trade only because they expect to profit. Successful speculators therefore must constantly consider whether their trades will be profitable. If you cannot predict whether you will trade profitably, you should not speculate. The most important decision speculators make is whether they should trade.

You also must be able to predict performance if you employ active investment managers to speculate on your behalf. *Active investment managers* speculate with their clients' money. They are *active*, as opposed to *passive*, because they actively try to identify and exploit speculative opportunities. Accordingly, they often trade frequently. You can hire their services by employing them as investment advisors or you can obtain their services indirectly by buying the mutual funds and commodity pools that they manage. In either event, when managers speculate on your behalf, you speculate on their success. To select good active investment managers, you must predict which ones will speculate successfully. If you cannot predict which managers will be successful, you should not employ active investment managers. The most important decision investment sponsors make is whether to employ active managers.

Investors who believe that they cannot speculate successfully often invest their money with passive investment managers. *Passive investment managers* use *buy and hold strategies*. They simply buy and hold securities. Passive managers therefore rarely trade. The most common buy and hold strategy is the index replication strategy. *Index replicators* buy and hold portfolios that they design to replicate the returns to a broad market index. We discuss how they do this in the next chapter (Index Markets).

Indexing is very popular because many investors have decided that they do not want to speculate. They do not believe that they would be successful traders, and they do not believe that they can pick successful managers. The limitations of performance evaluation and prediction help explain why index markets are so popular.

People often design investment management contracts so that the payments that investment managers receive depend on the performance they produce. Such contracts encourage investment managers to better serve their clients. You must appreciate the limitations of performance evaluation to understand how to best compensate investment managers and to understand the problems that arise in typical investment management contracts.

Our discussion begins with a discussion of the principal problem of discriminating between skill and luck. We then briefly consider the mechanics of performance evaluation. If you already know how analysts compute returns, and how and why they compare them to benchmark returns, you can skip this section. The discussion then turns to the problem of predicting performance. We consider first how statisticians approach the problem and explain why their approach is not very powerful. We then will consider alternative approaches to performance prediction based on economic theory.

By the end of this chapter, you will understand why past performance does not necessarily predict future returns. You will also understand how sample selection biases affect the inferences you may make about investment decisions. Failures to understand these issues probably account for more trading losses than any other mistakes traders make.

## **22.1 The Performance Evaluation Problem**

Portfolio performance depends partly on the quality of its management. Managers that perform well add value to their portfolios. Managers that perform poorly waste value.

Portfolio performance also depends on every factor that determines the values of the instruments in the portfolio. The factors may include macroeconomic, microeconomic, and firm-specific factors. Macroeconomic factors include changes in interest rates, general economic activity, productivity, and exchange rates. Microeconomic factors include industry supply and demand conditions, technological innovations, and government interventions. Firm-specific factors include a host of issues ranging from whether the firm is well managed to whether factories burn accidentally down to whether researchers make fortuitous discoveries.

Active managers try to foresee every factor that will affect values. They then buy those instruments that they expect will appreciate and sell those that they expect will depreciate. If they are very skilled, they will be able to add substantial value to their portfolios by selecting which instruments to buy and which to sell.

No one can anticipate most factors that affect portfolio returns. Unforeseeable factors therefore have a seemingly random effect on performance. Portfolios that perform well may be managed by skilled managers or by lucky managers. Likewise, poor performing portfolios may be managed by unskilled managers or by unlucky managers.

### **Sizzler Sick with *E. Coli***

Sizzler International is an operator/franchiser of family restaurants that specialize in grilled meats. Sizzler operates 65 company stores in the United States, and it franchises another 200 stores. In 1998, the company reorganized in a voluntary Chapter 11 bankruptcy. By the middle of 2000, its earnings were accelerating and many analysts, who had carefully studied the company and its future prospects, believed that it had a winning strategy for revitalizing the

chain. Based on their research, many investment managers bought Sizzler expecting that it would outperform the market.

They did not realize their expectations. In July 2000, the bacterium *E. Coli* infected 42 patrons of a Milwaukee Sizzler franchise. Seventeen were hospitalized and a three year-old girl died from complications resulting from the infection.

Eating undercooked meats, or food contaminated by raw meat, spreads the *E. Coli* infection. The Milwaukee Health Commissioner believed that eating contaminated watermelon spread the infection.

News about the outbreak was well publicized throughout the country. Following the announcement, Sizzler's stock fell 35 percent as investors feared the lawsuits and the lost reputation that would surely follow this tragic event.

The speculators who bought Sizzler may have been very well informed about its future prospects. They undoubtedly knew that food poisoning episodes occasionally plague restaurant chains, and they probably discounted Sizzler's stock—and those of other restaurant chains—accordingly. Some even may have considered whether Sizzler designed and implemented adequate sanitary procedures to appropriately control the risks that they faced. Despite all these considerations, the Sizzler *E. Coli* food poisoning episode probably was not predictable. These investors were simply unlucky.

The investment policies that govern many portfolios often have a substantial effect on portfolio performance. These policies may prohibit skilled managers from exploiting positive factors or from avoiding negative factors. They also may force unskilled managers to unknowingly exploit positive factors or avoid negative factors. Portfolios that perform well therefore may be managed by skilled managers or simply by lucky managers subject to investment policies that the market currently favors. Likewise, poor performing portfolios may be managed by unskilled managers or by skilled managers subject to investment policies that currently are out of favor.

For example, consider the performance of portfolios that must be fully invested in equity. These portfolios fluctuate in value with the market regardless of how management operates. When the market rises, even the worst managed portfolios may have high positive returns. A market rise can offset losses due to inept management. Likewise, when the market falls, the best-managed portfolios may have negative returns. A market fall can overwhelm gains due to superior management.

Unforeseeable factors and unavoidable factors greatly complicate the performance evaluation problem. These factors make it difficult to estimate the manager's contribution to portfolio performance. Good performance evaluations must discriminate between skill and luck. Analysts must break total performance into separate components representing the contribution due to management and the contribution due to factors that no one could anticipate or control.

The task of estimating the contribution of factors that no one could anticipate or control is very difficult because so many factors affect portfolio returns. Even the best estimates of manager performance are quite noisy. Discriminating between skill and luck as explanations for portfolio performance is very difficult.





## **Part VII**

### **Market Structures**

The final chapters of this book examine the economics of market structures. The topics we consider encompass many active regulatory debates.

In Chapter 23, we consider why index markets are organized as they are. Our discussion shows how uninformed traders benefit from trading indexes.

Chapter 24 examines the specialist trading system. Specialists are broker-dealers who supply liquidity and arrange trades at exchanges and at some proprietary trading firms. Exchanges, regulators, and their business models sometimes compel specialists to supply liquidity when they otherwise would not want to do so. To encourage them to offer such liquidity, they must receive some benefit from their unique positions.

The next three chapters examine how markets and dealers compete against each other for order flow. We examine internalization and order preferencing by dealers in Chapter 25, why markets consolidate and fragment in Chapter 26, and screen versus floor based trading in Chapter 27. We pay special attention to the problems that result when traders can trade the same instruments in different places.

Chapter 28 discusses the origins of extreme volatility. There we consider how market structures contribute to—and mitigate—volatility. We also consider whether markets should have circuit breakers to control excess volatility.

Chapter 29 considers the benefits and consequences of prohibiting insider trading. Interestingly, the most important issues involve labor economics rather than market microstructure.

## Chapter 23

### Index and Portfolio Markets

Index trading is one of the most important financial innovations of the twentieth century. The nominal dollar value of trading in equity index products now is greater than the total dollar value of trading in the underlying securities. The growth of index trading has had a profound effect on equity markets. It is also increasingly affecting debt markets.

*Index markets* trade index products. *Index products* include index futures contracts, index options contracts, and securities that represent ownership in index funds. *Index funds* are portfolios that their managers design to replicate the performance of various price indexes. Most index funds track market equity indexes. Some funds also track debt indexes and sector equity indexes.

Index products and index markets are extremely popular. Many people have decided that they would rather invest in an index product than risk losing money investing with an active investment manager. Index products also are attractive to speculators who want to speculate only on index risks or only on firm-specific risks. The former buy or sell index products to establish their speculative positions. The latter sell or buy index products to hedge the index risk in their long or short positions in individual securities.

The widespread use of index strategies has changed the character of markets. Index markets are far more liquid than the underlying cash markets upon which their products are based. Price changes in index products generally lead changes in the cash index. Consequently, many people believe that index markets are the “tail that wags the dog.” You must understand index strategies to understand the relation between index markets and their underlying cash markets.

In this chapter, we will briefly consider how indexes are computed, and how index funds are managed. We then will consider why index products and index markets are so popular. You may find this section particularly useful if you are unsure of whether you should invest or speculate in equities. The chapter closes with a discussion of the various ways that traders exchange index risks.

#### 23.1 Price Indexes

People use *price indexes* to characterize the values of lists of instruments. The instruments upon which a price index is based are the *index components*. The index components determine the character of the index. Indexes exist for entire markets, for subsets of a market, and for sets of markets. The instruments may be equities, debt securities, commodities, or currencies. Indexes that only include a small subset of market securities are *narrow indexes*. Narrow indexes have been defined for small and large securities, value and growth securities, industry sector securities, and securities of firms that do business in narrow geographic regions.

Most price indexes are proprietary products that exchanges, brokers, or data vendors compute. Although *index creators* sometimes sell their indexes, they also often offer them to their clients to promote their businesses. Many index creators also license their indexes to firms that base index products upon them.

All price indexes are essentially just averages of the prices of their index components. Indexes differ by the methods used to compute those averages. The two most common index types are price-weighted and value-weighted indexes.

A *price-weighted index* is proportional to the sum of the prices of the index components. The highest priced instruments therefore have the greatest influence over the values of price-weighted indexes. The Dow Jones Industrial Average (DJIA) and the Nikkei 225 Stock Average are the best-known price-weighted indexes.

### **The Major Market Index and *The* Major Market Index**

Dow Jones and Co. owns the Dow Jones Industrial Average (DJIA), which is a price-weighted index of 30 large US stocks. The list originally included only industrial stocks. It now includes some stocks in the finance and services sectors of the economy. The Dow 30 is the best-known US market index. It is *the* major market index.

For many years, Dow Jones refused to license the DJIA to options and futures exchanges that wanted to create contracts based upon it. The American Stock Exchange therefore created an index called the Major Market Index (MMI). The MMI is a price-weighted index of 20 blue chip stocks. Not coincidentally, most of the stock MMI stocks are also Dow 30 stocks. Changes in the MMI therefore are very closely correlated with changes in the DJIA. The American Stock Exchange trades options on the MMI using the ticker symbol XMI. They also licensed the index to the Chicago Mercantile Exchange, which traded futures on it.

In 1997, Dow Jones finally licensed the DJIA to the Chicago Board of Trade (CBOT) and to the Chicago Board Options Exchange (CBOE). The CBOT Dow Jones Industrials futures and the CBOE Dow Jones Industrials options contracts have been very successful. Both have killed their respective MMI competitors. The CME stopped trading their MMI contract in 1999. Although the AMEX MMI options contract continues to trade (as of December 2001), it no longer has significant open interest.

A *value-weighted index* is proportional to the total capital value of all index components. Traders therefore also call value-weighted indexes *capitalization-weighted indexes*. Securities with the highest capital value have the greatest influence over the values of value-weighted indexes. Most price indexes are value-weighted indexes. The S&P 500 Index is the best-known value-weighted index.

The value of an index is obtained by dividing the price or value sum by a constant *index divisor*. The divisor originally was a number that the index creator chose to ensure that the index started at an arbitrary initial value. Divisors now change only when necessary to ensure that the value of an index does not change when the creator adds or deletes index components, or, in the case of a price-weighted index, when a stock splits. For example, the divisor of a price-weighted index must increase when a high priced stock replaces a low priced stock. Otherwise, the change would unnaturally increase the value of the index. Likewise, the divisor of a value-weighted index must increase when a high capitalization stock replaces a low capitalization stock. The divisors of value-weighted indexes do not have to change when stocks split because splits do not change total capital values.

You may occasionally encounter *equal-weighted* and *geometrically weighted indexes*. *Equal-weighted indexes* measure the returns from investing an equal dollar amount in each index

component. The index values represent the cumulative returns to this hypothetical investment strategy. The best-known equal-weighted index is the CRSP (Center for Research in Security Prices) equal-weighted market index. It is used primarily in academic research. *Geometrically weighted indexes* average logarithmic returns rather than prices. The Value-Line Geometric Index is a value-weighted index of logarithmic returns.

A price index is *dividend-adjusted* if it is adjusted upwards when securities pay dividends. Traders also call dividend-adjusted indexes *total return indexes* because they measure the total return—capital gains plus income yield—that investors would receive if they could invest in the index without any transaction costs. People generally use total return indexes as benchmarks against which they measure the performance of their portfolios. The DJIA and the S&P 500 Index are not dividend-adjusted indexes. Corresponding total return indexes for these two indexes, however, are widely available.

### 23.2 Index Funds

An *index fund* is a portfolio that *index managers* design to replicate the performance of an index. *Tracking error* is the difference between the portfolio return and the corresponding dividend-adjusted index return. Index fund managers try to minimize their tracking errors. Most US index funds try to replicate the S&P 500 Index, although other indexes are becoming increasingly popular.

#### They Each Manage about 3 Percent of All World Equity

Barclays Global Investors is the world's largest index fund manager. As of December 2000, the firm had 571 billion dollars under management in various US and international equity index funds. (The firm had 802 billion dollars of assets under management counting all asset classes.) By comparison, total world traded equity market capitalization was then approximately 31 trillion dollars. Counting only index funds, Barclays Global Investors manages a bit less than 2 percent of all traded equity in the world.

The world's largest equity manager is Deutsche Asset Management which manages about 1 trillion dollars worldwide in many subsidiaries.

Sources: [http://www.barclaysglobal.com/about/who\\_we\\_are/assets\\_rankings.jhtml](http://www.barclaysglobal.com/about/who_we_are/assets_rankings.jhtml);  
<http://www.fibv.com/publications/Ta1300.pdf>

Replicating a value-weighted equity index is quite simple. If the value of the index fund is 0.01 percent of the total capitalization of all the index components, the index fund manager simply buys 0.01 percent of the outstanding shares of each index component. The value of the fund therefore is exactly proportional to the total value of all index components, which is proportional to the value of the value-weighted index. Consequently, percentage changes in these three quantities will be identical. Index managers must rebalance a value-weighted portfolio only when the list of index components changes. Otherwise, the fund simply holds its securities.

Replicating a price-weighted equity index is equally simple. The index fund simply holds an equal number of shares in each index component. The value of the portfolio therefore is proportional to the sum of the prices of the index components, which is proportional to the price-weighted index. Percentage changes in these three quantities therefore will be identical. Index

## Chapter 24

### Specialists

Some exchanges assign special responsibilities to members they designate as specialists. The *specialists* must continuously quote two-sided markets so that markets always exist in their *specialties*. They must also ensure that their markets are orderly and that prices do not jump too quickly.

Exchanges that designate specialists have *designated primary market maker trading systems*, or more simply, *specialist trading systems*. The largest equity exchange that designates specialists is the New York Stock Exchange.

Exchanges with specialist trading systems believe that their specialists enhance market quality and thereby attract traders to their exchanges. They believe that continuous and orderly markets increase investor confidence so that investors are more willing to invest in the exchanges' listed companies. By attracting investor interest, these exchanges encourage issuers to list their securities with them. The exchanges thereby obtain greater revenues from *listing fees* and *transaction fees*, and their members make greater profits as brokers and dealers.

In this chapter, we describe the various obligations that exchanges impose upon their specialists. We show how these obligations often require that specialists trade when they do not want to trade and refrain from trading when they do want to trade. Specialist obligations therefore can be quite costly to specialists. To encourage traders to accept these obligations, exchanges give specialists various trading privileges. We describe these privileges and explain how specialists profit from them. To prevent abuses of these privileges, exchanges also impose restrictions on when specialists may trade.

Although all traders appreciate the liquidity that exchanges obligate their specialists to provide, many traders resent that they have special privileges. The special privileges can be quite valuable to specialists and hence costly to other traders. The specialist trading system therefore is the subject of regulatory controversy. Regulators must consider whether the value that specialists obtain from their privileges is commensurate with the value of the services that they provide. The traders who benefit when specialists fulfill their obligations usually are not the same traders who are hurt when specialists exercise their privileges. Regulators therefore also must consider whether the resulting transfers of wealth among traders are appropriate.

You must understand the specialist trading system if you trade at exchanges that employ such systems. At such exchanges, the execution of your orders will somehow involve specialists. They may act as your broker, they may act as dealers and fill your orders for their accounts, or they may conduct the auctions in which brokers match your orders to other traders' orders. You will make better trading decisions when you understand how specialists handle your orders.

You also must understand the specialist trading system to understand how markets compete with each other. The liquidity services that specialists offer are *public goods* in the sense that everyone benefits from them. Unfortunately, public goods are hard to obtain in competitive markets. Few people will pay for them when they can freely obtain them. Regulators who value the liquidity that specialists offer must therefore carefully consider how markets compete with each other. We introduce these issues at the end of this chapter and expand upon them when we consider how markets compete with each other in Chapter 26.

Finally, you must understand the specialist trading system to responsibly consider whether floor-based exchanges that use specialist trading systems should convert to screen-based trading systems. Although exchanges can build a screen-based specialist trading system, many issues make such a structure unlikely. Analyses of conversions to screen-based trading therefore should consider the benefits lost and the costs saved if the specialist trading system were scrapped. This chapter will help you identify these benefits and costs.

Specialist trading systems differ across exchanges. The distinguishing characteristic of these systems is that they impose obligations on dealers to supply liquidity. The obligations vary, however. Most exchanges restrict the trades that specialists can do, but some do not. This chapter provides a general discussion of the principal economic and regulatory issues that arise in connection with all designated primary market maker trading systems. These issues are common to all variants of these systems. The examples that we will consider to illustrate these principals, however, are specific to the specialist trading systems that the New York and the American Stock Exchanges use.

## 24.1 Overview

Specialist trading systems are found primarily at US stock and options exchanges. Some markets in other countries also use them. The specialist trading system is most important at the New York and American Stock Exchanges. The US regional stock exchanges also have specialist trading systems, but most regional specialists are more like third market dealers than primary stock exchange specialists. The equity options markets organized by the Chicago Board Options Exchange (CBOE), the American Stock Exchange, the Pacific Exchange, and the Philadelphia Stock Exchange also use specialist trading systems.

Specialists are known by different names in various markets. The CBOE calls its specialists *designated primary market makers*. The Deutsche Börse calls its specialists *designated sponsors* in English and *betreuers* in German. At the Paris Bourse, they are known as *animateurs*.

Third market dealers also often call their traders specialists. The business models of these firms often obligate their traders to offer liquidity when they otherwise might not want to do so. These obligations are voluntary, however. The dealers propose and accept them as conditions for obtaining order flow from brokers. The NASD, the SEC, and some court decisions restrict the trades that these dual traders can do. These restrictions, however, usually are not as severe as those that exchanges impose upon their specialists.

Most specialists are dual traders who sometimes broker orders for their clients and other times fill orders for their clients from their own inventories. Exchanges that permit dual trading generally employ many regulatory safeguards to solve the resulting conflict of interest problems introduced in Chapter 7 (Brokers). Specialists therefore are subject to many regulations.

Exchanges with specialist trading systems usually assign only one specialist to each stock or options class. We will discuss below how they make these assignments.

Some exchanges use a *designated multiple market maker trading system* for trading their securities. These systems are similar to specialist systems except that the exchanges obligate multiple traders to offer liquidity that they otherwise might not want to offer. These obligations are best enforced in electronic markets because traders in open outcry markets will hide when

they do not want to trade. When nobody wants to trade, a computer usually assigns the obligation to trade in rotation to each of the designated market makers.

The CBOE uses a designated multiple market maker trading system for its most actively traded index options series. Unlike most specialists, their designated market makers are not dual traders. They deal only for their account, and they do not broker agency orders. Like specialists, the market makers have some obligations to provide liquidity when markets are not trading normally. Similar structures appear at some European options exchanges and at some futures exchanges.

The number of stocks or option classes that each specialist trades depends on how actively traded the instruments are. Specialists who specialize in very actively traded securities usually trade only one security or options class. Those who specialize in less frequently traded securities trade larger lists. Most specialists trade only a few securities. For example, most of the 482 individual specialists at the New York Stock Exchange trade between three and six stocks each. They usually have one actively traded security and a few less actively traded ones.

Most specialists work for firms that employ many specialists. In December 2001, only eight firms employed all specialists at the NYSE. Five of these firms handled stocks representing 95 percent of all the NYSE dollar volume.

Specialists play three roles in most markets. They are dealers when they trade for their own account. They are brokers when they broker orders and trades for other brokers. Finally, they are exchange officials who are responsible for conducting orderly markets. We consider these three main roles in the next three sections.

## **24.2 Specialists as Dealers**

Specialists act as dealers when they trade for their own accounts. Exchanges greatly regulate the trading that specialists can and must do for their own accounts.

Two sets of regulations govern specialist trading. *Affirmative obligations* obligate specialists to offer liquidity in various circumstances. *Negative obligations* prevent them from trading in other circumstances. Specialists accept these obligations because they enjoy the various privileges that come with them.

### **24.2.1 Affirmative Obligations**

The specialists' primary affirmative obligation is to ensure that a reasonable market always exists in their specialties. When no one else is willing to trade, specialists must be willing to trade. They must quote two-sided markets when no one else will, and their quotes must be meaningful in the sense that the spread between the best bid and the best offer cannot be too wide. Since specialists must often trade when no one else is willing to trade, they are often the *traders of last resort*.

Their obligation to make markets is limited, however. Specialists do not have to make firm quotes for large block sizes, and they are not required to support prices when values are falling or restrain prices when values are rising. They simply have to ensure that public traders can always trade some meaningful quantity.

## Chapter 25

### Internalization, Preferencing, and Crossing

Dealers *internalize* orders when they fill their clients' orders. Brokers *prefer* orders when they route their clients' marketable orders to dealers in exchange for various monetary or nonpecuniary *payments for order flow*. Brokers also prefer when they route their clients' limit orders to electronic communications networks (ECNs) that pay them *liquidity fees* when standing limit orders execute. Brokers *cross* orders internally when they arrange trades among their clients.

Internalization, order preferencing, and internal order crossing all arrange trades away from organized markets. Traders say that these practices *fragment* the markets.

Internalization, preferencing, and crossing practices raise important regulatory questions. Most notably, clients and regulators wonder whether brokers who engage in these practices meet their obligations to obtain best execution when filling their clients' orders. Less obviously, traders and regulators wonder whether these practices hurt markets by making it more difficult for traders to find each other. All three practices decrease order transparency. Many people wonder whether the markets would be better off with a single consolidated limit order book to which brokers would send all orders.

In this short chapter, we discuss the issues that underlie these processes. We shall see that internalization and preferencing may benefit small market order traders. The practices generally harm limit order traders, however. Internal order crossing tends to benefit crossing brokers and their clients at the expense of traders with whom the clients might have otherwise traded.

Internalization, preferencing, and crossing affect all markets in which traders can trade away from a central exchange. These practices have attracted the substantial attention in US equity markets. The attention undoubtedly comes from the high volumes traded in these markets, the high degree of transparency in these markets, and the ease with which traders and regulators can compare dealer and public auction markets that simultaneously trade similar securities. Most of the discussion that appears in this chapter therefore draws on examples from US markets. The forces that cause internalization, order preferencing, and internal order crossing, however, are present in all markets. If you understand how these forces work in US equity markets, you will be able to identify them in all other markets.

We start by discussing best execution and the effects of internalization and preferencing on commissions. We then discuss the anticompetitive aspects of internalization and preferencing. The chapter ends with a short discussion about issues associated with internal order crossing.

#### 25.1 Best Execution Practices

Brokers who internalize and accept payments for order flow have a significant conflict of interest that concerns clients and regulators. Brokers address these concerns by trying to provide *best execution* to their clients. Brokers provide best execution when they ensure that their clients' orders quickly fill at the best available prices.



Definitions of best execution are controversial because determining whether dealers fill orders at the best available prices is difficult. It is especially difficult when willing traders do not display their orders and quotes.

Definitions of best execution are also controversial because price is only one dimension of execution quality. Traders value speed of execution as well as price. The relative importance of speed and price depends on order type. Market order traders are primarily concerned about speed whereas limit order traders are most concerned about price. All traders, however, value both dimensions and accept reasonable tradeoffs between speed and price.

Brokers and the dealers to whom they preference orders have created a standard set of order handling practices that they claim assures best execution if followed. You may disagree. The procedures vary by order type.

In US equity markets, dealers claim that they provide best execution when they fill marketable orders at the national best bid or offer (NBBO)—the best bid or offer quoted by any other dealer or limit order trader. This standard applies only to marketable orders that are smaller than the total displayed quotation size at the best price. Best execution for larger marketable orders is harder to define because undisclosed size might also be available at the best price. To attract order flow, some dealers guarantee to brokers that they will always fill orders at the BBO up to a specified maximum size, regardless of the size displayed in the market.

In some markets, small market orders often trade at better prices than the best quoted price. In such markets, brokers must obtain average rates of *price improvement* for small market orders to ensure best execution. Dealers who fill their orders generally use complex algorithms to provide price improvement given various market conditions. These algorithms often expose an order to the market at an improved price. If anyone trades anywhere at that price, dealers then fill the order at that price.

### **The Primex Auction System**

The Primex Auction System allows participants to expose their marketable orders to an electronic crowd of traders who may offer improved prices. The Nasdaq Stock Market operates the system as a facility under an agreement between Nasdaq and Primex Trading.

Several large financial services firms, which have very large dealing operations, own Primex Trading. They include Bernard L. Madoff Investment Securities, Goldman Sachs, Merrill Lynch, Morgan Stanley Dean Witter and Co., and Salomon Smith Barney.

Source: [www.primextrading.com](http://www.primextrading.com)

Best execution standards for standing limit orders are also difficult to define. Since standing limit orders typically execute at their limit prices, brokerage clients are most concerned about whether and when their orders execute. Best execution for orders that are not marketable upon submission therefore depends on whether and when they execute.

In markets that match public orders to public orders, best execution standards for standing limit orders are especially difficult to define. Clients generally expect that their brokers will represent their orders wherever they have the highest probability of executing. Brokers who internalize their agency orders or who preference them to dealers must ensure that they execute at least as

soon as they would otherwise execute in the primary markets. Many dealers who accept limit orders have *limit order price protection* procedures to provide this standard of best execution.

### **Best Execution of Limit Orders by Third Market Dealers in NYSE-listed Stocks**

Many third market dealers who accept agency limit orders for NYSE-listed stocks use some version of the following algorithm to provide best execution for limit buy orders. They use similar procedures for limit sell orders.

If the limit order bids a better price than the dealer is bidding, the dealer will adjust his bid to reflect the limit order price and size. If the two prices are the same, but the limit order bids for more size than does the dealer, the dealer will increase his bid size to the order size.

While the limit price matches the best bid in the market, the dealer will match any marketable sell orders that he receives with the limit buy order. If a trade occurs anywhere at a price below the limit order price, the dealer will fill the limit order for his own account at the limit price. The dealer may fill all of the order, or just the size of the trade that occurred below the limit order price.

When the limit order price is first equal to the best bid in the market, and the NYSE quote is also at the best bid, the dealer will record the size of the NYSE bid. If the NYSE bid is behind the best bid, the dealer will record zero NYSE size. He then will count volume traded everywhere at the limit price. When that total volume exceeds the recorded NYSE size, the dealer will execute the limit buy order for his own account.

The dealer also may place a limit order into the NYSE specialist's limit order book at the same price. If the NYSE order fills, he will fill his agency limit order. If he fills the agency order first, he will immediately cancel the NYSE order. By placing the NYSE order, he ensures that he will obtain no worse execution for the agency order than it would have received had it gone to the NYSE. He can also query the SuperDot order routing system for the size ahead of the order.

The fact that dealers pay for marketable orders suggests—but does not necessarily imply—that they could provide better execution services than they do. In particular, dealers may not be providing as much price improvement for marketable orders as they might. They may also be extracting too much option value from standing limit orders that brokers often force them to accept as a condition of receiving marketable orders. If brokers demanded more price improvement and better limit order executions, dealers would pay less for their preferenced order flows.

To fully understand how payments for order flow affect retail traders, we must consider more than just that the payments exist. We also must consider how those payments are determined, and what effect those payments have on retail brokerage commissions. The next subsection describes the economic factors that determine payments for order flow, and how they affect brokerage commissions.

## **25.2 The Economics of Best Execution**

We start our discussion with a well-known property of all competitive markets. In *perfectly competitive markets*, nobody earns profits in excess of a fair rate of return on their dedicated resources. Perfectly competitive markets arise when suppliers with identical cost functions can

## Chapter 26

### Competition within and among Markets

In the last few years, many exchanges, brokers, electronic communications networks (ECNs), and dealers have created innovative trading systems to provide traders with better services at lower costs. The competition among these *market centers* is significantly changing how all markets operate, and the pace of change is accelerating.

The competition among market centers has some worrisome consequences, however. The proliferation of market centers is fragmenting the markets. Buyers and sellers often are in different places so that they may have trouble finding each other. Their transaction costs therefore may be higher than they would be if all traders traded in the same place. The benefits of competition among market centers may be offset by the increased costs it creates for traders who are searching for the best price.

#### Where Is the Market for AOL?

AOL Time Warner common stock trades in each of the following market centers:

- The New York Stock Exchange, its primary listing market.
- All US regional exchanges: The Boston, Chicago, Cincinnati, Pacific, and Philadelphia Exchanges.
- Most ECNs and alternative trading systems (ATSS). The most important of these are Island, Instinet, REDIBook, Archipelago, Bloomberg Tradebook, BRUT, and POSIT.
- The third market and Nasdaq. Bernard Madoff Investment Securities and Knight Capital Markets are the largest dealers in these markets.
- The upstairs block trading market.
- Some large foreign stock exchanges.

The risk in AOL common stock also trades in the following derivative contract markets:

- US options exchanges all trade AOL stock options contracts cleared by the Options Clearing Corporation. These include the Chicago Board Options Exchange, the American Stock Exchange, the Pacific Exchange, the Philadelphia Stock Exchange, and the International Securities Exchange.
- Futures contracts on AOL common stock shares trade at several exchanges.
- Many large investment banks will write individually tailored synthetic derivatives contracts in AOL for their clients.

A market in which people can trade essentially the same thing in different market centers is a *fragmented market*. A market in which all traders trade in the same market center is a *consolidated market*.

Regulators and practitioners wonder whether markets should be consolidated or fragmented. Regulations can produce either alternative. Most futures markets are fully consolidated, as are some national stock markets.

The issue is quite complicated. The competition among traders to obtain the best price works best in consolidated markets. The competition among market centers to provide low cost services to traders, however, implies fragmented markets. The two competitions therefore are inconsistent with each other. Any reasonable attempts to address competitive issues must consider why market fragmentation occurs, and what are the benefits and costs of market diversity.

### **Slogans Don't Help**

All languages promote wisdom with slogans. Slogans, however, will not resolve debates on market structure. For example, “United We Stand, Divided We Fall” suggests that consolidated markets are good, but “Strength through Diversity” suggests that fragmented markets are good. When applied to market structure, these two slogans promote the two different competitions that take place in the trading industry. The first slogan promotes the competition of traders to find the best price while the second promotes the competition among market centers to provide the best services.

In this chapter, we consider the economic forces that cause markets to consolidate and to fragment. Our discussion starts with a short description of how technology has changed trading markets. This part presents the technological context of the main issues. The economic analysis starts with a discussion of why markets consolidate. We then consider why markets fragment, and how fragmented markets coalesce into segmented markets. Finally, we address the public policy problems related to externalities among market segments.

## **26.1 Trading Systems and Technology**

New trading systems have proliferated largely due to advances in communications and computing technologies. New communications technologies have given traders instantaneous presence in markets that they formerly could not attend. Traders no longer need to be on an exchange floor to know what is happening there or to trade effectively. Instantaneous market data reporting systems and order routing systems now allow traders anywhere in the world to see and act upon opportunities wherever they occur.

### **From Dispatch Messenger to ECN**

In the beginning, markets reported some trade prices—and almost no quotations—by dispatch messengers. They usually traveled by horseback and ship. Later they reported prices by carrier pigeon, semaphore, telegraph, telex, and telephone. Now most organized markets continuously report all trade prices and all quotations as they occur via dedicated communications systems run by computers. Information that once moved at equine speed now moves at the speed of light.

Likewise, traders once made all trading decisions themselves and brokers once arranged all trades manually. Now computers commonly make and implement trading decisions while dedicated exchange, ECN, broker, and dealer trading systems arrange trades automatically.

New computing technologies have allowed market centers to organize sophisticated algorithm-based order-matching systems that would be impossible to implement by hand. These systems

provide traders with complex order management tools that permit traders to more effectively solve their trading problems. Examples of such features include systems that

- display orders only to traders who commit to filling them,
- ensure that a trader buys and sells equal dollar values,
- ensure an order that is part of a larger strategy will fill only if all orders in the strategy fill,
- allow traders to submit orders with limit prices indexed to market conditions, and
- substitute orders in one instrument for orders in another instrument based on market conditions.

Trading systems that incorporate these features use complex rules to treat all traders fairly subject to various constraints. They could not be implemented without the assistance of a computer. New computing technologies therefore have allowed markets to develop new applications that formerly would have been economically infeasible.

### **The OM SAXESS Trading System**

OM Gruppen of Stockholm sells and operates exchange trading systems. Their SAXESS system allows traders to submit various types of contingency orders: combination orders, linked orders, stop loss orders, block orders, and balance orders. The algorithms necessary to provide these services are quite complex because the execution of some orders is contingent on the execution of other orders.

Source: <http://www.omgroup.com/>

Even when clerks can effectively operate a trading system by hand, they are not as cost effective as are computers. New computing technologies therefore have allowed market centers to lower the costs of existing services in addition to providing new services.

#### **26.1.1 A Very Short History of Fragmentation and Consolidation**

In the beginning, most trading occurred on the trading floors of regional exchanges. Professional traders wanted to belong to these exchanges because only by being on these floors could they learn about market conditions and access trading opportunities. Nonmembers traded through member-brokers because that was the only way they could trade in these markets. Although no single market structure can simultaneously best serve the needs of all traders, most traders traded at exchanges because everyone traded there.

Trading in many instruments fragmented across regional exchanges because impatient traders would not send their orders to distant exchanges. These traders incurred high transaction costs to compensate dealers who moved liquidity through time and arbitrageurs who moved liquidity from market to market. Wide arbitrage spreads reflected the high costs of obtaining information and acting upon it across large distances.

When new communications technologies reduced the costs of transmitting market information and orders, regional exchanges consolidated to form large international markets. Where permitted, many alternative trading systems operate on the periphery of these markets. These systems provide special services to traders whose needs vary substantially. Arbitrageurs ensure that prices in all systems reflect market conditions throughout the world.

## Chapter 27

### Floor versus Automated Trading Systems

Advances in communications and computing technologies now allow exchanges to completely automate their trading systems. Many exchanges have done so and many brokers, ECNs, and dealers have created automated trading systems.

Despite these developments, many of the most liquid exchanges in the world still employ floor-based trading systems. The New York Stock Exchange, the Chicago Board of Trade, the Chicago Mercantile Exchange, the New York Mercantile Exchange, and almost all US options exchanges primarily use floor-based trading systems. Although traders on their floors now rely extensively on electronic systems to route orders and report confirmations, they still arrange trades essentially as they did when these markets first started.

If the floor-based market structures at these exchanges encourage traders to offer liquidity, eliminating their floors would be foolish. However, if other reasons account for the liquidity in these markets, switching to electronic trading may be desirable.

When floor-based trading systems and electronic trading systems compete head-to-head with each other, the results have been mixed. During the 1980's, the London Stock Exchange was the most important market for large French stocks. In 1989, the Paris Bourse introduced an automated electronic trading system. Since then, much of the trading in French stocks migrated from London to Paris. More recently, the electronic German DTB futures exchange wrested trading in German T-bond futures from the floor-based London International Financial Futures Exchange (LIFFE). Neither example, however, provides definitive evidence for or against floor-based trading because other events have also influenced the outcomes. The market share of the Paris Bourse grew following the 1994 repeal of a French transaction stamp tax which traders formerly avoided by trading in London. Likewise, the German T-bond futures contract moved from LIFFE to DTB in response to a coordinated effort by German banks to repatriate their market.

In contrast, brokers, dealers, exchanges, and ECNs have created many automated systems for trading NYSE stocks and US equity options. Some of these systems have been notably successful. Optimark—discussed in the previous chapter—failed spectacularly. The Arizona Stock Exchange proved to be a disappointment to people who believe that markets would benefit from electronic call markets. Instinet, Archipelago, and Island ECN have not taken substantial market share from the New York Stock Exchange despite their tremendous success competing against the electronic Nasdaq Stock Market. The electronic International Securities Exchange obtained a 16 percent share of US equity option trading in the issues it trades, within 18 months of its 2000 launch. However, it has not yet displaced the traditional floor-based options markets. The most successful electronic competitors to the NYSE have been third market dealers, like Bernard L. Madoff Investment Securities and Knight Capital Markets. Their automated trading systems provide very quick service primarily to retail traders represented by discount brokers.

Floor-based oral auctions and automated rule-based auctions are very similar. Both are order-driven markets that match buy orders to sell orders using very similar rules. Their primary difference lies in the technologies they use to arrange these matches. Traders in oral auctions

arrange trades by personally exchanging information among themselves whereas in automated markets, computers arrange the trades.

Since the two market structures are so similar, exchange officials, regulators, and traders naturally consider which is best. There is no simple answer. Both structures have strengths and weaknesses.

### **The Bangladeshi Stock Exchange and the New York Stock Exchange**

In 1999, the Bangladeshi Stock Exchange replaced its trading floor with an automated trading system. At the same time, the New York Stock Exchange considered where to build a new trading floor.

The continued commitment of the New York Stock Exchange to its trading floor may be its most important decision at the turn of the millennium. The members and officers of the Exchange are fully aware of its significance. They believe that the tremendous success of the NYSE is due in large part to its floor-based market structure. They also know that they may lose much, if not all, of their franchise if they are wrong.

In this chapter, we consider the arguments for and against these two trading structures. Our discussion examines how they differ in fairness, convenience, capacity, speed, efficiency, and cost.

## **27.1 Fairness**

Two concepts of market fairness concern traders. Traders want their markets to operate fairly, and they want fair access to those markets. In *operationally fair markets*, trading rules are uniformly applied, and no cheating occurs. In *fair access markets*, all traders have an equal chance to take advantage of any opportunities that arise.

### **27.1.1 Operational Fairness**

Many traders believe that automated trading systems are the fairest of all market structures. Automated systems do only what they are programmed to do. They implement their trading rules exactly and without exception. They expose orders only as instructed, and only to those traders to whom the system permits orders to be exposed.

In contrast, fairness in oral auctions depends on the skill and honesty of the traders who arrange the trades. Traders must be highly skilled to follow the trading rules faultlessly when the market is active, and when prices are moving quickly. They must honestly follow those rules even when doing so may cause them to lose an advantage.

Although most oral auctions are quite fair, all oral auction markets have suffered from well-documented trading scandals. These scandals usually involve front running, inappropriate order exposure, fraudulent trade assignment, or prearranged trading by dishonest brokers.

Although these problems can also arise in automated markets, they cannot take place within their automated trading systems. Instead, dishonest brokers must conduct their frauds on the side.

Markets prevent these frauds by having officials supervise trading, by investigating suspicious trading practices reported by honest traders, and by maintaining—and reviewing—reliable audit

trails. An *audit trail* records the submission and disposition of every order. Good audit trails include detailed information about everything that happens to each order. Regulators use audit trails to determine whether traders have violated trading rules. An accurate audit trail helps keep brokers honest.

Floor-based markets have extensive rules that govern how traders process orders and record trades. Markets design these rules to make the audit trail complete, reliable, and accurate. These rules require traders to time-stamp their orders when they receive them and when they fill them, to record trades sequentially, and to report trades immediately.

Automated trading systems easily produce complete and flawless audit trails of all activity that takes place within their systems. Many traders and regulators especially like these systems for this reason.

### What Would You Think?

Eli needed to roll a 10-contract short futures position in the Dow Jones Industrial Average Index futures from the June to September contracts. Via the Internet, he submitted a spread order to buy 10 June contracts and sell 10 September contracts with a limit of 75, premium to the sell side. The DJIA index futures contracts trade in a pit on the floor of the Chicago Board of Trade.

About a half hour later, Eli queried his broker's Internet site and discovered that he bought the June contracts for 11,060 and sold the September contracts at 11,130. The 70-point difference was less than the 75 points that Eli specified.

Since the nominal size of the DJIA contract is 10 times the Dow index, each point is worth 10 dollars per contract. For ten contracts, the five-point difference between the reported spread and the limit represents 500 dollars.

Eli naturally called his broker and inquired about the discrepancy. Since the broker did not follow his instructions, Eli could have refused to accept the trade, or he could have demanded that his broker make up the difference. The sales broker who answered the phone asked him to hold the line while she called the floor to inquire about the problem. One minute later, she reported that the floor incorrectly reported the trade price of the sale. She said that the September contract actually sold for 11,137 so that the spread trade occurred at 77 rather than 70. Eli was pleased with the result.

What really happened? Consider the following four alternatives:

- A. Somebody incorrectly reported the trade, most probably due to a typo or a transcription error. Had Eli not reported the discrepancy, someone would have noted it later, and the broker would have properly adjusted Eli's account.
- B. Somebody incorrectly reported the trade. Had Eli not reported the discrepancy, the broker might have pocketed the difference.
- C. The floor trader executed the trade incorrectly by mistake. The trader or Eli's broker made up the difference and added two points to keep Eli happy.
- D. The floor trader intentionally executed the trade incorrectly and hoped that Eli would not notice the mistake. The trader or broker made up the difference and added two points to keep Eli happy.



## Chapter 28

### Bubbles, Crashes, and Circuit Breakers

Bubbles and crashes occur when prices greatly differ from fundamental values. The wealth that these events create, destroy, and redistribute is often enormous. Bubbles and crashes thus are quite scary when prices change quickly.

Extreme volatility concerns many people:

- Traders pay close attention to it because large unexpected price changes expose them to tremendous risks and opportunities.
- Clearinghouses worry about extreme volatility because traders who experience large losses may be unable to settle their trades or contracts. Clearinghouses and their members must bear the costs of resulting settlement failures.
- Exchanges and brokers plan for extreme volatility because extreme price changes usually generate—or are generated by—huge volumes that can overwhelm their trading systems and cause them to fail. Large sustained price drops especially concern them because trading volumes usually shrink substantially and remain low for a long time afterwards.
- Microeconomists fret over extreme volatility because very large price changes often appear inconsistent with rational pricing and informative prices. They wonder whether excess price volatility causes people to make poor decisions about the use of economic resources.
- Macroeconomists fear that the wealth effects associated with large, broad-based changes in market values may adversely affect the investment and consumption spending decisions that companies and individuals make. Poor spending decisions can cause unsustainable booms and protracted contractions in economic activity.

These concerns explain why market regulators regularly examine trading practices and trading rules that might induce or attenuate extreme volatility. Some policies that they consider can create markets that are more resilient. Other policies have little value, and many policies can harm the markets. Regulators therefore must carefully analyze how market structure affects volatility before adopting new policies.

In this chapter, we consider what causes extreme volatility, and how regulations might make it less likely or less dangerous. Not surprisingly, analysts generally understand the causes of extreme volatility better after the fact than beforehand. Volatility episodes rarely have common causes. They do, however, tend to fit a common pattern. Traders who can recognize conditions that may lead to extreme volatility can take positions that are highly profitable. Regulators who can recognize these conditions can occasionally adopt policies to reduce the harmful aspects of extreme volatility.

We start our discussion by distinguishing among the types and causes of extreme volatility and then illustrate these points by considering several examples of bubbles and crashes. We next examine how changes in market structure can affect extreme volatility. Finally, we briefly consider how politics affect regulatory policies taken in response to extreme volatility.

## 28.1 Bubbles and Crashes

*Bubbles* occur when prices rise to levels that are substantially above fundamental values. (Fundamental values, of course, are not common knowledge. If they were, crashes and bubbles would not occur.) Some bubbles occur very quickly. Others occur over long periods. Many bubbles end with a crash. Traders say that such bubbles pop.

*Crashes* occur when prices fall very quickly. Crashes often follow bubbles, but they also occur in other circumstances. Crashes sometimes are called *market breaks* because the price path breaks when prices fall very quickly. They also are called *market meltdowns* when they overload the order handling capacity of a market.

Bubbles and crashes may affect an individual trading instrument or many instruments at once. Those that simultaneously affect many instruments are *broad-based events* or *market-wide events*. Very large price changes most commonly affect only an individual instrument. Broad-based bubbles and crashes are quite rare.

### 28.1.1 Typical Bubble and Crash Dynamics

Bubbles start when buyers become overly optimistic about fundamental values. The potential of new technologies and the potential growth of new markets can greatly excite some traders. Unfortunately, many of these traders cannot recognize when prices already reflect information about these potentialities. They also may not adequately appreciate the risks associated with holding the securities that interest them. If enough of these enthusiastic traders try to buy at the same time, they may push prices up substantially.

The resulting price increases may encourage momentum traders to buy on the hope that past gains will continue. Some momentum traders may buy because they hope to obtain the profits that their neighbors and friends have already earned. If enough traders follow them, they will realize their hopes. The last buyers, however, will lose badly.

Order anticipators may also buy in anticipation of new uninformed buyers. They will profit if they can get out before prices fall.

The combined trading of these traders can cause a bubble in which prices exceed fundamental values. Momentum traders and order anticipators, in particular, tend to accelerate price changes. Prices also accelerate when early buyers grow more confident as their wealth increases, and when early sellers repurchase their positions to stop their losses.

#### **The Price Accelerator**

Increases in prices transfer wealth from pessimistic traders who have short positions to optimistic traders who have long positions. These transfers can cause accelerate price changes.

When prices rise, optimistic traders get wealthier. The most optimistic traders may buy more. If they do, they may cause prices to rise further.

When prices rise, pessimistic traders lose. The losses of the most pessimistic traders may force them to buy back short positions to cover margin calls. Their buying may cause prices to rise further.

In both cases, the sellers will be traders who do not have such strong opinions. Mild pessimists will sell because the increase in market price makes short positions more attractive. Mild optimists will sell because the increase in market price makes their long positions less attractive.

Source: "The Canonical Bubble," manuscript by Jack Treynor.

Value traders and arbitrageurs may recognize that prices exceed values, but they may be unable or unwilling to sell in sufficient volume to prevent the bubble from forming. These traders may be unable to sell as much as they want to sell if they do not have large positions to sell, if they do not have enough capital to carry large short positions, or if they cannot easily sell short. They may be unwilling to sell if they suspect that uninformed traders will continue to push prices up, or if they lack confidence in their abilities to estimate values well.

**You Believe You Are Right, But ...  
(Confidence Is Everything)**

Even when value traders believe that prices greatly differ from fundamental values, they may lack the confidence to trade on their opinions. To trade against the majority opinion requires great courage. Since markets generally aggregate information from diverse sources extremely well, value traders must always wonder why they believe that they understand values better than everyone else does. Value traders will not trade unless they are confident that they are right, even after considering that the majority of traders think otherwise.

Value trading is especially difficult when unresolved uncertainties make it impossible for anyone to estimate values well. In which case, value traders will not trade until price is far from their estimates of value. This observation explains why bubbles often form in the stock prices of companies that hope to profit from highly promising, but unproven technologies.

Eventually prices rise to a level that causes sellers to start trading aggressively. The sellers may be long-term holders, early buyers who want to realize their gains, contrarians, value traders, or arbitrageurs. Once their selling causes prices to fall, momentum buyers lose their interest. Overly optimistic buyers lose their confidence and sellers become more confident. Late buyers especially worry about their positions and often start selling to stop their losses. Those traders who financed their positions on margin may have to sell their positions to satisfy margin calls from their brokers. Other long holders who have placed stop loss orders also will start to sell. Order anticipators may anticipate these margin calls and these stop orders and sell before them. A crash occurs when the combined effect of all their selling causes prices to quickly fall.

**You Know You Are Right, But ...  
(Timing Is Everything)**

Consider the trade timing decisions that value traders must make when they believe that prices are too high:

If they initially have long positions, and they sell them too soon, they will lose the opportunity to sell at higher prices as uninformed traders cause prices to continue to rise.

If they initially have no positions, and they sell short too soon, they initially will lose on their short positions. If they cannot finance their losses, their brokers will force them to buy to cover their losses, and they will lose the opportunity to ultimately profit when prices fall.

## Chapter 29

### Insider Trading

Traders engage in *insider trading* when they base their trades on material information about the value of an instrument that is not publicly available. Most insider trading involves private information that corporate managers know about the future prospects of their companies. Insider trading also may involve information that traders improperly obtain from other sources.

In most countries, insider trading is illegal and is punishable by fines or imprisonment. Insider-trading laws are very difficult to enforce, however. Only a few countries—primarily the United States, Canada, and Britain—regularly and seriously attempt to enforce their insider-trading laws.

Insider trading has many economic effects. In the financial markets, it affects investor confidence, price efficiency, and liquidity. In the overall economy, insider trading affects the labor market for senior corporate managers, and the quality of management decisions that these executives make.

In this chapter, we define insider trading and explain how regulators enforce insider-trading laws. We then consider the debate over whether to restrict insider trading. As we debate the two sides of the issue, we will identify the effects that insider trading has on the markets and on the overall economy.

If you trade, you must recognize insider information to avoid making illegal trades. More generally, you must understand insider trading to fully understand market liquidity. Finally, and perhaps most unexpectedly, you must understand the effects of insider trading on managerial labor markets to fairly interpret comparisons of senior executive compensation across countries.

#### 29.1 Inside Information and Insider Trading

Insider trading and inside information are hard to define. Both are complex legal concepts that are subject to substantial interpretation. If you are confronted with an issue that may involve insider trading, you should consult a competent attorney.

##### An SEC Definition of Insider Trading

Statutory laws, the government regulations that implement them, and the case law created by successful and unsuccessful attempts to prosecute inside traders define insider trading. As a public service, the US Securities and Exchange Commission provides a one paragraph summary definition of insider trading on its web pages:

“Insider trading” refers generally to buying or selling a security, in breach of a fiduciary duty or other relationship of trust and confidence, while in possession of material, nonpublic information about the security. Insider trading violations may also include “tipping” such information, securities trading by the person “tipped” and securities trading by those who misappropriate such information. Examples of insider trading cases that have been brought by the Commission are cases against: corporate officers, directors, and employees who traded the corporation's securities after learning of significant, confidential corporate developments; friends, business associates, family members, and

other “tippees” of such officers, directors, and employees, who traded the securities after receiving such information; employees of law, banking, brokerage and printing firms who were given such information in order to provide services to the corporation whose securities they traded; government employees who learned of such information because of their employment by the government; and other persons who misappropriated, and took advantage of, confidential information from their employers.

This one paragraph summary nicely illustrates the complexity of the law on insider trading.

Source: [www.sec.gov/divisions/enforce/insider.htm](http://www.sec.gov/divisions/enforce/insider.htm) (January 4, 2002)

The primary purpose of this chapter is to help you understand the economic issues that surround insider trading. For this purpose, we define *inside information* as material information about the value of a security that is not available to public traders. *Material information* is information that would cause prices to change if it were widely known. In the equity markets, corporate managers control most inside information.

In jurisdictions that prohibit insider trading, nobody can trade on inside information until after the information is publicly available. In particular, corporate managers cannot trade on the information nor can their friends nor can the friends of their friends. Inside information generally retains its status regardless of how many people have passed it. You may not trade on a stock tip that you receive from your barber who received it from another client who received it from a corporate insider, if the tip is based on inside information. Inside information loses its special status only when it becomes available to the public. After a firm releases information to the public through a broadly distributed press release or through a public filing, the information is publicly available.

### **Texas Gulf Sulfur**

In late 1963, Texas Gulf Sulfur discovered very valuable deposits on copper, zinc, and silver in Ontario. Between November 12, 1962 and April 16, 1964, officers, directors, employees, and their friends bought Texas Gulf Sulfur stock and call options. During this period, the stock price rose from  $17\frac{3}{8}$  to  $29\frac{3}{8}$  dollars.

The company, however, did not disclose information about the find until April 12, 1964. On that date, it merely revealed that its drilling had “not been conclusive” and that “the rumors about the discovery were unreliable ... premature and possibly misleading.” Four days later, on April 16, the company announced a major ore discovery. Following the announcement, the stock price rose to 71 dollars.

The Securities and Exchange Commission sued various directors, managers, and employees of Texas Gulf Sulfur alleging insider trading and deliberate efforts to mislead the public. The suit was successful.

Source: Facts paraphrased from Jie Hu and Thomas H. Noe, “The Insider Trading Debate,” *Federal Reserve Bank of Atlanta Economic Review*, Fourth Quarter 1997, p. 36.

Sometimes, information that traders do not obtain directly from management is inside information. For example, suppose that a financial printer prints a prospectus for a takeover offer. While operating the presses, a pressman reads the copy and calls a friend to tell him to buy the target. The friend will be trading on insider information.

**Vincent Chiarella, the Printer**

In 1975 and 1976, Vincent Chiarella worked as a "markup man" in the New York composing room of Pandick Press, a financial printer. Among the documents that he handled were five announcements of corporate takeover bids. When these documents were delivered to the printer, the identities of the acquiring and target corporations were concealed by blank spaces or false names. The true names were sent to the printer on the night of the final printing.

Chiarella, however, was able to deduce the names of the target companies before the final printing from other information contained in the documents. Without disclosing his knowledge, he purchased stock in the target companies and sold the shares immediately after the takeover attempts were made public. By this method, Chiarella realized a gain of slightly more than 30,000 dollars in the course of 14 months. Subsequently, the Securities and Exchange Commission began an investigation of his trading activities. In May 1977, Chiarella entered into a consent decree with the SEC in which he agreed to return his profits to the sellers of the shares. On the same day, Pandick Press discharged him.

Chiarella was later convicted of 17 counts of violating Section 10(b) of the Securities Exchange Act of 1934 (1934 Act) and SEC Rule 10b-5 under the principle that Chiarella owed a responsibility to the sellers to disclose his information. In 1980, the US Supreme Court reversed the conviction because he had no fiduciary duty to the acquiring or target firms.

The law has subsequently changed. If Chiarella were brought to trial now, he would be convicted of insider trading because he misappropriated information.

Source: The first two paragraphs of this box are taken almost verbatim from Section I of the Supreme Court decision in *Chiarella v. United States*, 445 U.S. 222 (1980). The decision appears at [caselaw.lp.findlaw.com/scripts/getcase.pl?court=us&vol=445&invol=222](http://caselaw.lp.findlaw.com/scripts/getcase.pl?court=us&vol=445&invol=222).

Managers must control the dissemination of material information. In particular, they must either keep it secret or widely distribute it. When they distribute confidential information to business associates, they must execute confidentiality agreements. If managers distribute inside information to their friends who then trade upon it, the managers risk prosecution.

**A Noble Cause and a Base Explanation**

In Fall 2000, the US Securities and Exchange Commission adopted Regulation FD. This regulation requires that "whenever an issuer ... discloses any material nonpublic information regarding that issuer or its securities to any person ..., the issuer shall make public disclosure of that information ... simultaneously, in the case of an intentional disclosure; and promptly, in the case of a non-intentional disclosure."

Before the adoption of Regulation FD, corporations would frequently tell their analysts material information before they reported it to the public. The analysts, their clients, or both would then trade on this information.

Not surprisingly, analysts adamantly opposed the new regulation. They claimed that it would make security prices less informative. In particular, they argued that their reports would be much less informative if they could not privately interview management and ask them probing questions. Without this privilege, they claimed that they would not be able to discover incompetent or dishonest management.

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This bibliography provides selected references for further reading. I classified the references using the chapter outline of this book. Since some articles and books cover topics that appear in many of the chapters, the classification is somewhat arbitrary.

The market microstructure literature has grown large very quickly. This bibliography therefore is not comprehensive. I included many works because they provide the first clear presentation of a principle or because they include extensive bibliographies of their topics. I included other works because I especially appreciated what I learned from them or because I found them to be particularly well written.

I undoubtedly failed to include many excellent works simply because I did not remember them. Although I am blessed with an excellent memory for ideas, I regrettably have a poor memory for names. The omission of many excellent works from this bibliography therefore reflects more on me than on them.

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