DARKNESS BY DESIGN

THE HIDDEN POWER *in* GLOBAL CAPITAL MARKETS

WALTER MATTLI

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EBSCO Publishing : eBook Collection (EBSCOhost) - printed on 2/12/2023 9:09 PM via
AN: 1908101 ; Walter Mattli.; Darkness by Design : The Hidden Power in Global Capital Markets
Account: ns335141

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The Hidden Power in Global Capital Markets

Walter Mattli

PRINCETON UNIVERSITY PRESS
PRINCETON AND OXFORD

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Published by Princeton University Press
41 William Street, Princeton, New Jersey 08540
6 Oxford Street, Woodstock, Oxfordshire OX20 1TR

press.princeton.edu

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LCCN 2018957495
ISBN 978-0-691-18066-3

British Library Cataloging-in-Publication Data is available

Editorial: Eric Crahan and Pamela Weidman
Production Editorial: Sara Lerner
Jacket Design: Will Brown
Production: Jacqueline Poirier
Publicity: James Schneider and Caroline Priday

This book has been composed in Adobe Text Pro

Printed on acid-free paper. ∞

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

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To my brothers Charlie and Arthur, exemplary citizens of the world.

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1

Introduction

From New York to London, from Chicago to Tokyo, and from Frankfurt to Sydney, capital markets the world over have undergone revolutionary changes during the past two decades. The frenzied activity of traders buying and selling stocks and other financial instruments on the trading floors of the New York Stock Exchange (NYSE), the London Stock Exchange (LSE), and the Chicago Board of Trade—traditional icons of global capitalism—has been replaced by algorithmic trading and supercomputers tucked away in gigantic nondescript "datacenters" in out-of-the-way places such as Mahwah, New Jersey; Aurora, Illinois; and Basildon, outside London. Trading has become extraordinarily complex and opaque, with trading speeds no longer measured in minutes or seconds but in time units beyond human perception: milliseconds (thousandths of a second), microseconds (millionths), and even nanoseconds (billionths). By way of comparison, a millisecond is to a second as one second is to 11.6 days; and a nanosecond is to a second as one second is to 31.7 years. The blinking of the human eye takes about 400 milliseconds, and a nerve impulse reaches the brain in about 80 milliseconds—near eternities compared with the speed of modern communications and trading.

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Technological advances have scaled up imperceptible and previously irrelevant time differences into operationally manageable and enormously profitable business opportunities for those with sufficient high-tech trading tools. These tools include the fastest private communication and trading lines, the most powerful computers, and sophisticated algorithms (algos) that are capable of speedily analyzing incoming news and trading data and determining optimal trading strategies in microseconds. High-tech trading also relies on possession of gigantic collections of historical and real-time market data. One Chicago-based market operator is said to possess a collection that contains "the rough equivalent of approximately 100 times the amount of data included in the Library of Congress."[1] The storage, management, organization, and analysis of such big data require enormously costly and complex systems that only a small number of large operators can afford.

But there is another central factor that has contributed to the extraordinary complexity of capital markets: *market fragmentation*. At the dawn of the twenty-first century, the NYSE was the world's preeminent equity market, listing companies from all over the globe. Today, the NYSE is no longer dominant; its overall share of the domestic market dropped from 80 percent to about 24 percent over the past decade.[2] Trading in U.S. equity markets is now split between 12 public (also called "lit") exchanges and many more off-exchange trading venues, including about 40 so-called dark pools (see below) and over 200 internalizing broker-dealers.[3] This fragmentation is a feature not only of equity markets but also of other markets, including options markets and foreign exchange markets. And the trend is global—fragmented capital markets are a growing reality in Europe as well as parts of Asia.

In this hyperfast fragmented global marketplace, algos battle algos for trading dominance (i.e., preferential execution position), and the most sophisticated trading supercomputers deal not only in securities but increasingly across asset classes, including futures, fixed income, currencies, and commodities, and across hundreds of markets and dozens of countries. A retired regulator with a distinguished 15-year record at the helm of two major

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financial regulatory organizations recently confessed to me that he no longer understands how these complex capital markets really work. The average investor is even more in the dark about these markets. When an investor sends an order to buy or sell a stock by the click of the mouse, the order may take a lightning journey through a maze of dark pools and exchanges before being filled. How does the investor know that on the journey to execution the order was treated fairly and was filled at the best available price? Adding to market complexity is the extraordinary explosion in order traffic—from millions of orders daily 10 years ago to many billions today.

A comprehensive examination of the functioning of these capital markets of today is opportune and should matter to all of us—for the health of these markets affects our savings and pensions and ultimately has profound implications for the general welfare as well as for equality and justice in society.

Some argue that the recent transformations have introduced, on the whole, greater efficiency through enhanced market competition, resulting in narrower spreads and reduced commissions, for the benefit of investors. Others, however, are sceptical. In a 2014 U.S. survey, a striking 70 percent of financial industry participants said that today's capital markets are not fair to investors; only 18 percent felt they were fair.[4] Many other recent surveys show a persistent majority of buy-side market participants (i.e., asset managers and managers of hedge funds, pension funds, and trusts) expressing negative views on overall market quality.

Telltale signs that all is not well occasionally make the newspaper headlines, including the Flash Crash of May 2010, when the U.S. equity markets dropped 9 percent in value, for no obvious reason, only to fully recover within 30 minutes, or the similarly dramatic and mysterious flash crash of the British pound in October 2016. Less noticed, however, are so-called mini flash crashes—large erratic price swings in individual stocks over milliseconds—which are a daily occurrence in today's fragmented markets. According to one source, about 18,500 mini flash crashes occurred between 2006 and 2010 in U.S. stock exchanges alone.

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These unfavorable opinions of the market and worrisome recent events need explanation. Are they linked to the recent changes that have taken place in the markets? Economists traditionally view markets as simple coordination systems that facilitate the efficient exchange of goods and services between buyers and sellers. This view is a helpful starting point for understanding how markets operate, but it is incomplete for understanding why they change and who benefits or loses from changes in market structure. In this book I explain the dramatic recent transformations and events in capital markets and assess how they affect core public policy objectives such as investor protection, as well as market transparency, fairness, and efficiency. I do this by offering a new analytical lens through which to view these events and transformations, based on a reconceptualization of markets.

Markets are more than simple coordination systems or "disembodied" meeting places of demand and supply. They are organizations governed by their own rules and regulation. Moreover, markets are deeply political organizations or governance systems where contending groups of members or stakeholders are frequently embroiled in intense battles to shape market rules and structure according to their own narrow preferences. These contending groups are not necessarily equal in power, and sources of power may quietly change over time, thereby altering bargaining power. In short, power politics must be at the heart of any analysis of markets. Power is central to explaining markets both in the sense that general power politics arguments about who wins or loses apply to market settings, and in the sense that markets themselves are political institutions governed by power relations.

Furthermore, just as with any political system, some markets are well governed and others are poorly governed. A main challenge in capital markets is not primarily the expense and hazards of forging contracts between buyers and sellers, it is opportunistic behavior key market operators—so-called market makers who stand between buyers and sellers (see chapters 3 and 4 and glossary). Their vantage point at the center of the market gives them access to privileged information about order flow, prices, and

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market trends that they may be tempted to use for private gain at the expense of their clients. Good market governance seeks to anticipate and preempt such opportunistic behavior. More broadly, good governance is about managing conflicts of interest for the long-term benefit of all in society. It ensures fair, orderly, and efficient markets. Bad governance is about exploiting conflicts of interest for a quick profit, thereby surreptitiously transferring wealth from the weak in society to the powerful. If designed smartly, these exploitative schemes are practically invisible and silent, and can last for many years.

Good governance does not mean that everything is always perfect. Accidents and lapses do happen, and individual bad apples or occasional criminal gangs can cause damage to society. However, good governance is a system where the "governors" and stakeholders have a strong incentive to punish bad apples and criminals, as well as to invest in norms, rules and regulations, and policing and compliance systems in order to deter opportunistic or parasitical behavior by a few and safeguard and protect the interests of the many. For a capital market, reputation can be a powerful incentive for good governance.

Bad governance, by contrast, rewards bad behavior. Deception, lying, obfuscation, and misrepresentation are pervasive in bad governance. The creation of exploitative schemes by particularly powerful actors to benefit themselves is rational in a system of bad governance because the chances of getting caught are tiny and the reputational or material consequences of such behavior are largely insignificant while the profits from such schemes are high.

I argue that markets vary in the quality of their governance. If markets can manifest either good governance or bad governance, the question is what explains the difference? What explains when reputational concerns will trump power and create an incentive for the formation of good governance systems? What explains when and why power can trump reputational concerns?

I show that good capital market governance prevailed, on the whole, during most of the twentieth century (see chapter 3). Over the past decade and a half, by contrast, bad governance has been

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on the rise (see chapters 4 and 5). Market makers have fewer obligations, market surveillance is neglected or impossible, enforcement is rendered ineffective, and new technologies are no longer used primarily to improve market governance but to offer lucrative preferential market access to select clients, often in undisclosed or hidden ways. Specifically, although some of the evidence remains partial, I show that information asymmetries and secrecy—often deliberate governance-design strategies—have enabled a small but powerful group of unscrupulous market operators to milk conflicts of interest at the expense of the unsuspecting investing public.

Powerful actors claim to "innovate" to achieve greater market competition for the benefit of all in society. In reality, the modern fragmented markets that they have constructed (see chapter 2) tend to undermine competition. Fragmentation produces many "shallow" pools of liquidity (see glossary)—a proliferation of public exchanges, broker-dealer dark pools, and other private off-exchange trading places—that enable the powerful to more easily extract private rents on the back of hoodwinked investors.

Latent in the minds of many victims of these strategies is a belief that "modern" markets are technologically determined and that technological progress must be good. But new technology is neither bad nor good per se. Its social value is solely determined by the incentives or motives of the users of this technology. I show that in the old system of centralized markets, the dominant exchange had a strong reputational incentive to use technology for the benefit of all investors; in today's fragmented markets, by contrast, costly new technology is often used by powerful market operators in quiet and nearly invisible ways to maximize their profits at the expense of ordinary investors.

This book thus offers a new—and sobering—perspective on why capital markets have fragmented, as well as when and why algorithmic capital markets (i.e., "instantaneous" electronic trading) may fail the public.

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A Deeply Puzzling Market Transformation

For over two centuries, securities markets in all major countries tended toward greater concentration. Concentration of trading in one large organized public market or trading "pool" seemed natural and inevitable in the wake of improvements in information and communication technologies. Consider, for example, the case of the United States: in the first half of the nineteenth century, securities trading was largely local, and all large cities, including Boston, Philadelphia, New Orleans, Chicago, and San Francisco, had their own exchanges. The size of these exchanges reflected the size and wealth of the local population; the NYSE was only marginally larger than the Boston or Philadelphia exchange.[5] It derived its slight edge from its location in the most populous U.S. city and in the center of a prosperous region. With its large port, New York was a principal channel of international commerce, and the opening of the Erie Canal in 1825 helped it become a major hub of interregional trade. As a result, the local catchment area of the NYSE comprised the largest number of affluent investors.[6]

With the advent of the ticker-tape machine, enabling the speedy diffusion of NYSE stock prices throughout the country, and continuous improvements in telegraph technology during the second half of the nineteenth century, the catchment area of the NYSE expanded rapidly.[7] Increasingly, major companies in Boston, Baltimore, Philadelphia, and other cities sought listings on the large NYSE, and the bulk of share trading gradually moved to New York.

The reason for the expansion is so-called user-network effects. The greater the number and variety of users of a given exchange market, the more attractive the market is to new or potential users, since new buyers or sellers are more likely to find a counterparty to a transaction in a large market than in a small one. A central market naturally has the highest concentration of orders: it has the greatest trading depth (volume of bids and offers) as well as breadth (range of tradable securities); in other words, it has the highest liquidity. In addition, highly liquid markets both reduce investment risks, by making it easy to quickly enter or exit a trade, and lower the cost

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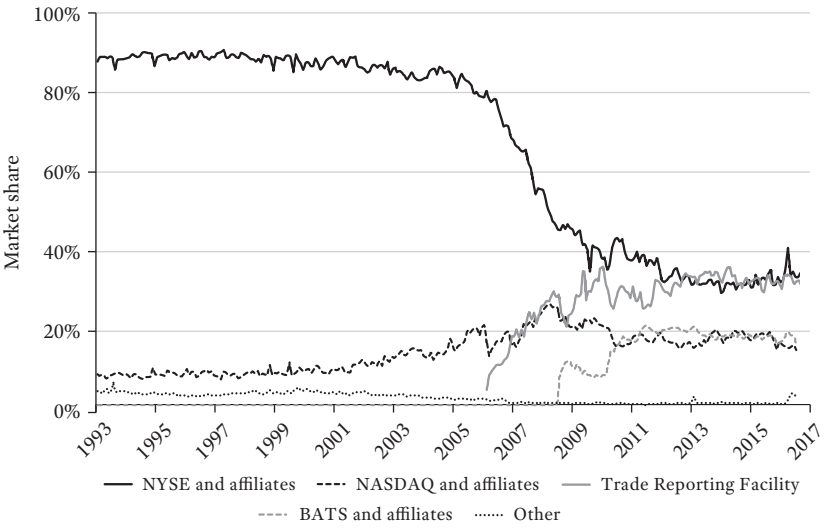

FIGURE 1.1. NYSE-listed equities trading on various markets. *Source:* Mnuchin, Steven, and Phillips, *A Financial System That Creates Economic Opportunities: Capital Markets*, Washington, DC: U.S. Department of the Treasury, 2017, 53.

of trading, since competition among buyers and sellers narrows the spread—that is, the price difference between the best bid and offer.[8] Unsurprisingly, therefore, "liquidity begets liquidity. It [is] a fundamental law of markets, like gravity. The bigger the flow of trades, the stronger the pull."[9] And NYSE's pull proved irresistible. Centralization of the securities market was accomplished by the end of the nineteenth century: about two-thirds of all domestic trading now took place on the NYSE, while the rival exchanges in Boston and Philadelphia saw their shares reduced to 6.5 percent and 3.5 percent, respectively.[10]

The NYSE maintained its dominant position for over 100 years. Then, quite suddenly, the apparent iron law of liquidity begetting liquidity no longer seemed to apply, and market centralization was replaced by fragmentation. NYSE-listed stocks trade today in dozens of separate markets (see figure 1.1).[11]

It is important to emphasize that this development was by no means limited to the U.S. equity market. Elsewhere, too, market centralization was replaced with a common pattern of market

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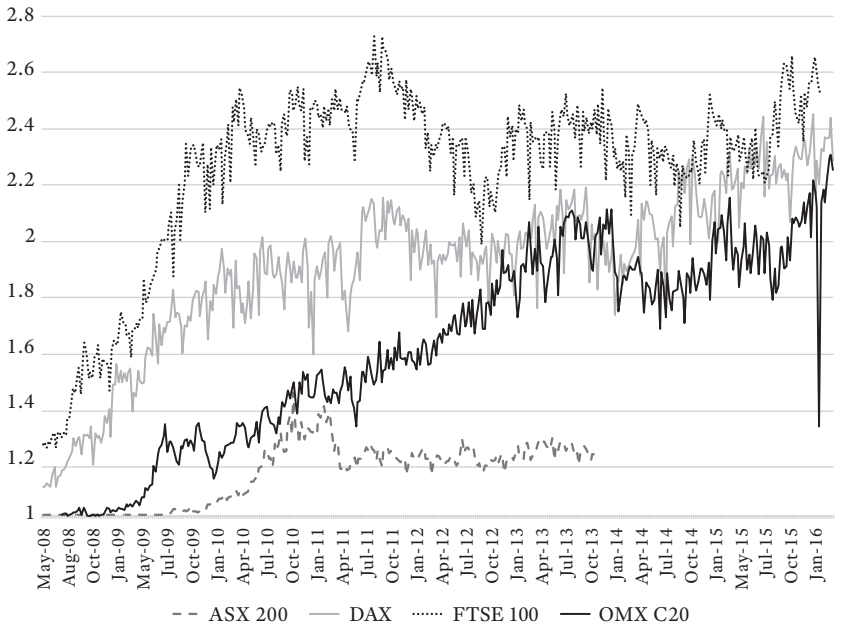

FIGURE 1.2. Market fragmentation outside the United States. *Source:* Private data received from Fidessa Group Plc in 2016.

fragmentation. Figure 1.2 illustrates this graphically, by plotting the Fidessa Fragmentation Index (FFI) for stocks included in four geographically diverse equity indices: the ASX 200 (Australia), DAX (Germany), FTSE 100 (United Kingdom), and OMX C20 (Denmark). Summarized briefly, the FFI represents the number of trading venues an investor is likely to have to visit to achieve best execution for an order—accounting for both the number of venues on which a given security is traded and their relative market share—such that a higher FFI score indicates greater market fragmentation. It is a commonly used aggregate-level measure of market structure. The picture that emerges from these statistics is clear: from a starting point of relative centralization in 2008, all four indices experienced a significant shift toward greater fragmentation over the subsequent decade. While this development was comparatively moderate in Australia, it was all the more pronounced elsewhere, with FFI scores effectively doubling over the period. This mirrored

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the pattern observed in the United States with the fall from dominance of the NYSE. Across the globe, then, a new reality of market fragmentation rapidly emerged. What explains this deeply puzzling transformation of market structure?

The conventional narrative of securities market transformation in the United States runs as follows: the NYSE was *the* market—monopolistic and organized as a private club or a not-for-profit "utility." As such, it had little incentive to innovate or fix inefficiencies. In the words of a prominent set of authors: "The NYSE's members…preferred to milk a profitable franchise rather than aggressively innovate.… The supreme irony…[is that] throughout its history this bastion of the free-enterprise system has been operated as the very model of a socialist collective. That is why the NYSE has rarely been in the forefront of innovative services to investors."[12]

And like a socialist collective, according to this narrative, its fate was sealed; it would not withstand the pressure from a wave of highly competitive new-age electronic trading platforms spawned by the computer revolution. To survive, it had to shed its old "private club" ways and incorporate as a for-profit company—a process referred to as "demutualization"—and use the injection of public capital to completely overhaul its trading systems. From this process, facilitated by the regulators, an efficient new market structure with multiple modern exchanges fiercely competing for business emerged in the mid-2000s. A similar narrative has been used to explain the reasons behind equity market transformation in other major economies.

In this narrative, investors are the principal beneficiaries owing to narrower trading spreads and lower commissions. In sum: "The old [monopolistic] membership association structure fail[ed] to provide the flexibility and financing needed to compete in today's competitive environment. Over the long run, for-profit stock exchanges run by entrepreneurs and disciplined by profit-seeking investors should produce better-funded organizations with greater ability to…adapt to a fast-changing marketplace."[13]

This deeply entrenched conventional view is flawed. It is little more than a moral free market tale with a happy denouement.

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First, market dominance should not be confused with monopoly. A monopoly restricts supply in order to raise prices and increase profits. The NYSE was never a monopoly; it had competition and could not increase commission charges and spreads at will without losing business to over-the-counter (i.e., off-exchange) traders or new rivals. In the nineteenth century, for example, NYSE fiercely competed for business with several New York–based trading venues, including the New Board, the Open Board of Stock Brokers, the National Stock Exchange, the New York Mining Stock Exchange, the Consolidated Exchange, and the New York Curb Exchange.[14] In the second half of the twentieth century, NYSE similarly came under intense competitive pressure from the over-the-counter market, the regional exchanges, and automatic electronic trading platform providers.

Second, the claim that NYSE failed because it was organized as a member-owned cooperative or "socialist collective" and thus lacked an incentive to innovate is manifestly wrong from a historical perspective. Survival in the competitive securities industry has always depended on NYSE's ability to continually improve its governance system and incorporate the latest technologies in support of its operations, as detailed in chapter 3. Critics are quick to point to one or another episode where the Exchange seemed complacent, failing to quickly spot a lapse in good governance or missing a chance to be ahead of the competition. The relevant issue, however, is not whether the NYSE was faultless or always at the forefront of innovation but whether it had a (market) structural incentive to improve and innovate. The NYSE was in a position similar to that of other old established corporate giants, such as General Electric or General Motors. They all had the occasional adjustment crisis but survived in their respective competitive markets on the back of a powerful incentive to innovate.

NYSE was the first exchange in the world to install stock tickers (in 1867) and telephones on the trading floor (in 1878). It had other firsts. In 1930, it introduced a high-speed ticker service, supplanting it in 1964 by an even more rapid ticker system capable of displaying 900 characters per minute. In 1966, it launched a fully

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automated system that transmitted trade and quote data from the floor. Six years later, NYSE teamed up with the American Stock Exchange to form the Securities Industry Automation Corporation to develop computer support systems and provide consulting services in automated systems to the financial industry.

NYSE's response to the looming competitive threat from new electronic trading venues (so-called electronic communications networks, or ECNs) was greater automation. In 1976, it introduced the Designated Order Turnaround (later SuperDOT) electronic transmission system. In 1983, NYSE launched an electronic order book, providing for partial computerization of small buy and sell orders. By the late 1990s, over 90 percent of NYSE trades were handled electronically.[15] In 2000, finally, the NYSE introduced NYSE Direct+, a new system of automatic order execution. Investors were given the choice to enter orders either through SuperDOT for potential price improvement in the auction market managed by the floor specialists, or through the automatic execution system, where orders were executed directly against contra-side bids or offers. By the end of the 1990s, no trading floor brokerage fees applied to orders sent through SuperDOT, and NYSE-related transaction fees and commissions represented only 2.6 percent of the total amount paid by individual and institutional investors in brokerage commissions for NYSE-listed securities.[16]

Total NYSE spending on new technologies in the 1990s was over $2 billion.[17] This investment paid off. At the dawn of the twenty-first century, the NYSE was the world's preeminent equity market: average daily trading volume grew from 157 million shares in 1990 to 781 million in 1999—in a trading system with a technical capacity of processing 4 billion shares a day. Over the same period, listings more than doubled to nearly 3,000, including over 400 from 48 other countries. NYSE-listed companies had a staggering total market capitalization of $19.8 trillion—$12.8 trillion for American stocks and $7 trillion for foreign stocks. By comparison, the next largest equity market outside the United States was the Tokyo Stock Exchange, running a distant second with a market capitalization of $3.7 trillion. This was followed by the London Stock Exchange with

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$2.8 trillion, Euronext with $2.4 trillion, and the Deutsche Borse with $1.2 trillion.[18] These trends and figures belie the image of a complacent, lazy, inefficient, or moribund market organization.

In short, it was not monopoly complacency then, or "membership socialism," or any disease of organizational old age that killed the dominant exchange model and changed market structure. The answer must lie elsewhere.

Power Politics and Market Governance

The mysterious death of the world's leading equity market, the old NYSE, is forensically investigated in chapter 2. The key finding is that power politics within the NYSE killed it—a plot by a coterie of powerful insiders who had grown weary of the traditional way of organizing trading, viewed the old model increasingly as contrary to their economic interests, and quietly pushed for a different market structure more aligned with those interests. Technology plays a central role in explaining the rise in power of some NYSE members, but, in the final analysis, it is power politics—not technological change per se—that explains the end of organized market dominance and the advent of a fragmented market reality.

There is a simple logic to the plot. Traditionally, the typical member of NYSE was the small broker partnership. NYSE membership comprised about 600 such partnerships during the first half of the twentieth century. Some member firms handled retail clients, others looked after wholesale customers, still others specialized in market making in specific stocks, thus serving as brokers of (retail and wholesale) brokers, and so on. The picture that emerges from the empirical investigation in chapter 2 is that of a membership teeming with a multitude of relatively small and highly specialized operators. They were essential cogs in a sophisticated market-constituting "machine" and depended for their livelihood on trading operations on the floor. They thus had a strong vested interest in the success and good reputation of their market. Each member had an equal voice on key regulatory and policy matters, and no single member group was dominant or prevailed.

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The face of the NYSE membership changed in the second half of the twentieth century as a result of successive waves of mergers and acquisitions triggered by the computer revolution and changes in membership rules that allowed public companies, notably highly capitalized banks, to become members. The long-standing balance of power within the membership disappeared. In its place emerged a hierarchy of economic power, with a few giant broker-dealers at the top, including Merrill Lynch, Goldman Sachs, Morgan Stanley, JP Morgan, UBS, Credit Suisse, Barclays, and Deutsche Bank. Their big size made them latent markets; that is, they had such an enormous client base that they could profitably match client orders in-house, rather than routing the orders to NYSE and paying a fee for trade execution. Only unmatched orders would be sent to the Exchange. They could further profit by setting up proprietary trading desks and trading against client orders.

Big size was a source of power because it reduced dependence on the Exchange, even while the Exchange remained heavily dependent on big members for liquidity. The larger the members, the greater the potential gains and savings from running in-house markets and the stronger these members' incentive to push for a breakup of the old system. A democratic form of market governance, where a numeric majority of small members had an operational voice and voting rules failed to reflect economic importance, was of no interest to them. It held them back in their desire and ambition to freely expand their business. In the early 2000s, they decisively moved against the old NYSE. Death came swiftly and ushered in an era of market fragmentation.

This plot travels well beyond the NYSE. Most formerly dominant market organizations, including the London Stock Exchange and leading commodity exchanges in the world, share many of the key organizational features of NYSE, and they underwent similar transformations. So why should we be concerned about such change in market structure?

Market transformations matter because they shape the incentives of market organizations to invest in either good or bad governance. As noted above, good market governance is about managing

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conflicts of interest for the long-term benefit of all in society. Well-governed market organizations perform several socially beneficial functions. They create standardized financial instruments (like stocks and bonds), facilitate trading among strangers, transfer ownership as well as risk, and, perhaps most importantly, provide "price discovery"—that is, they produce price information that accurately reflects the true value of a security or its underlying asset. Accurate price information is a public good. "[It] help[s]…to allocate the economy's scarce capital to the most promising potential real investment projects and…improv[es]…the utilization of the economy's existing productive capacity through optimizing the signals provided to management about investment decisions and the signals given to boards and shareholders about the quality of management decisions."[19] Good governance reduces the likelihood of opportunistic market manipulations that distort the production of accurate price information.

Good market governance is expensive, however, necessitating extensive investments in developing stringent private rules, robust surveillance, and strict enforcement. A dominant exchange, I argue, is likely to have an incentive to make these investments. This is because dominance means public visibility, which, in turn, entails particular reputational vulnerabilities. Fraudulent trading by one exchange member risks damaging the reputation of the entire exchange. And because the potential wealth gained by one member acting opportunistically is generally more than offset by the wealth lost by the many other exchange members as a result of the reputational damage inflicted by the one, a dominant exchange has a particularly strong incentive to invest in robust governance safeguards.

Reputational sensitivity is compounded by the fact that dominance may attract blame even in the absence of fault or culpability. A dominant or focal exchange is all too easy a scapegoat for anything that may go wrong in the wider financial market. The chief economist of the NYSE recognized this problem in the early 1920s, lamenting that "rumors…never start on the floor of the Exchange but outside it; [but] since their effects are principally felt in the

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stock market, the opposite is commonly supposed. The tense and imaginative atmosphere of Wall Street is peculiarly liable to magnify trifles into bonanzas or catastrophes—but we must remember that the Stock Exchange and Wall Street are not synonymous."[20]

Evidence of high levels of investment in governance in centralized markets is abundant (and assessed more systematically in chapter 3). The LSE, for example, early on had an unusually stringent admissions policy to protect its reputation. Members had to reapply annually for admission, giving the Exchange "regular opportunity to refuse re-entry to those considered unsatisfactory.... This was in addition to the ability to expel for specific misdeeds or to reject unsuitable new applicants."[21] On the trading floor, deals were made based on honor and the word of Exchange members. "Reputations [were]...more important...than ironbound contracts complete with sinuous codicils."[22] Reneging on a deal with another member resulted in immediate expulsion, not only from the Exchange but from the social life of the city.[23]

A well-governed exchange, however, faces a serious challenge—a so-called free rider problem. A free rider is an actor who is able to benefit from the provision of a public good by another actor without having to incur the cost of creating, providing, or maintaining it. In this case, rival exchanges or off-exchange trading venues may take price information from the well-governed exchange to undermine it. Because they do not incur the considerable expense of creating and maintaining a price discovery mechanism, these rivals can charge lower commissions or offer better prices. In the nineteenth century the dominant NYSE competed for business with many local exchange providers. Some of these rivals were ingenious free riders.[24] For example, in the 1830s the members of the New Board rented a room in a building "next to the...room [occupied by the NYSE], and dug the bricks out of the wall in order that they might see and hear what was going on."[25] Another example is provided in the July 1857 issue of Hunt's *Merchants' Magazine*: "Curbstone brokers have leased a large room directly under that occupied by the [NYSE].... Any transaction [on the NYSE] is known below as

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soon as made."[26] And, as expected: "The contracts of many of the curb-stone brokers are infinitely better than many of the [NYSE deals], and are taken more readily by outsiders."[27]

How, then, did dominant exchanges survive in a context of free riding by rivals? The key here is economies of scale that derive from dominance and, in effect, represent a "subsidy" essential to the maintenance of good market governance.

Scale economies stem from two sources. The first source is diminishing marginal costs in market operations. The capital costs of setting up a market organization (i.e., the fixed costs) have historically been substantial. Funds have to be raised to build a trading house and equip it with the most up-to-date trading technologies. However, once the organization is in place with its rules and sophisticated systems, the marginal cost of managing an increase in trading volume (or additional listings) declines over a long stretch, until a maximum operational limit is reached.

This limit is only ever attained in exceptional circumstances. Nevertheless, dominant exchanges, eager to protect their reputations, have to be able to cope with sudden volume surges in moments of great market stress. Writing in the 1950s, Wall Street observer Martin Mayer noted: "One of the reasons the Stock Exchange is so expensive to operate is that nobody ever knows what the volume of trading will be tomorrow; and the Exchange likes to be prepared for the three-million-share days that mean prosperity. Since the average day will probably run under two million shares . . . the place is pretty badly overstaffed."[28]

The significance of scale economies that derive from an initial investment in large fixed market-building assets appeared to wane with the advent of new electronic markets in the 1990s and the subsequent closure of many traditional trading floors. However, the price of advanced trading systems has been escalating of late. This may lead in the coming years to a growing significance of fixed costs and thus the size—and economies of scale—of a market organization (see chapters 4 and 5).

The second source of scale economies derives from user-network effects. As discussed above, the greater the number and

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variety of users of a given market organization—speculators as well as retail and institutional investors—the more attractive the market is to new or potential users. Such users (buyers or sellers of a security) are more likely to find counterparties in a large market or "trading network" than in a small one. And as "liquidity begets liquidity," more revenues are generated to finance investments in good market governance. Such governance, in turn, further strengthens the exchange's appeal, solidifying commercial success and securing continuing investments.

In North America, this virtuous dynamic interplay of factors affirmed the position of NYSE as the leading exchange by the early twentieth century. "Increasingly, refinements were added to the operations of the NYSE whereby it became better than any of its rivals.... In terms of the volume of securities to be bought or sold, the speed at which it could be done, [and] the narrowest spread between buy and sell prices...no other exchange in the Americas could challenge the NYSE, and so it attracted business from throughout the nation."[29] And though free riding and price competition remained a persistent challenge, powerful economies of scale allowed NYSE to achieve savings and attract clients to finance expensive governance investment, generating a further pull of business that enabled the Exchange not only to survive but to prosper over the next hundred years, as detailed in chapter 3.

The governance implications of market fragmentation, which is an accelerating trend in today's capital markets, contrast sharply with those of market centralization. In a fragmented system, liquidity no longer flows naturally into a single large pool, and economies of scale are thus much reduced or absent. Competing trading venues now have to balance costly investments in good governance against an overriding new mandate to attract liquidity to survive. Not all market participants are equal in their ability to supply liquidity. Large liquidity providers are enormously powerful in fragmented markets because they can shop around in the bazaar of abundant market options, extracting extensive trading privileges and various other concessions from competing exchanges and off-exchange trading venues. The most powerful liquidity providers include the

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traders at large broker-dealer banks—not coincidentally the very same market actors who successfully pushed for fragmentation in the first place (see chapter 2)—and a new generation of high-speed proprietary trading firms. They possess the fastest communications lines, the most advanced computers, and sophisticated algos capable of dispatching huge numbers of orders to trading venues within milliseconds of spotting profit opportunities. When their demands for privileged treatment clash with principles of good governance, the latter become dispensable for trading venues. Institutional investors are second-class citizens in this new market order. Long-standing commitments of traditional exchanges to fairness, equality, and transparency are sacrificed to efforts to curry favor with the powerful. The result is the emergence of bad market governance—a system designed to milk conflicts of interest for the benefit of the powerful at the expense of the investing public.

The evidence for this stark claim is examined in great detail in chapter 5. Although it is empirically challenging to quantify the harm being done to investors, the findings are troubling. They reveal an extraordinary and unprecedented catalog of governance failings by market providers since the onset of fragmentation in the second half of the 2000s: secretive discriminatory operations; undisclosed business practices inconsistent with exchange rules or securities law; ineffective oversight and accountability mechanisms; deliberate strategies to keep regulators and investors in the dark through various forms of deception, including lying, concealing, and spinning; failure to take corrective action even when told to do so by the regulators; and inadequate testing protocols and monitoring procedures to ensure that the operational systems comply with rules and regulations. The cloak-and-dagger and systematic nature of many of the shenanigans quietly facilitated by market providers, and the utter disregard of the architects of such shenanigans for the adverse consequences for investors and for society more generally, are deeply disturbing.

These governance failings are the inevitable by-product of determined and relentless efforts by competing trading venues to win

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over the business of high-speed liquidity providers. Trading venues today offer a wide range of special services favoring high-speed traders—at the expense of investors. One such proprietary service is labeled "enriched private data feeds." These feeds contain an astonishing amount of trading information that exchanges collect each time a client places an order, including order execution details, modifications, and cancellations. Although access to enriched data feeds is nondiscriminatory in principle, only relatively few market participants possess the costly hardware and software to standardize raw data feeds and decrypt millions of messages in milliseconds. Millions of investors have no idea that such trading data is being collected and sold to high-speed traders.

A companion service, "colocation," involves placing a high-speed trader's computer server or black box next to the exchange's trade-matching engine in the data center of the exchange, thus reducing the order and information travel time between server and matching engine.

Private data feeds and colocation enable high-speed liquidity providers to anticipate investor order flow, infer short-term price movements of stocks, and trade ahead of other market participants. Individual or institutional investors do not typically possess the resources to pay for these special services or invest in the telecommunications and computer systems needed to support and benefit from them. The high cost of these services crowds out most investors. As a result, investors run the risk of paying more for stocks they buy or receiving less for stocks they sell.

So-called special order types (SOTs) are another service on offer. SOTs are complex buy and sell orders that define how an order is placed in a market, how it is displayed, and how it interacts with other orders. Certain opaque SOTs allow orders of powerful clients to remain hidden and jump the queue to be first in line of execution when the clients wish to enter a trade. This discriminatory treatment of order handling imposes significant costs on investors. Exchanges have produced hundreds of SOTs in the rat race to attract liquidity from high-speed traders.

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A third prominent service is the provision of dark pools. These pools were initially designed to enable big institutional investors to place large "block" orders without tipping the market to their intentions, which could trigger adverse price changes. In a lit market, the risk of displaying a large sell order, for example, is that buyers may pull their orders out of the market in the hope of soon buying at lower prices, thereby depressing the price for the seller. Dark pools provided a solution by simply matching large buy and sell orders. In a fragmented market system, however, many dark pools became vehicles of market abuse. By adding a layer of darkness to the invisibility of ultrafast trading, these pools created a practically foolproof environment for opportunistic trading. As will be detailed in chapter 5, the abuse in dark pools has been truly shocking.

This evidence may represent only the tip of the iceberg of market shenanigans. Firms are exploiting conflicts of interest under cover of darkness, so to speak, to the detriment of investors. For regulators and academics alike, governance failings and market manipulation are hard to spot and investigate in today's highly fragmented and complex markets where tens of billions of trades are executed daily at the speed of micro- or even nanoseconds. No watchdog possesses adequate surveillance tools or data analytical capabilities to be able to systematically monitor these markets and deter market abuse.

The book concludes with a few reflections on how to reengineer good market governance in today's capital markets—that is, how to bring back healthy markets that ensure fairness, orderliness, and efficiency. My main propositions may surprise the reader. Failings in market governance are rarely fixed by governmental intervention. It is a considerable challenge for governmental rules to keep apace with changing technology and resulting new market practices. Governments can provide the basic parameters of fair play, most importantly through disclosure regulation or legislation, but market failures are most effectively resolved through market intervention. Here governments can play an important role in enabling

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certain market players to contribute to market solutions, by nudging or incentivizing them in the right direction. Specifically, a transformation from a heavily fragmented market toward consolidation or centralization will bring about a simpler and more transparent marketplace. The existence of a dominant market organization exposed to relentless sunlight and persistent competition from ambitious newcomers or free riders will generate better market governance.

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2

The Puzzling Transformation of Capital Market Structure

FROM GRADUAL CONCENTRATION TO SUDDEN FRAGMENTATION

The commonly held belief that "free markets" stand in opposition to regulated hierarchies or organizations is wrong. Markets are organizations governed by their own rules and regulations. What is more, markets are deeply political organizations where contending groups of members or stakeholders battle for dominance to shape internal rules and define market structure. Power politics must therefore be at the heart of any analysis of markets. Economists have shied away from modeling politics in markets, and few understand markets as organizations.[1] They tend to view markets as simple coordination systems that facilitate the efficient exchange of goods and services between buyers and sellers. The approach proposed in this book seeks to enrich this bare-bones conception of markets with a dose of real-world organizational power politics to shed light on the recent striking and paradoxical transformation in capital market structure—the sudden market fragmentation after 200 years of

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ever-greater market centralization (see chapter 1). Specifically, it posits that changes in size, power, and trading preferences of contending market participants, often triggered by new technologies, alter the constellation of coalitions within a market organization or system as well as their effectiveness in pushing for or opposing change in rules and market structure.

This chapter's focus is on the world's largest equity market in the twentieth century, the New York Stock Exchange. Using extensive primary documents from the NYSE archives, supplemented by a wide range of data from various state company registries, news archives, and company websites, I searched for answers to the following questions: Who are the member (or owner) groups of this market organization? What are their preferences and relative power? How and why do preferences and power change over time, and with what consequences? Though several fine historical works have been published on the NYSE, none offers much of a description—let alone analysis—of changes in membership over time and the consequences thereof. The focus in those histories is on big financial and political events affecting NYSE, in-house scandals, and colorful personalities. An examination of the power politics within the NYSE market organization is missing in this literature.

The Evolution of the Market Organization and Its Body Politic

Securities trading in New York can be traced to the early eighteenth century, when a small number of bonds issued by the colonial governments traded at the commodity and slave auction house on Wall Street.[2] After the War of Independence (1775–1783), trading activity picked up considerably as the U.S. federal government began to issue bonds. In 1790, a group of coffeehouse merchants in Philadelphia laid the foundation of the first stock exchange in America, the Philadelphia Board of Brokers. Two years later, 24 brokers in New York signed the famous Buttonwood Tree Agreement, setting up the precursor of the NYSE. Beneath the

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shade of the buttonwood tree on Wall Street and in other nearby open-air locations, the 24 brokers used to meet in a leisurely fashion to compare orders and strike deals. Trading moved in 1793 to a rented room at the Tontine Coffee House on Water and Wall Streets and then to various other rented locations in the Wall Street district.[3]

The need for a more formal market organization emerged with the revival of business following the War of 1812. A large number of banks and insurance companies were established, significantly increasing the number of marketable securities. In 1817, the brokers adopted a constitution modeled on the Philadelphia Stock Exchange and named their association the New York Stock and Exchange Board (the Board). The constitution provided for an annual election of a president and secretary, listed the procedure for approving new members, mandated minimum commissions for nonmembers, and prescribed fines for offenses such as nonattendance and disruption of trading.[4] Trading was conducted in a daily morning auction with the president calling (i.e., reading out) one listed security after the other and brokers leaping from their seats as each security was called, shouting their bids and offers.[5] In 1830, the Board listed 30 securities, including 16 insurance companies and 9 banks.[6] By 1836, the list had quadrupled, comprising 38 banks, 32 insurance firms, 21 railway companies, and 4 canal and 3 gas companies, as well as federal government bonds.[7] To cope with the increased volume in trading, the Board decided to add an afternoon auction.

Over the years, the number of member brokers steadily rose, reaching about 100 in 1830. By the time of the merger with its main rival stock exchange, the so-called Open Board, in 1869, the Board—also referred to as the Big Board, Regular Board, or Old Board—counted 533 members. The consolidation of the two exchanges created a market organization of 1,060 members that took the name New York Stock Exchange.[8] With the exception of 40 further seats (i.e., memberships)[9] sold in 1879 to finance an enlargement of the Exchange building, the number of seats remained unchanged until 1929.

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This large increase in membership and the rapid growth in trading in the wake of the merger posed serious organizational challenges for the NYSE. First, the two daily auction sessions became inadequate to handle the increased trading volume. The brokers responded by taking to trading with each other continually throughout the day. Second, trading in an amorphous crowd of over 1,000 brokers on a large floor imposed enormous search costs to achieve execution of client orders at best prices. As a result, the NYSE promoted specialization on the floor, giving rise to different types of brokers.

The *specialist* operated at a fixed trading post and specialized in one security or two—"making a market" in this security, that is, quoting bid and offer prices and buying and selling at the request of other brokers. Each listed stock was covered by at least one specialist whose location was known to all. The *commission broker* continued the traditional broker activity of buying and selling securities for the general public for a fixed commission. The *two-dollar broker* assisted the commission broker by executing orders for a two-dollar commission when the commission broker was swamped with orders or needed to spend time with clients. Some members abandoned commission trading entirely and went into business on their own account as *floor traders*, buying and selling with their own capital whenever they saw a chance of profiting from short-term price fluctuation and long-term market trends. A further division of labor occurred when some members, known as *odd-lot brokers*, began to specialize in buying and selling "odd lots"—that is, orders for a number of shares less than the normal minimum trading unit of 100 shares.[10] The interplay of all these specialized member groups ensured that the NYSE could meet the needs of any broker's client "without the broker having to spend time and effort on negotiating…special deal[s], which would involve both delay and expense."[11]

This specialization in trading functions, combined with a continuous investment in new technologies, created a uniquely efficient market organization that attracted ever more business.[12] In 1877, NYSE listed 163 stocks and 334 bonds, mostly for railroads, banks,

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and local industry.[13] By 1913, stock listings had grown to 565 and bond listings to 1,089.[14] NYSE's position as the leading American exchange was now firmly established. Brokerage houses considered the NYSE "the best market"[15] because of its unrivaled market depth and breadth.

The Body Politic of the Exchange. Who exactly were the members of the NYSE? In the early years, all members were individual brokers. Each had a few wealthy clients, many of them family members and close friends. Brokers tended to their accounts, suggested stock selections, bought and sold, and remitted dividends and interests. "Such men did not seek new accounts, and should a potential client walk through the door…he would arrive with references and letters of credit. Brokerage was a gentleman's profession in those days, with little work and much time for social life."[16] Admission to the Board's gentlemen's club was both selective and expensive. Candidates had to be "of undoubted credit and character" and were voted on by the whole membership.[17] Most applicants failed to gain acceptance. Eames reports, for example, that "during the year 1861 twenty-nine candidates were balloted for seventy-six times, and only seven were admitted."[18]The lucky few still had to pay a substantial entry fee and a yearly membership fee. In 1868, however, the NYSE decided to make memberships tradable, opening a new path to admission through the purchase of a seat of a retiring member. Seat prices generally were high but fluctuated considerably between bull and bear markets. They traded for up to $4,500 in 1870, $22,500 in 1890, $94,000 in 1910, and an astonishing $625,000 at the height of the 1929 bull market.[19]

The individual member-broker was gradually replaced during the nineteenth and early twentieth centuries by partnerships. These became a defining characteristic of the Exchange's membership until the 1970s. Most partnerships were small; initially many had no more than two partners. One partner operated on the trading floor, and the other cultivated client relationships and oversaw affairs at the office, where orders were received and payments arranged. The partnership model suited the financial conservatism and risk

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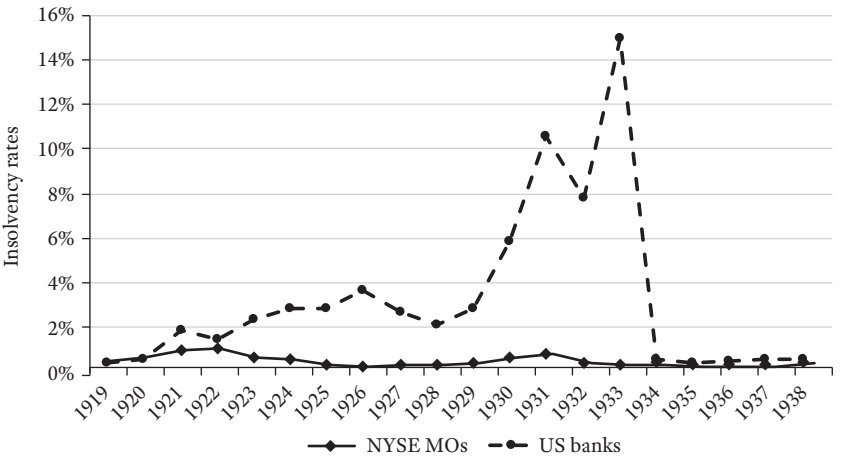

FIGURE 2.1. Insolvency rates of NYSE Member Organizations (MOs) and U.S. banks, 1919–1938. *Source:* "Insolvencies" in Factbook, nyxdata base, NYSE Archives, Mahwah, NJ.

aversion of the Exchange membership—partners had unlimited liability, risking forfeiture of all business and personal property in case of failure.

Another important protection befitting this conservatism of the Exchange was the rules on who could become a member. Excluded from membership were joint-stock and limited liability firms as well as partnerships not primarily dedicated to the securities business. This primarily affected banks and investment trusts. One key reason for such restrictive rules was a fear that large losses potentially incurred by a "nontraditional" member in dealings outside the Exchange could rebound on Exchange members through a sudden failure to pay or deliver. Evidence of the effectiveness of this rule in protecting NYSE members from the fallout of risky or reckless behavior by others in finance can be gleaned from a comparison of insolvency rates of Exchange members and banks in the aftermath of the Wall Street Crash of 1929, as shown in figure 2.1. For example, in 1931, only 0.6 percent of NYSE members failed, compared with a huge 10.5 percent of American banks.[20] In short, the Great Crash and ensuing economic depression barely left a dent on the NYSE membership but had a devastating effect on banking, wiping out about 11,000 of the nation's 25,000 banks.[21]

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An additional critical reason for these restrictive membership rules was a deep concern with maintaining a healthy balance of power within the membership. Large corporate members risked disturbing this balance, bullying small partnerships into accepting new practices inimical to their interests. A powerful new member sooner or later would flex its muscle and try to change the rules and operation of the market in its favor. Insistence on balance of power is a steady theme in governance discussions in most of the history of the Exchange. Specialization in trading tasks during the second half of the nineteenth century had created great brokerage diversity in the Exchange membership, and such diversity was deemed virtuous as long as it was balanced.

The importance of maintaining such a balance in the membership was laid out particularly forcefully in 1970 by William McChesney Martin, former president of the NYSE and chair of the Federal Reserve Bank. Martin had been instructed by the NYSE to undertake a full independent review of the constitution, rules, and procedures of the Exchange and make suggestions on how to improve the Exchange's governance.[22] In a key passage, he revisits the issue of whether an "institution" whose primary business lies outside brokerage should be considered for membership. It is ironic that Martin's warning came on the eve of a relatively brief period of fundamental transformation in power relations within the membership that led to the demise of the old Exchange. The passage raises a point of central importance to my analysis and thus deserves to be quoted at some length:

> All of the arguments on both sides of the question of institutional membership have been weighed and considered.... The question...involves several overriding considerations. One is the concentration of economic power which might result from institutional membership.... Because of the strategic importance of the securities industry to the operation of the free enterprise-capitalistic system, control of this industry cannot be permitted to be concentrated in the hands of a few [large] firms. Such concentration of power [should] not be tolerated even on the grounds of efficiency.... Another [consideration] is that

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> institutional membership could lead to a market dominated by dealers dealing for their own account and tend toward the elimination of the agency relationship between broker and customer. A third…is the necessity of recognizing and preserving the difference between the securities business and other businesses. This separation should be maintained…because of the unique professional role that the public exchange auction market plays in a very sensitive part of the mechanism of the free enterprise system. Accordingly, it is recommended that the primary purpose of every MO and any parent of any member corporation should continue to be "the transaction of business as a broker or dealer in securities" as presently provided in New York Stock Exchange Rule 318. This rule, in effect, prohibits membership by banks, trust companies, insurance companies, mutual funds and other institutions.[23]

This recommendation was ignored. Instead, publicly listed businesses were allowed to become members, and, gradually, a small number of powerful banks moved to a position of dominance within the Exchange, with fateful consequences for the small partnerships and the old Exchange model, and for market structure.

The Transformation of Power Relationships among Members

Before World War I, the number of Americans owning stocks stood at about 500,000, or 3.1 percent of all households. During the great bull market of the 1920s, many more Americans were drawn to the stock market. The number of shareholders shot up to 2 million in 1920 and 10 million in 1930, representing 7.8 percent and 33.4 percent, respectively, of households.[24] Trading volume on the NYSE rose sharply from 175 million in 1921 to half a billion in 1927 and 1 billion in 1929.[25]

To cope with this explosion in trading, the NYSE decided in February 1929—eight months before the Great Crash in the stock market—to increase its membership by 275 to a total of 1,375. This resulted in an increase of member partnerships to an all-time high

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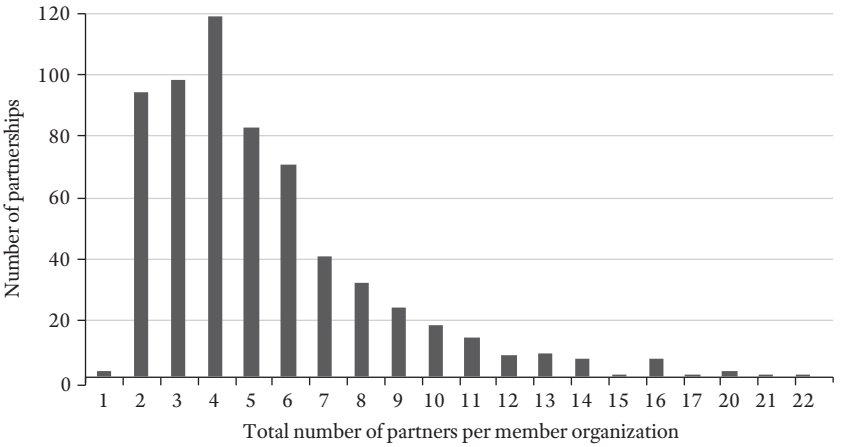

FIGURE 2.2. Size distribution of NYSE MOs in 1934. *Source:* Author calculations based on data in the New York Stock Exchange Directory of 1934, NYSE Archives, Mahwah, NJ.

of 665 in 1929, up from 563 in 1919. The number of these Member Organizations (MOs) remained remarkably steady over the next three decades, with an average of 629 partnerships in the 1930s, 610 in the 1940s, and 611 in the 1950s.[26] Also largely unchanged was the total membership number,[27] as well as membership distribution, diversity, and balance. Figure 2.2 offers a typical representation of the distribution of partnerships by size as they remained for every year from the early 1930s through the early 1950s.[28]

All MOs were partnerships, and most partnerships were relatively small. About 75 percent of partnerships had between 2 and 6 partners (see table 2.1). Only 46 of a total of 622 partnerships had more than 11 partners, and the largest partnerships were not enormous. Several future giant MOs were still relatively small: Bear Sterns had 4 partners, Goldman Sachs 6, Kidder Peabody 4, Lehman Brothers 9, Salomon Brothers 10, and Spear Leeds 3. NYSE rules did not require every partner of a MO to be a registered member. The minimum was one registered partner per organization. Larger MOs tended to have several registered members. In 1934, 966 of a total of 3,321 partners working for 622 MOs were registered members. The remaining 409 of a total membership of 1,375 were individual broker members.

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TABLE 2.1. Size Distribution of NYSE MOs in 1934

Number of Partners in MO	Number of MOs per Size	Total	%	Cumulative %
1	2	2	0.32%	0.32%
2	94	188	15.11%	15.43%
3	98	294	15.76%	31.19%
4	119	476	19.13%	50.32%
5	82	410	13.18%	63.50%
6	70	420	11.25%	74.76%
7	40	280	6.43%	81.19%
8	31	248	4.98%	86.17%
9	23	207	3.70%	89.87%
10	17	170	2.73%	92.60%
11	13	143	2.09%	94.69%
12	7	84	1.13%	95.82%
13	8	104	1.29%	97.11%
14	6	84	0.96%	98.07%
15	1	15	0.16%	98.23%
16	6	96	0.96%	99.20%
17	1	17	0.16%	99.36%
20	2	40	0.32%	99.68%
21	1	21	0.16%	99.84%
22	1	22	0.16%	100.00%
	622	3321	100%	

Source: Author calculations based on data in the New York Stock Exchange Directory of 1934, NYSE Archives, Mahwah, NJ.

The picture that emerges from these numbers is that of a membership teeming with a multitude of relatively small operators. This multitude cuts across specializations, suggesting a finely balanced distribution of different groups of members. Writing in the 1950s, one noted Wall Street observer summarized the situation as follows:

> Of the 1,300 active members of the Exchange, about 650 are specialists, $2 brokers, traders and odd-lot dealers. The other 650 do business directly with the public. This neat balance presents an interesting problem, because the broker who does business with the public has an entirely different attitude towards life from the man whose working existence is spent entirely in the company of his friends on the floor. As a matter of fact, they disagree on 80 percent of all subjects. Recently a specialist who is also

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> a member of a Commission house was asked his opinion on a question of floor procedure. "Now, you know I cannot answer that," he said. "As a specialist I've got one opinion, and as a [commission] broker I've got another."[29]

Important differences existed even among the members doing business with the public. Some "commission houses" offered highly personalized services to a select number of very wealthy clients, while others handled small orders of thousands of average investors through their branch offices and out-of-town correspondents all over the country.[30] Moreover, some members depended entirely on commissions for their profits, while others also made money from underwriting securities and advising corporate clients on mergers and acquisitions.

In short, the Exchange was a body of many voices, and no single one was dominant or prevailed. Each member had a vote in elections of representatives to the governing body and key committees, and differences were sorted out democratically.[31]

Two related events would ultimately disturb this image of balance within the highly pluralistic membership organization: first, the computerization of large-scale back-office operations; and, second, the entry into the securities business and admission to NYSE membership of highly capitalized national commercial and non-U.S. "universal" banks. These events triggered successive waves of mergers and acquisitions that fundamentally altered the distribution of power among MOs.

Computerization and Consolidation. In the 1960s, rapid advances in data-processing technology increased the speed and capacity of batch processing—that is, preplanned runs of standardized computer tasks.[32] This new technology opened the possibility of automating routine clerical tasks of the kind done in the back offices of brokerages, including settling transactions, sending trade confirmations and monthly statements, and maintaining stock records, margin records, client balances, and so on. The attraction of this technology was not lost on retail-oriented brokerages with the responsibility of settling a large and growing number of transactions

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for tens of thousands of small accounts managed through dispersed branch networks. These brokerages had the requisite large scale of back-office operations to justify the considerable expense of acquiring and maintaining the new computer systems.[33]

As partnerships, however, they faced severe constraints on their ability to raise large sums. Capital commitments by partners were insufficient to cover the high cost of the capital-intensive new technologies. Public offerings of shares promised relatively easy access to the amounts of capital necessary to invest in the new systems, but NYSE rules barred public corporations from membership. This posed a significant hurdle, but the largest retail members responded by organizing and relentlessly lobbying to change the rules, and they succeeded. In May 1970, NYSE approved public ownership of member firms. Merrill Lynch was the first retailer to go public in July 1971, followed by Bache later in the year, and E. F. Hutton, Dean Witter, and Paine Webber in 1972. In sum, "it is no coincidence that among NYSE member firms, retail-oriented [ones]…were among the most vocal proponents for permitting [share] flotation and also the first to take advantage of the subsequent opportunity."[34]

Equipped with powerful automated systems, these early movers leaped ahead of the competition; and with capital to spare, they embarked on an aggressive spree of acquisitions and mergers, magnifying their retail brokerage business and diversifying into other areas, such as underwriting stock issues, proprietary trading, securities clearing, corporate advisory services, and over-the-counter (i.e., off-exchange) trading.

How significant were these developments for NYSE membership balance and composition? To assess this question, I have collected archival membership data for 1934 (offering a representative image of membership distribution and diversity during the first half of the twentieth century) and compared it with similar data for 1981 (exactly a decade after the first MOs went public, triggering the first wave of consolidation).

The findings reveal a dramatic impact: the image of balanced NYSE membership had vanished. By 1981, the majority of MOs (including the largest ones) dealt with the public; specialist and

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other floor trading firms were in a minority; individual member brokers had practically disappeared;[35] the number of member firms had dropped from 622 to 575; the average number of partners/directors[36] per MO had risen to 11.4; and, most tellingly, the top 25 percent of member firms employed about 70 percent of all partners/directors at member firms compared with only 45 percent in 1934.[37] The largest MOs had grown into gigantic operations with hundreds of directors, hundreds of thousands of employees, and millions of clients all over the world.

This growing size inequality in membership is represented in figure 2.3. The solid line is the benchmark line of perfect equality in size among members. Points on the so-called Lorenz curves for 1934 and 1981 represent percentages of all partners/directors (measured on the vertical axis) employed by a cumulative percentage of all NYSE MOs (horizontal axis). For example, the bottom 40 percent of MOs employed about 20 percent of all partners in 1934 but only about 7 percent of partners/directors in 1981.[38]

Entry of Banks and Further Consolidation. The march toward ever-greater concentration of economic power within the NYSE membership continued steadily in the 1980s and 1990s. Large commercial banks played a central role in the consolidation process during this period, as explained and documented here.

In the United States, the Glass-Steagall Banking Act of 1933 separated investment banks from deposit-taking (or commercial) banks.[39] Long before the repeal of the act in 1999, large commercial banks and trust companies sought loopholes in this New Deal legislation to reenter the securities market. For example, in 1958, First National City, the second-largest American bank, established a holding company, First National City Corporation, into which the bank was placed as its sole functioning unit. As a holding company, it now could add other operating units dealing, for example, with mortgage banking, leasing, or consumer finance. The new corporate form proved attractive, and within a year 800 banks had converted to holding companies.[40]

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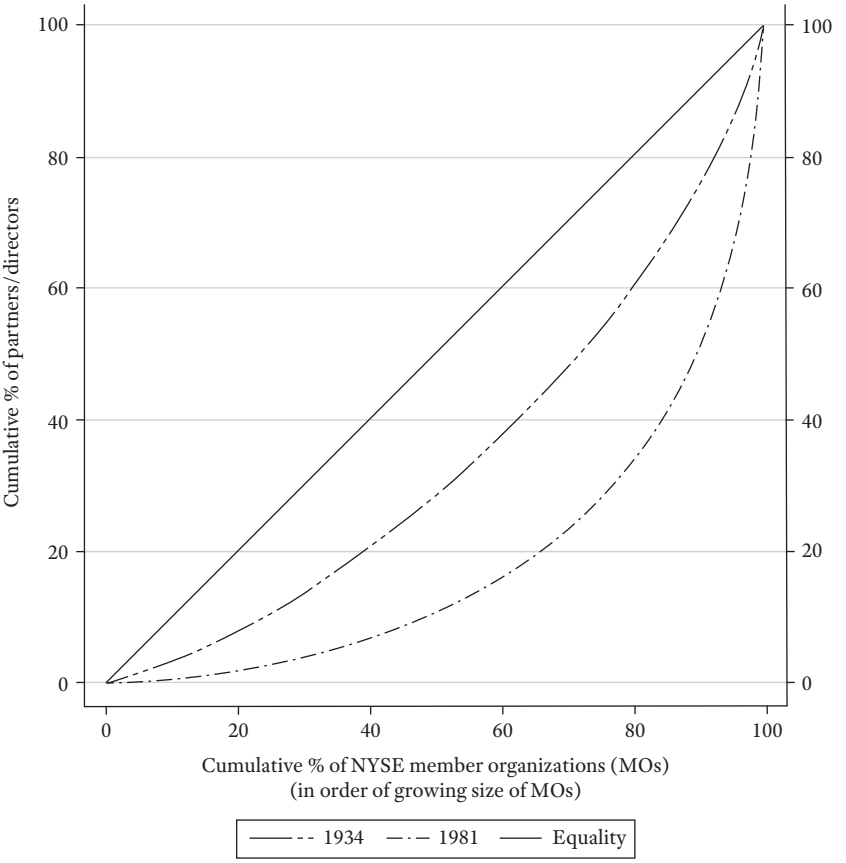

FIGURE 2.3. Growing size of inequality in NYSE membership, 1934 and 1981. *Source:* Based on firm-level data in the New York Stock Exchange Directories of 1934 and 1981, NYSE Archives, Mahwah, NJ.

Could a bank holding company acquire an investment bank or create a securities subsidiary? The Securities Industries Association recognized the potential threat. Its president, Edward O'Brien, prophetically warned in testimony before Congress in 1975: "We are witnessing a trend toward the concentration of financial resources into fewer and fewer hands. Adding additional services to an increasingly monolithic banking structure only exacerbates this trend.... If it comes to a head-on competition with the banks, the securities industry cannot survive."[41]

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And so it came to pass—more or less.[42] Time and again, the banks found ways around hurdles erected by Congress to slow their march into the brokerage and investment banking business. Economically powerful and with friends in high places, they could not be stopped. Writing in the 1970s, one prominent Wall Street expert noted: "The nation's largest banks have fashioned their own method of dominating securities-based capitalism. There seems no way of legislating . . . [restrictions of their operations], for banks—as a community—are already more powerful than Congress."[43]

Large foreign universal banks[44] also wished to enter the profitable brokerage business in the United States. They seized their chance when, in 1977, the NYSE changed its rules to permit foreign broker-dealers to obtain membership.[45] They first established securities subsidiaries in the United States and then applied for NYSE membership via their subsidiaries.

To assess the impact of the entry of banks into the securities business and the NYSE—an event that both William McChesney Martin and Edward O'Brien had passionately warned against—I have investigated the fate of each of the 575 MOs listed in the 1981 NYSE membership directory. I first examined the period 1981–1999, when the Glass-Steagall Act was repealed, and then 1999–2004, the final years of the old NYSE. In the first instance, I compared archival data on MOs for 1981 with data for 1999, and then complemented this comparative analysis with an examination of additional corporate data from the NYSE archives as well as a wide range of secondary and online sources on the MOs. The investigation of the final years is similarly based on archival information and other diverse data sources.[46]

The key findings are summarized in the following tables, showing a startling impact on NYSE membership. Table 2.2 (Panel A) gives an overview: between 1981 and 2004, cash-rich banks acquired 80 MOs listed in 1981, representing 13.9 percent of all member firms. The banks naturally targeted the larger brokerages: the acquired 80 firms represented 35 percent of all partners/directors, 20.1 percent of seats or votes, and 53.9 percent

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TABLE 2.2. Breakdown of Acquisitions of NYSE MOs by Banks, 1981–2004

Panel A: For MOs registered at NYSE as of 1981

Country or Region of the Bank Headquarters	Number of MOs Acquired by Banks	Total Directors & Partners in These MOs	Total NYSE Seats/Votes	Offices/ Branches
North America:				
USA	**41**	1188	128	1605
Canada	**14**	367	36	147
Europe	**24**	737	104	410
Rest of the World	**1**	13	4	0
Total:	**80**	**2305**	**272**	**2162**
Percentage of the Total Number of MOs	13.9%	35.0%	20.1%	53.8%

Panel B: For New MOs registered at NYSE after 1981

Country or Region of the Bank Headquarters	Number of MOs Acquired by Banks	Total Directors & Partners in These MOs	Total NYSE Seats/Votes	Offices/ Branches
North America:				
USA	**32**	1123	239	994
Canada	**2**	30	3	94
Europe	**15**	576	28	37
Rest of the World	**0**	0	0	0
Total:	**49**	**1729**	**270**	**1125**
Percentage of the Total Number of MOs	11.5%	26.5%	20.6%	18.8%

Source: Author calculations based on data on NYSE MOs in the archives of the NYSE, Mahwah, NJ. The data was complemented by information from the firms' websites, historical records in various state company registries, and archives of news publications from 1981 to 2004.

of offices/branches of all NYSE member firms. Most acquisitions were by American banks, followed by European and Canadian banks.[47] Table 2.3 shows that breakdown of acquisitions by banks. The most voracious buyers were Citigroup, Union Bank of Switzerland (UBS), Wachovia Bank, Royal Bank of Canada (RBC), and JPMorgan. These five banks were responsible for 52 percent of all 80 acquisitions, representing 72 percent of partners/directors, 52 percent of seats or votes, and 90 percent of offices/branches of MOs bought by banks.[48]

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TABLE 2.3. Acquisitions of NYSE MOs (Breakdown by MOs, Directors/Partners, Seats, Offices/Branches)

For MOs registered at NYSE in 1981

Bank Name and Region:	Number of Acquired MOs	Directors & Partners	% of Total (all MOs)	NYSE Seats/Votes	% of Total (all MOs)	Offices/ Branches	% of Total (all MOs)
North America:							
USA							
Citigroup	9	**532**	*8.07%*	**47**	*3.47%*	**1019**	*25.39%*
Wachovia Bank	8	**275**	*4.17%*	**32**	*2.36%*	**423**	*10.54%*
JPMorgan Chase & Co	7	**57**	*0.86%*	**9**	*0.66%*	**23**	*0.57%*
First Union	3	**130**	*1.97%*	**4**	*0.30%*	**69**	*1.72%*
Bank of America	6	**50**	*0.76%*	**22**	*1.62%*	**35**	*0.87%*
NationsBank	2	**62**	*0.94%*	**5**	*0.37%*	**0**	*0.00%*
SunTrust Banks	2	**52**	*0.79%*	**4**	*0.30%*	**30**	*0.75%*
4 other banks	4	**30**	*0.45%*	**5**	*0.37%*	**6**	*0.15%*
Total for USA:	**41**	**1188**	**18.01%**	**128**	**9.45%**	**1605**	**40.00%**
Canada							
RBC	8	**299**	*4.53%*	**14**	*1.03%*	**117**	*2.92%*
CIBC	4	**61**	*0.92%*	**18**	*1.33%*	**30**	*0.75%*
2 other banks	2	**7**	*0.11%*	**4**	*0.29%*	**0**	*0.00%*
Total for Canada:	**14**	**367**	**5.56%**	**36**	**2.65%**	**147**	**3.67%**
Total for N. America:	**55**	**1555**	**23.57%**	**164**	**12.10%**	**1752**	**43.66%**

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TABLE 2.3. (*continued*)

Bank Name and Region:	Number of Acquired MOs	Directors & Partners	% of Total (all MOs)	NYSE Seats/Votes	% of Total (all MOs)	Offices/ Branches	% of Total (all MOs)
Europe							
UBS	10	**495**	*7.51%*	**39**	*2.88%*	**365**	*9.10%*
Barclays Capital	3	**41**	*0.62%*	**19**	*1.40%*	**0**	*0.00%*
Credit Suisse	3	**97**	*1.47%*	**30**	*2.21%*	**26**	*0.65%*
Deutsche Bank	3	**42**	*0.64%*	**7**	*0.52%*	**18**	*0.45%*
ING	1	**29**	*0.44%*	**1**	*0.07%*	**0**	*0.00%*
Commerzbank	1	**17**	*0.26%*	**3**	*0.22%*	**0**	*0.00%*
3 other banks	3	**21**	*0.32%*	**6**	*0.44%*	**1**	*0.02%*
Total for Europe:	**24**	**742**	**11.25%**	**105**	**7.75%**	**410**	**10.22%**
Rest of the World (RoW)							
Sumitomo Bank Ltd	1	**8**	*0.12%*	**3**	*0.22%*	**0**	*0.00%*
Total for RoW:	1	**8**	**0.12%**	**3**	**0.22%**	0	**0.00%**
Total for All Regions:	**80**	**2305**	**34.95%**	**272**	**20.07%**	**2162**	**53.87%**

Source: Author calculations based on data on NYSE MOs in the archives of the NYSE, Mahwah, NJ. The data was complemented by information from the firms' websites, historical records in various state company registries, and archives of news publications from 1981 to 2004.

The fate of one prominent NYSE brokerage, representative of the fate of many old-established MOs, illustrates the relentless consolidation process and final entanglement with a large bank. Paine Webber was founded by William Paine and Wallace Webber in 1881 as a Boston-based brokerage firm with a seat on the Boston Stock Exchange. Nine years later, it also acquired a seat on the NYSE. By 1934, it had grown into one of the larger NYSE member firms with 14 partners. In 1972, the firm went public and embarked on an acquisition spree, buying smaller brokerages, a closed-end investment company, and a leading equity research boutique.[49] Eight years later, it had 38 directors and 161 branches. In 1995, Paine Webber acquired the prominent NYSE member firm Kidder Peabody. By the end of the 1990s, it was the fourth-largest brokerage firm in the United States, with 385 offices and employing 8,554 stockbrokers. In 2000, UBS bought Paine Webber for $10.6 billion to expand its North American brokerage business. The subsidiary operated under the name UBS Paine Webber, until it dropped the 122-year-old Paine Webber name in 2003 and assumed the new name of UBS Wealth Management USA.

Several major old-established broker-dealer members avoided being taken over by commercial or universal banks. A few of them emerged as giant operators in their own right as a result of a series of acquisitions. For example, Goldman Sachs, Merrill Lynch, and Lehman Brothers were responsible for 13 major acquisitions of MOs listed in the 1981 NYSE directory with a total of 260 directors/members and 93 seats/votes.

In conclusion, successive waves of mergers and acquisitions triggered by the computer revolution of the 1960s fundamentally changed the face of NYSE membership. Gone were the many small operators; with them the balance among various groups working on the trading floor had also disappeared. In its place emerged a hierarchy of economic power, with a few giant corporations at the top reigning supreme. They now controlled most of the securities business. Power was concentrated in the hands of a few former retailers such as Merrill Lynch, wholesale members such as

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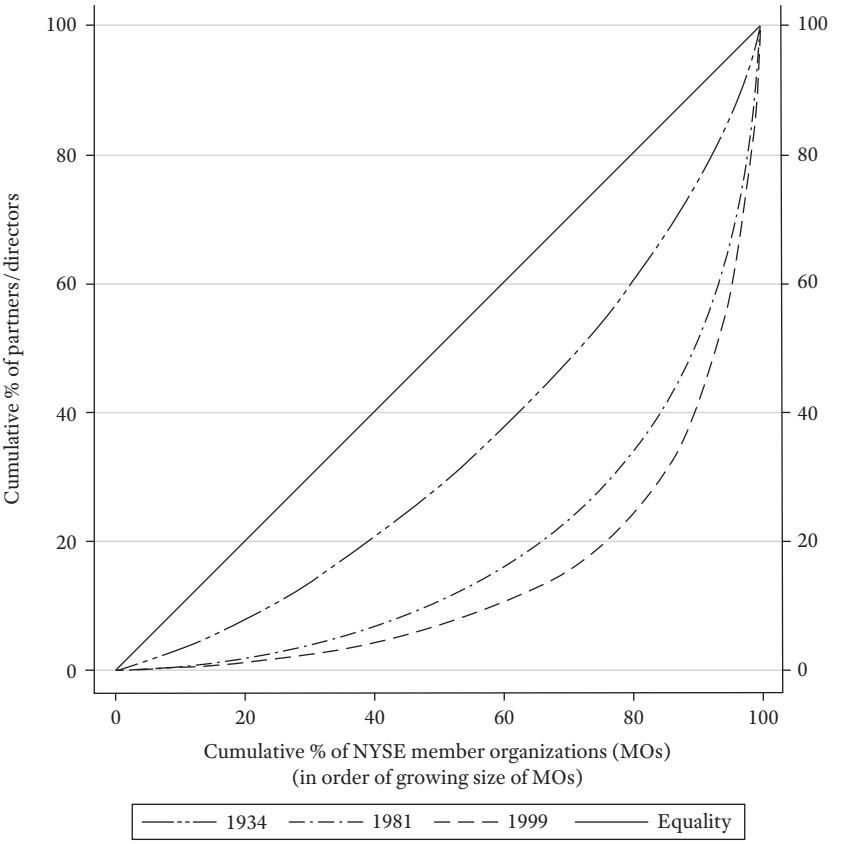

FIGURE 2.4. Growing size of inequality in NYSE membership, 1934, 1981, and 1999. *Source:* Based on firm-level data in the New York Stock Exchange Directories of 1934 and 1981, NYSE Archives, Mahwah, NJ.

Goldman Sachs, Lehman Brothers and Morgan Stanley, and half a dozen banking conglomerates. The once highly pluralistic and functionally specialized ecosystem on the floor of the NYSE had been transformed into a monolithic structure dominated by a small number of global competitors.

Figure 2.4 sums up the new power distribution at the end of the century, with the Lorenz curve for 1999 showing a further move away from the benchmark line of equality. For example, the top 20 percent of member firms employed about 40 percent of all partners/directors in 1934, 66 percent in 1981, and 76 percent in 1999.[50] And figure 2.5 shows the concentration of economic might in terms

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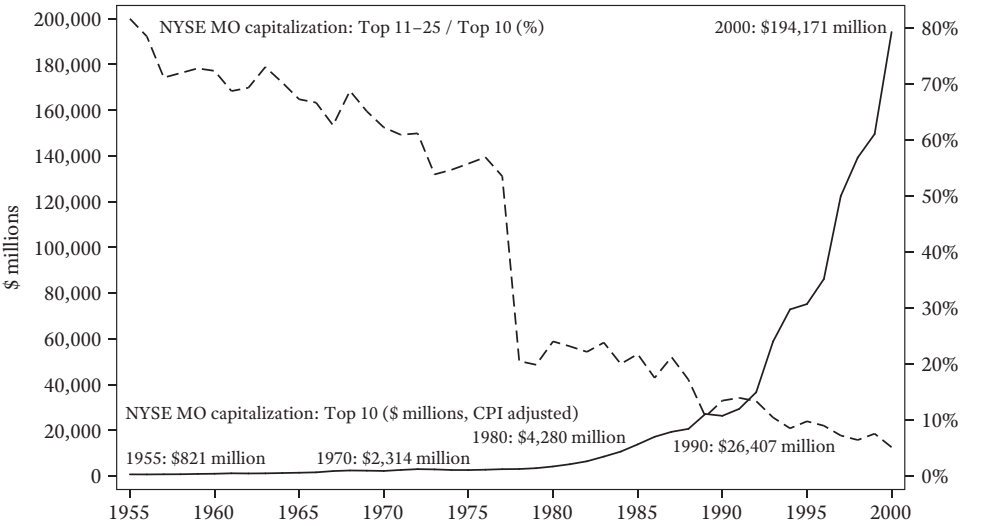

FIGURE 2.5. Capitalization of NYSE MOs. *Source:* Author calculations based on data from Morrison and Wilhelm, "The Demise of Investment Banking Partnerships: Theory and Evidence," 2008.

of relative capitalization of the 35 largest member firms. This group is divided into two groups: a top-tier group of 10 leading firms and a second tier comprising the next-largest firms. In 1955, the 25 second-tier firms had an aggregate capitalization equal to about 80 percent of the capital maintained by the top tier. By 2000, this ratio had declined to less than 10 percent, suggesting an extraordinary concentration of power in the hands of the 10 largest broker-dealer firms.[51]

The Impact of Power Asymmetry

The staggering rise in inequalities within the NYSE membership affected the strength of the commitment that some members felt toward the Exchange, which in turn had fateful implications for NYSE (see below). Commitment to an organization depends on two key factors: the relative importance of the organization to the economic bottom line of a member and the opportunity cost of membership. The significance of these factors is strongly corroborated in the case of the NYSE.

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During most of the history of the NYSE, the private benefits of membership were large and the opportunity cost was negligible or nil. No other American exchange had greater liquidity or commanded greater respect than the NYSE. And though views on procedural, regulatory, and policy matters often differed, the members had an overriding economic interest in ensuring not only the survival but also the success of the market organization. This consensus began to weaken as some members grew ever larger. Concentration of economic power affected their commitment in two fundamental ways.

First, the corporate form of the Exchange—a membership cooperative or mutuality—ensured that all members had an equal voice. But when voting strength no longer reflected economic importance, the powerful began to contest the one-member, one-vote principle. In the early 1990s, for example, Merrill Lynch had gross revenues that accounted for 19 percent of the entire brokerage industry, yet it had only 29 votes, or 2 percent of the voting power of all Exchange members.[52] The new Gullivers felt shackled by a corporate cooperative form they deemed anachronistic. They quietly moved against it in the late 1990s, seeking ways of dismantling it and replacing it with a system where ownership was based on shareholdings. Such a system would allow them to accumulate large equity stakes with relative ease, giving them tighter control over the Exchange. Small and medium-sized brokerages and specialists opposed such change. Their commitment to the one-member, one-vote system remained firm.

Second, large size meant less dependence on the Exchange for profits. Brokerages charged their clients a commission and then paid the specialist on the floor a percentage of it for the execution of a trade. Some retail brokerage houses, like Smith Barney Shearson and Merrill Lynch, had such an enormous client base that they constituted latent pools or in-house markets. Rather than routing an order to the Exchange, they could simply match one client's order to buy with another client's order to sell. This internal matching, or "crossing," was attractive because it obviated the need to pay any fees to the Exchange for trade execution. In addition, an in-house

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market would allow the firm's proprietary trading desks to trade against client-order flow, profiting from the bid-offer spreads and price fluctuations. The translation of a latent in-house pool into an effective internal trading system, however, depended in part on the cost of operating an in-house market. Merrill Lynch was the first large member firm to attempt running such a market. It abandoned the effort in 1983. "Given the fixed costs of maintaining an in-house trading operation, the effort was not worth the trouble."[53] The advent of a new generation of electronic trading technologies in the 1990s changed this calculus, dropping costs and stimulating internalization.[54]

Large wholesale-oriented member firms, such as Goldman Sachs and Morgan Stanley, also found ways to thrive in securities trading areas outside the Exchange.[55] One example is the profitable business of block trading:[56] until the 1950s, individual investors owned almost all stocks and dominated trading at exchanges. Over the next five decades, individuals were gradually replaced by institutions, such as pension funds and mutual funds. By 2004, institutions owned or managed about 68 percent of all equity capital.[57] Block trading, which was controlled by wholesalers, arose from this "institutionalization" of equity markets.[58] Block trading worked as follows: a pension fund wishing to sell a block of 100,000 shares of IBM contacted a block dealer or "positioner" at a wholesale-oriented brokerage. The block dealer responded by lining up perhaps five institutional clients with whom the dealer was in regular contact and who were willing to buy. He then made an offer to the seller and distributed the block to the five buyers at a price slightly higher than what he had paid to the seller. He charged no commission on any transaction but made a profit from the difference of the prices at which he bought and sold.

The NYSE was not oblivious to these competitive threats. It fully realized that in-house markets and block trading reduced liquidity on the NYSE and competed with the Exchange. As ruefully put by a NYSE official in the early 1990s: "There are very few corporations where your major competitors sit on your board of directors."[59] The Exchange decided to fight back. It argued, for example, that

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institutional trading should occur on the floor of the Exchange to contribute to price discovery, benefitting all investors.[60] It then moved against the block-trading competition by developing the Block Automation System, which enabled institutional investors to match their large orders before bringing them to the floor for execution. Tellingly, the system failed because of internal opposition: "Some major institutional traders felt threatened by the system. Traders like Bob Mnuchin of Goldman Sachs had knocked themselves out for years to develop their own extensive institutional networks to buy and sell stocks: the Block Automation System would endow any institutional trader with the same distributional capabilities, thereby allowing the smallest [member brokerage] with no effort whatsoever to bypass the major institutional houses like Goldman."[61]

In sum, the Gullivers of the equities trading world had found new ways of making money that did not involve the NYSE. Off-exchange trading and trading for their own accounts became increasingly important sources of revenue. Their commitment to the Exchange was quickly waning; and, in some respects, the relationship became adversarial. Certain NYSE rules limited the Gullivers' ability to freely trade NYSE-listed stocks away from the floor of the exchange, reducing the profitability of internalization and block trading. In other words, membership entailed a growing opportunity cost.

It was time to plot the demise of the Exchange. Regulation NMS (National Market System), a 500-page legal document adopted by the Securities and Exchange Commission (SEC) in 2005 to "modernize" equity markets, in effect, killed the old NYSE.[62] It codified many of the recent business practices of the largest broker-dealers and introduced new rules that catalyzed the transformation of the market structure. For example, it mandated routing orders of NYSE-listed stocks to more than just the dominant Exchange, accelerating the process of market fragmentation.

The largest broker-dealers, including Goldman Sachs, UBS, Bear Stearns, Citigroup, and Morgan Stanley, played a central role lobbying for the adoption of Regulation NMS. They held numerous meetings with SEC officials and wrote long and detailed comment letters

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at critical stages of the lobbying process. They were supported in their efforts by high-frequency trading firms and alternative trading system providers. Not coincidentally, most alternative trading firms had been launched and were privately owned by the big broker-dealer banks.[63] Their presence in the "pro-reform" camp strengthened the hand of the broker-dealers in talks with the SEC. Unsurprisingly, the Gullivers won the lobbying game despite a vigorous fight-back campaign by groups such as the NYSE Specialist Association, the Alliance of Floor Brokers, and small and midsize traditional brokerages.[64]

In 2005, NYSE officially ended the sale of seats. In 2006, the Exchange merged with Chicago-based Archipelago Holdings, a major electronic trading firm, to form the NYSE Group, Inc., a for-profit, publicly owned company whose shares traded on the NYSE. The merger, valued at $3.5 billion, was the largest merger involving a securities exchange up to that time. When the merger was prepared, NYSE was run by John Thain, a former Goldman Sachs president. The corporate advisor to both sides in the deal was Goldman Sachs. The largest stakeholder in Archipelago, with a 15.5 percent holding, was Goldman Sachs. And as an owner of 21 NYSE seats, Goldman also had clout in the old Exchange. Little surprise it got its way.

What evidence exists to suggest that the large broker-dealer banks emerged as the biggest beneficiaries of this change? Has off-exchange or dark trading via internalization and new private pools increased since the adoption of Regulation NMS; and how much of the dark trading business is controlled by large broker-dealer banks? Figure 2.6 shows a steady growth of various forms of dark trading (broker-dealer internalization and dark pools) since the adoption of Regulation NMS and a relative decline of lit trading (trading on public exchanges). Table 2.4 identifies the largest dark pool providers. Without fail, the owners are former members of the NYSE who grew enormous in size and used new electronic trading technology and their political clout in Washington to translate their latent internal market into profitable dark trading operations, thereby fundamentally transforming the structure of equity markets.

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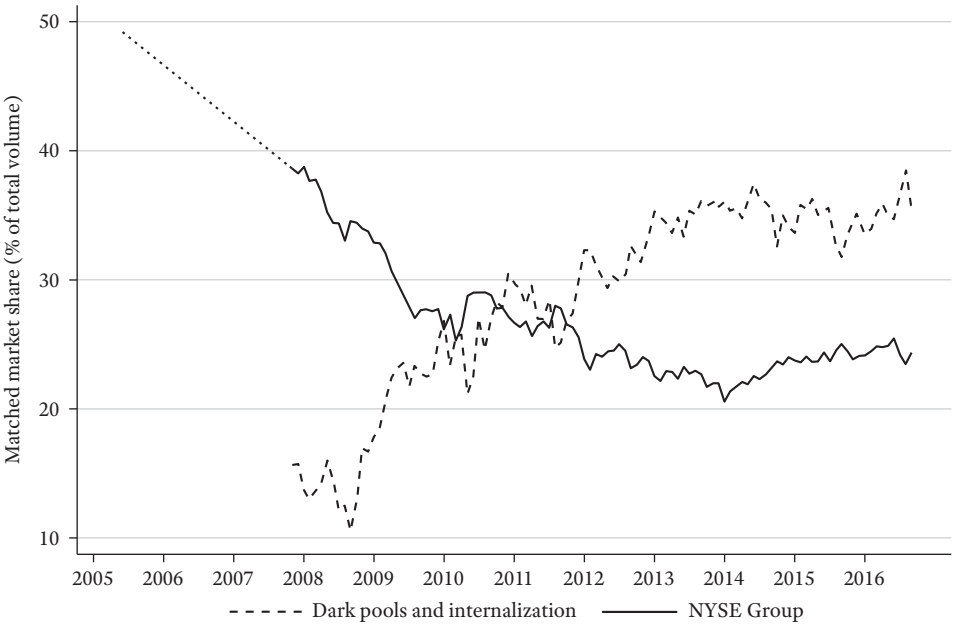

FIGURE 2.6. NYSE and dark pools/internalization market shares, 2005–2016. *Source:* BATS Trading, TABB Group, nyxdata base.

TABLE 2.4. Largest Dark Pool Providers, April–June 2016

Dark Pool	Main Stakeholder	Market Share %	Cumulative %
UBS ATS	UBS	16.4	16.4
Crossfinder	CreditSuisse	12.1	28.6
SuperX	Deutsche Bank	9.2	37.8
MS Pool (ATS-4)	Morgan Stanley	7.9	45.7
Barclays ATS "LX"	Barclays	5.7	51.4
JPM-X	JPMorgan	5.6	56.9
LeveL ATS	Citigroup, Credit Suisse, Barclays, Bank of America Merrill Lynch	5.1	62.0
Instinct X	Merrill Lynch	5.1	67.1
Sigma X	Goldman Sachs	4.6	71.7

Source: FINRA ATS Transparency Data, Quarterly Statistics.

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Implications

This chapter has rejected the deeply entrenched conventional narrative of capital market transformation in terms of a victorious march of highly competitive new-age electronic trading venues against an antiquated monopolistic and monolithic incumbent. Instead, I have argued that power politics within the old market organization transformed market structure. As a small number of insiders grew ever bigger and more powerful, they began to quietly push for a different structure that offered a better alignment with their changing commercial interests.

There is a simple logic to this political maneuvering by big members. The traditional market organization—a membership cooperative or mutuality—was a democratic private governance system where all members had an equal voice on key matters. Its members, small broker partnerships, fully depended for their livelihood on the gains derived from membership operations. As some members grew large, however, their commitments to the traditional market organization began to wane for the following reasons. Large size offered cost saving and new revenue sources. A large member could match client orders internally and send only unmatched orders to the exchange. Such internal trading was attractive because it obviated the need to pay commissions to the exchange and opened profitable new business options, including proprietary trading by the member against internal client order flow. The larger the member, the greater the potential savings and gains, and thus the stronger the incentive to break away from the status quo and push for change. Big size was a source of power because it reduced the dependence of the large member on the exchange, while the exchange remained heavily dependent on the large member for order flow or liquidity. With growing inequality among members, the powerful lost interest in the democratic form of market governance. Restrictions on their businesses, insisted on by the majority of small members, were no longer acceptable. They lobbied for, and obtained, demutualization.

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Does this logic of market transformation hold more broadly? There is strong preliminary evidence to suggest an affirmative response. Practically all major market organizations in the history of capitalism were private "clubs" whose members or owners were individual brokers or small partnerships.[65] The rise of broker-dealer behemoths and the entrance of new actors, notably highly capitalized banks, fundamentally changed traditional market organizations at the end of the twentieth century. The transformation, for example, of the London Stock Exchange (LSE), the leading global equity market in the nineteenth century, bears strong resemblance to the NYSE case study in this chapter. During most of its 215-year history, the LSE comprised almost exclusively small members. In 1862, the LSE member firms had an average number of 2.25 partners, rising modestly to 3.14 in 1914 and 5 by the mid-1960s.[66] The events that transformed the NYSE membership beginning in the 1970s played out very similarly in London.[67] As a result, by 1999, 20 percent of the 298 LSE member firms were responsible for 80 percent of the value of all floor-trading business, and the largest members were a dozen or so American and European broker-dealer conglomerates.[68] This concentration of market power then gave rise to fragmentation and dark trading controlled by these broker-dealers. Consequently, the LSE's market share dropped from 90 percent of total securities trading in the UK in the late 1990s to 55 percent in 2016.

Finally, it is noteworthy that fragmentation and dark trading is a growing trend in other markets too, including foreign exchange, options, and fixed income. Perhaps not coincidentally, the same dozen or so global broker-dealer banks that now dominate equity trading are also dominant players in these other markets. The political organization approach developed in this book may thus help shed light on these markets too. More generally, it promises to open up exciting future research into a long-neglected domain that arguably belongs in the natural preserve of political scientists and governance scholars.

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Appendix

TABLE 2.5. Insolvency Rates of NYSE MOs and U.S. Banks, 1919–1938

Year	NYSEMOs	All U.S. Banks
1919	0.27%	0.17%
1920	0.45%	0.39%
1921	0.73%	1.65%
1922	0.82%	1.22%
1923	0.45%	2.17%
1924	0.36%	2.67%
1925	0.09%	2.67%
1926	0.00%	3.50%
1927	0.09%	2.50%
1928	0.09%	1.92%
1929	0.18%	2.62%
1930	0.45%	5.67%
1931	0.59%	10.47%
1932	0.22%	7.64%
1933	0.07%	14.90%
1934	0.07%	0.36%
1935	0.00%	0.21%
1936	0.00%	0.28%
1937	0.00%	0.38%
1938	0.22%	0.36%

Source: "Insolvencies" in Factbook, nyxdata base, NYSE Archives, Mahwah, NJ.

TABLE 2.6. Measures of Inequality among NYSE MOs

Year	Gini Coefficients[a]	Atkinson Indices[b]
1934	0.31535	0.27251
1981	0.62264	0.73259
1999	0.70955	0.83312

Notes:

[a] The Gini coefficients were computed using the Stata statistical package. They measure inequality in size distribution among NYSE MOs (in terms of partners/directors). A Gini coefficient of zero expresses perfect equality, and a coefficient of 1 indicates maximum inequality.

[b] The Atkinson indices (see Atkinson, Anthony, "on the Measurement of Inequality," *Journal of Economic Theory 2* (1970): 244–263) were used to account for subgroup consistency over the years and sensitivity to changes in different parts of the distribution. The reported Atkinson indices were calculated with the inequality aversion parameter [$\varepsilon = 2$], increasing the weight on the bottom part of the size distribution (MOs with a smaller number of partners/directors). This computation (generated in Stata) allows for better accounting of changes and extinction of smaller MOs. The indices reflect a larger inequality gap between 1934 and 1981/1999 years and a greater sensitivity to changes in the lower part of the distribution, pointing to a higher vulnerability of smaller MOs.

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TABLE 2.7. Fate of NYSE MOs Registered in 1981

	Number of MOs			1981–1999			2000–2004			Total for Both Periods		
History Codes for Member Organisations (MOs)	1981–1999	2000–2004	Total MOs Acquired by Banks	Total Directors/ Partners	Total Seats/ Votes	Offices/ Branches	Total Director/ Partners	Total Seats/ Votes	Offices/ Partners	Total Directors/ Partners	Total Seats/ Votes	Offices/ Branches
0: Missing Information	139											
% of total	*24.2%*											
1: Dissolved or Inactive	80	85		738	168	319	674	191	204			
% of total	*13.9%*	*14.8%*		*11.2%*	*12.4%*	*7.9%*	*10.2%*	*14.1%*	*5.1%*			
2: Remain Independent	220	135		2266	510	1408	1114	234	312			
% of total	*38.3%*	*23.5%*		*34.4%*	*37.6%*	*35.1%*	*16.9%*	*17.3%*	*7.8%*			
3: Acquired by/Merged with an Existing MO	82	62		2036	208	1940	1273	151	1547			
% of total	*14.3%*	*10.8%*		*30.9%*	*15.4%*	*48.3%*	*19.3%*	*11.1%*	*38.5%*			
4: Acquired by/Merged with a Non-MO	54	50		898	153	274	1072	157	600			
% of total	*9.4%*	*8.7%*		*13.6%*	*11.3%*	*6.8%*	*16.3%*	*11.6%*	*15.0%*			
Acquired by Banks	**51**	**29**	**80**	**1383**	**142**	**1286**	**922**	**130**	**876**	**2305**	**272**	**2162**
% of total	8.9%	5.0%	13.9%	21.0%	10.5%	32.0%	14.0%	9.6%	21.8%	35.0%	20.1%	53.8%

Source: Author's calculations based on data on NYSE MOs in the archives of the NYSE, Mahwah, NJ. The data was complemented by information from the firms' websites, historical records in various state company registries, and archives of news publications from 1981 to 2004.

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TABLE 2.8. Bank Acquisitions of NYSE MOs (Breakdown by MOs, Directors/Partners, Seats, Offices)

Panel A: For MOs registered at NYSE as for 1981

Region of Bank Headquarters	Number of MOs Acquired by Banks			1981–1999			2000–2004			Total for Both Periods		
	1981–1999	2000–2004	Total	Total Directors/ Partners	Total Seats/ Votes	Offices/ Other	Total Directors/ Partners	Total Seats/ Votes	Offices/ Other	Total Directors/ Partners	Total Seats/ Votes	Offices/ Other
North America:												
USA	26	15	**41**	836	70	1164	352	58	441	1188	128	1605
Canada	7	7	**14**	70	16	26	297	20	121	367	36	147
Europe	16	7	**23**	464	52	96	273	52	314	737	104	410
Rest of the World	2	0	**2**	13	4	0	0	0	0	13	4	0
Total:	**51**	**29**	**80**	**1383**	**142**	**1286**	**922**	**130**	**876**	**2305**	**272**	**2162**
Percent of Total Number of MOs	8.9%	5.0%	13.9%	21.0%	10.5%	32.0%	14.0%	9.6%	21.8%	35.0%	20.1%	53.8%

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TABLE 2.8. (*continued*)

Panel B: New MOs registered at NYSE after 1981

Region of Bank Headquarters	Number of MOs Acquired by Banks			1981–1999			2000–2004			Total for Both Periods		
	1981–1999	2000–2004	Total	Total Directors/ Partners	Total Seats/ Votes	Offices/ Other	Total Directors/ Partners	Total Seats/ Votes	Offices/ Other	Total Directors/ Partners	Total Seats/ Votes	Offices/ Other
North America:												
USA	17	15	**32**	669	125	456	454	114	538	1123	239	994
Canada	1	1	**2**	19	1	88	11	2	6	30	3	94
Europe	13	2	**15**	507	25	32	69	3	5	576	28	37
Rest of the World	0	0	**0**	0	0	0	0	0	0	0	0	0
Total:	**31**	**18**	**49**	**1195**	**151**	**576**	**534**	**119**	**549**	**1729**	**270**	**1125**
Percent of Total Number of MOs	7.3%	4.2%	11.5%	18.3%	11.5%	9.6%	8.2%	9.1%	9.2%	26.5%	20.6%	18.8%

Source: Author's calculations based on data on NYSE MOs in the archives of the NYSE, Mahwah, NJ. The data was complemented by information from the firms' websites, historical records in various state company registries, and archives of news publications from 1981 to 2004.

3

Good Governance in Centralized Markets

THE OLD NYSE

> The New York Stock Exchange . . . by the wise and successful management of the members, has given to [its] members an important pecuniary value. It is fair to presume that this prosperity and success were, in an important degree, due to the regulations adopted looking to the conduct by a member of his business, and the restraints imposed upon reckless or dishonest methods.
>
> —*BELTON V. HATCH*, COURT OF APPEALS OF THE STATE OF NEW YORK, 109 N.Y. 593, 17 N.E. 225 (1888)

> The title of this Association shall be the "New York Stock Exchange." Its object shall be to furnish exchange rooms and other facilities for the convenient transaction of their business by its members, as brokers; to maintain high standards of commercial honor and integrity among its members; and to promote and inculcate just and equitable principles of trade and business.
>
> —CONSTITUTION OF THE NYSE, AS AMENDED AND ADOPTED IN 1902, ARTICLE 1, IN STEDMAN, *THE NEW YORK STOCK EXCHANGE*, 1905, 486

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> The present organization of the [New York] Stock Exchange has . . . resulted from an intensely practical and varied experience since 1792 . . . [leading to] steady growth and extension of the Exchange system to all parts of the country. Ill-managed and economically dangerous institutions do not continue to grow in this way from century to century.
>
> —MEEKER, *THE WORK OF THE STOCK EXCHANGE*, 1922, 356–357

> The two-hundred-year history of the NYSE reveals a legacy of successful internal control efforts.
>
> —ABOLAFIA, *MAKING MARKETS*, 1996, 108

Fair, orderly, and efficient markets require good market governance in order to minimize the likelihood of conflicts of interest and opportunistic trading practices. The degree to which fair, orderly, and efficient markets are achieved determines the quality of a market, but their achievement is extraordinarily challenging. First, it requires large investments in building and maintaining a robust market infrastructure—that is, a set of rules and norms of good market-making practices, a monitoring system to detect violations, and an enforcement system that sanctions bad behavior. However, rules, surveillance, and enforcement systems change only in discrete steps, whereas market conditions and trends change continually and sometimes unpredictably. As a result, rules and systems tend to play catch-up. They ensure rule-compliant behavior, but rule compliance is insufficient to ensure high-quality markets. Therefore, a second requirement of good governance is investment in performance assessment and reward systems that continually incentivize market makers to strive for excellence.

The conventional narrative of the New York Stock Exchange maintains that during its long period of market dominance it was a complacent and lazy monopoly. However, I argued in chapter 1 that the NYSE—the world's largest equities market in the twentieth century—had strong reputational reasons and the requisite financial resources to invest in good governance *because* it was the dominant

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market organization. Dominance means public visibility, which brings with it particular reputational vulnerabilities. Fraudulent trading by one exchange member risks damaging the reputation of the entire exchange. And because the potential wealth gained by one member acting opportunistically is generally more than offset by the wealth lost by the many other exchange members as a result of the reputational damage inflicted by the one, a dominant exchange has a particularly strong incentive to invest in robust governance safeguards. This chapter examines this proposition by taking a close look at the key components of the NYSE governance system and identifying the main drivers of change during most of the twentieth century.

At the heart of the Exchange was the trading floor. On most days, it was abuzz with the frenzied activity of some 3,000 market operators. The constant shouting and rushing on the floor must have evoked an image of utter chaos and disorder to an outside observer. Yet extraordinary order reigned in this trading arena, underpinned and enabled by a carefully designed system of norms, rules, and principles that had evolved over many decades.

Most of NYSE's regulatory and surveillance activity was focused on the so-called specialists, the roughly 400 market makers who were the elite of the trading floor. The specialists were entrusted with executing orders from buyers and sellers and were mandated to maintain a fair and orderly market. This chapter describes their activities, examines the rules and norms relating to market making, and charts the evolution of the market surveillance, enforcement, and reward systems.

Evidence of the workings of the system stems mainly from archival documents, including confidential memos, special reports, and the annual reports of the Quality of Markets Committee and Market Performance Committee. It is supplemented by personal accounts from a few former high-ranking trading floor officials—whose ranks are rapidly thinning—with intimate knowledge of the workings of the NYSE during the second half of the twentieth century, when this system was still in place.

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What emerges from this archival and interview-based evidence is a striking image of a dominant market organization obsessed with reputational concerns and constantly wary of competitors, and thus continually investing to improve its rules and practices. Not all initiatives achieved their desired effects. Like any complex organization, the NYSE experienced failures. However, it proved itself adept at learning from these episodes and continued to strengthen its rules and control systems to prevent the erosion of its trading business to over-the-counter and other competitors. Many of the organizational and operational details presented in this chapter are little known, yet some are surprising in their originality and ingenuity. They will resonate with students of organizational theory who are broadly interested in institutional design and good governance mechanisms, although they will no doubt be received with scepticism by those who have bought into the conventional narrative of the NYSE.

The examination of good market governance in this chapter provides a useful benchmark by which to assess the significance of the failings in today's markets in the areas of rule making, surveillance, enforcement, and reward systems in chapter 4. The most striking finding arising from this comparison will be the extent to which elaborate mechanisms of good market governance that had evolved over many decades vanished shortly after the death of the old NYSE. In the new era of fragmented markets, costly investments in good governance and commitments to fairness, equality, and transparency have to be balanced against an overriding new mandate to attract liquidity to survive. As a result, market-making obligations have largely been abolished, surveillance neglected, enforcement farmed out and rendered ineffective, and new technologies are no longer being used primarily to improve governance but to offer preferential market access to large liquidity providers in a variety of often undisclosed and hidden ways, on the back of small investors.

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The Market Makers: Functions and Obligations

From the 1870s on, specialists operated at fixed trading posts on the floor.[1] Each of them specialized in making markets for a small number of securities[2]—that is, quoting bid and offer prices, executing buy and sell orders at the request of commission brokers and other floor members, and providing liquidity by buying and selling for their own account when such intervention was necessary to ensure orderly markets.

A specialist thus had two functions—one as agent and the other as principal. Whenever the specialist executed orders for a commission broker,[3] he acted as the *agent* (or the broker) of a broker. Most orders brought to the specialist were either so-called market orders or limit orders. Market orders were for immediate execution at current market prices, but limit orders had to be executed at the price specified by the investor. When this price was above or below current prices, the specialist would enter the order in his "book"—a closely guarded loose-leaf notebook that recorded limit orders. These orders were executed when market prices reached the limit prices stated in these orders.[4]

The agent function was relatively straightforward. The specialist's function as *principal*, however, raised potentially serious conflicts of interest and thus was more challenging from a regulatory perspective. As a principal, the specialist traded for his own account; that is, he no longer acted as a broker but as a dealer. The possibility of a conflict of interest arose from the specialist's privileged position at the center of the market, giving him a unique view of order flow in his stocks and thus a sense of likely price movements. Trading as a dealer, the specialist could capitalize on this private information by front running a large public order, enriching himself at the expense of the investor.

The Exchange responded to this risk of opportunistic dealing by adopting and continually refining rules referred to as the specialists' "affirmative" and "negative" obligations.

The affirmative obligation required a specialist to maintain a fair and orderly market in his stocks. A *fair* market is a market where the

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investor need not worry about the integrity of the market maker, price manipulations, or discriminatory treatment. An *orderly* market is characterized by the absence of sudden and unreasonable price fluctuations; prices are expected to move in small and continuous graduations.[5] The specialist was obliged to maintain an orderly market by stepping in as a significant buyer for his own account in a falling market and as a seller in a rising market. This stabilizing intervention was called "leaning against the wind."

The affirmative obligation also required the specialist to solve the so-called time-discontinuity problem typical in thin markets. Thin markets tend to have few buyers and sellers and only small numbers of shares available at different price levels in the specialist's book. The specialist solved the problem by providing liquidity (or "depth") to the market—that is, selling from his inventory when no seller appeared or using his own capital to buy when no buyer entered the market.[6] To summarize in the words of a former specialist: "Orderly meant that every trade should be relatively close [in price] to the previous one, that a stock should go up or down as if on a stairway. When planks were missing from the stairway because there were no public orders, the specialist was charged with using his own capital to fill in the missing steps."[7]

Finally, the Exchange's negative obligation required the specialist to refrain from trading for his own account except in cases where such dealer intervention helped minimize the effects of temporary disparities between supply and demand, thus ensuring fair and orderly markets. It follows that the specialist was expected to operate in normal times primarily as an agent and intervene as a principal only in times of turbulence or in thin-market conditions.

Specialists often put significant personal capital at risk when they intervened to stabilize markets. For example, when news hit the wire that President Eisenhower had suffered a heart attack on May 28, 1955, investors panicked and triggered a selling stampede. The specialists sprang into action by furiously buying to stem the market downswing. They succeeded but ended the day with large debit balances and huge losses on paper.[8] In the following days and weeks, the market rallied and the specialists were able

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to unload their surplus inventories at a profit. Similarly, specialists intervened robustly during the stock market crash of October 1987 to ease selling pressure. According to one major report: "On October 19, specialists as a whole purchased just under $486 million worth of stock…in the face of unprecedented selling pressure. At this critical time, specialists were willing to lean against the dominant downward trend in the market at a significant cost to them."[9]

Specialists sought to manage risk, in part, by developing an almost uncanny feel of the market. As explained to me by a prominent former floor operator: "A specialist trades the same stocks all day, every day, perhaps for years, and he gets to know their behavior intimately.… He knows all [there is to know about a stock's trading patterns] in his bones."[10] Similarly, Mitchel Abolafia notes: "Specialists…have a strong sense of where a stock 'ought to be trading.' Much of this comes from their privileged access to the 'book' which gives them a clear picture of supply and demand for the stock at an array of prices. But it also comes from intimate familiarity with a stock's historical patterns of movement. These patterns give the specialist a sense of how the stock 'ought to move.'"[11]

Intimate knowledge came not only from the market-making activity but also from engaging with the company and understanding its business. In the words of another specialist: "I try to know as much as I can about the company. I try to know the people who run it. I call the treasurer of the company every month to find out how last month's business was.… I try to work closely with the company, and I think we help them. The better a market is for a security, the more friends a company has."[12]

In short, intimate knowledge helped the specialist differentiate between well-founded and unfounded market pressures on a stock, thus enabling the specialist to calibrate his intervention strategy. He would choose to fully "lean against the wind" in cases of sudden panic but would intervene more cautiously or incrementally when a business suffered from long-term decline. The specialist was not, of course, expected to become insolvent in an effort to stem a long-run market downswing but was indeed obliged to manage a price

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decline in an orderly fashion—that is, to provide planks when they were missing from the stairway.

Two accounts of trading on the floor of the NYSE (see Box A) offer instructive glimpses into how the specialists operated to provide fair and orderly markets. The examples highlight the often creative and subtle ways in which fairness and price continuity were achieved in particularly challenging cases of huge public orders—that is, buy or sell orders of 50,000 shares or more. Such orders can have a big impact on share prices if not properly managed. The examples stand in sharp contrast to trading experiences in today's electronic markets, where a few thousand shares can easily trigger mysteriously large and disproportionate price swings (see chapter 4).

Box A. Achieving Fair and Orderly Markets with Big Orders

These trading stories from the NYSE floor were conveyed to me by Robert (Bob) Seijas, former governor of the Exchange and copresident of the Specialist Association. Bob began his career on the NYSE trading floor in 1968 as the commission broker of a small investment firm in California, eventually rising to CEO of Merrill Lynch Specialists and then executive vice president of Fleet Specialists. Bob retired in 2001. The examples date from the late 1980s and early 1990s when Bob worked as a specialist.

First Example. If a potential big buyer [i.e., a commission broker serving an investor wishing to buy a large number of shares] came in to explore the market, you didn't say anything overt like "Goldman is a big seller at 60," you kind of summarized the picture with something like: "It's kind of light in here, but up at the figure [i.e., an offer price of $60] I might be able to bring size out" [meaning the specialist may be able to organize a large number of shares to sell]. If the buyer then came back and said, "I am real, I need 100,000" you called the Goldman Sachs broker and told him, "I've got size to buy in line, see if you can firm up your interest." You didn't divulge the buyer at this stage, you were simply feeling out what kind of fit there might be. If Goldman then came back and said, "I can sell 50,000 at 60" you might respond with, "My guy is bigger than that." Goldman may then say, "I can do 100,000 at 60 and I'm even bigger." Then you called the buyer [i.e., the commission broker acting for the buyer] and told him, "You can offer your buyer 100,000 at 60, but the seller will have more." You can see from this realistic scenario that *the specialist is filtering the information so as not to disadvantage either party*. The more they divulge, the more you tell them.... You do this because your job is to bring buyers and sellers together.

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Second Example. [Bob was the market maker for stocks in RJR Nabisco, an American conglomerate in the tobacco and food product sector. One day he received a big buy order for 60,000 shares of RJR Nabisco. At the same time, he had an interaction on the sell side with Steve, a commission broker working for the firm Smith Barney, tipping Bob off to the fact that Steve had a very large number of shares in RJR Nabisco to sell from a client who was willing to take his time if necessary. Bob was now trying to obtain some clarity about the scale of the intended sale.] I called Steve and said: "I know we don't usually ask each other questions like this, but this smells to me like Warren Buffet's style" [meaning Bob was suspecting the big seller was Buffet]. We had an exceptional relationship of trust and…so he said: "Strictly for your ears, you are not wrong."

I knew that Buffet had 5 million shares of RJR Nabisco and rarely just sold a small portion; it was in or out with him. That told me that there was *a lot* of stock available, even though it was not showing in the marketplace.… When a broker came in later and said he was a buyer of 50,000 RJR Nabisco shares, I asked him if he would pay the last sale [price] for it. His customer said he would be delighted to get it all at one price without moving the market, so I called Steve and bid him [meaning offered to buy 50,000 shares]. In five minutes, Steve came back and made the sale; and the market continued trading in a normal way. Shortly afterwards, the buyer returned and said he…had another 50,000 to buy.… I assured him it was not a problem and called Steve, bid him for another 50,000. He came back and made the sale, then disappeared again.

This went on for three months. I was able to bring out stock whenever a size buyer appeared, and *we never moved the stock [price] unduly*. Buffet was very pleased with how quietly he was able to sell a tremendous amount of stock, and the buyers were happy to be able to execute a big order smoothly and efficiently, all because I knew where the bones were buried.

Market Surveillance

The opening article of the constitution of the NYSE, quoted at the beginning of this chapter, prominently mentioned two key objectives: "to maintain high standards of commercial honor and integrity among its members; and to promote and inculcate just and equitable principles of trade and business." Words are cheap, a sceptic may interject. What business, however corrupt in practice, would not claim to be fully committed to the welfare of its clients?

Strikingly, however, observers of trading practices on the floor of the NYSE reported with great consistency throughout most of

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the twentieth century the central importance of business ethics, a strong internalized commitment by most floor members to honesty, fair play, and equity, as well as a deeply embedded norm in floor culture that "you cannot go in front of one of your customers."[13] This "rule of agency," together with the rule of price continuity or integrity, defined the moral compass of the specialist.

Many market makers had started their careers as young clerks working for brokers and were socialized into the value system of the Exchange as they steadily moved up the ranks to eventually become specialists. They knew that violations of floor norms and rules would jeopardize the considerable financial and social rewards of membership in the largest and most prestigious financial market organization in the world. "[The specialist] puts the entire value of his future business behind his words when he says, very casually, 'Sold' or 'I'll take it', or 'I'll bid twenty-three'. The risks he undertakes by living up to this contract are nothing next to the risks he would run by breaking it."[14]

An illustration of the risks of violating the rule of agency is provided by the chief economist of the NYSE writing in the early 1920s: "Years ago a certain specialist sold 500 shares for his own account when he had [public] orders for that amount to sell, and made a point, or $500, on his illegitimate [i.e., front running] transaction. But he was caught within three days, and facing the loss of a good business reputation acquired over the course of thirty years, died of heart failure before he ever came to trial."[15] Expulsion from the Exchange and social ostracism were common penalties for violating core rules and values of the market organization.

It would be naive, however, to assume these rules and values were sufficient per se to deter cheating. It is true that strong norms and a distinct culture of rule compliance undoubtedly exerted a powerful disciplining effect on the members of the tight-knit floor trading community. Norms shape behavior by aligning the incentives of the individual with the collective interest of the community,[16] thus serving to lay the foundation of an organization that works effectively and smoothly. Nevertheless, they will have little mental grip on the proverbial bad apple and generally are

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insufficient on their own to ensure broad compliance and organizational efficiency.

Good market governance also requires a robust system of surveillance. The NYSE showed great organizational inventiveness and talent in the area of surveillance. It designed and refined over several decades a complex surveillance system that operated in two ways: horizontally, at the level of the trading floor, and vertically, via top-down monitoring by a specially designated staff that operated independently of the floor. The following descriptions of floor-level surveillance and top-down surveillance assess each type of surveillance in turn. The sophistication of NYSE's surveillance system stands in sharp contrast to the striking lack of a comprehensive monitoring system in today's capital markets, as discussed in chapter 4.

The central principle of floor-level surveillance was the openness or "public-ness" of the trading context. Specialists did not operate in seclusion or the dark but were fully exposed to the "crowd"—a constantly shifting group of commission brokers, two-dollar brokers, odd-lot dealers, and floor traders that gathered around the specialist eagerly awaiting the opportune moment to strike a deal. In the words of an Exchange official in the early twentieth century: "You must remember that the specialist is not over in a closet or up on a pillar where nobody can see what he is doing, but is standing down on the floor; and in an active market, twenty, thirty or forty men see him; they see him get the orders and see him execute these orders, so that there is almost—you might say—a check-up on him every single minute."[17] Writing thirty years later, another Wall Street observer noted: "An attempt by the specialist…to take advantage of his knowledge of his orders…would be practically certain of detection by the crowd."[18]

The crowd tended to be particularly large at posts trading securities of big (i.e., highly capitalized) companies, such as General Electric or U.S. Steel. But the watchful eye of the bystander was equally effective in small crowds more typical of thin markets, as illustrated by the trading story in Box B.

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Box B. Floor-Level Surveillance in a Thin Market

This real-life trading story from Robert Seijas dates from the early 1980s when he was working as a commission broker.

I had an order one day in a stock allocated to Specialist JS and was standing in the crowd waiting for traffic to show up. While I was standing there, Tom, a broker I knew well, arrived with an order to buy a lot of shares in one of JS's stocks, a tough stock that was thin and not very active. Tom asked if anything was going on. The last trade was 48 $\frac{3}{4}$. JS quoted the stock as 48 $\frac{1}{4}$ bid, 48 $\frac{3}{4}$ asked with 100 shares either way [meaning JS was willing to buy 100 shares at 48 $\frac{1}{4}$ and sell 100 shares at 48 $\frac{3}{4}$ for his own account], as there were no limit orders on his book anywhere near the last trading price. Tom grimaced and said, "I know it's a tough stock but I have a big appetite [meaning he had a client order to buy a large number of shares but for some reason preferred not to disclose the full size of the buy order]. Take an order to buy 5,000 shares but show me anything that comes in." Not five minutes later, a new broker showed up. He got the same wide quote and minimum size [100 shares] that Tom had gotten. "Anything going on?" he asked. "Nothing here," the Specialist said. I thought, "What? I just watched Tom tell him he had a big appetite and leave a partial order to buy 5,000." The new broker said: "Ugh, I have 10,000 to sell as low as 48, let me know if anything develops." He gave the order to JS and left to execute other orders.

"This will be interesting," I thought. JS waited several minutes, then used the sell order to trade [buy] 100 at the 48 $\frac{1}{4}$ bid and 9,900 at 48; my friend Tom bought his 5,000 and the Specialist bought the other 5,000 for his own account at 48 [intending to sell them at a higher price later and make extra money for himself]. Before reporting it to the tape,[a] he sent for the seller and told him: "You got lucky, I was able to sell your stock at 48." The dope actually thanked him and left. Then JS reported the trade and it appeared on the tape. He was completely unconcerned that I had seen the whole thing. Tom was in like a shot as soon as he saw the prices on the tape. "What the f**k was that?" he shouted. JS said: "A seller showed up; I was able to get you 100 at 48 $\frac{1}{4}$ and 4,900 at 48." Tom exploded: "I told you I have a big appetite; I would have taken the whole 10,000 at 48 $\frac{3}{4}$! Who bought the other 5,000?" "I picked up another buyer," JS replied.

"Jesus," Tom hollered, "don't let *anything* trade without me; I have a lot to buy!" He left the Specialist an order for another 10,000 and stormed out to try to explain to his customer how he let 5,000 get away. Tom knew that technically he didn't have any recourse. Despite making it very clear that he had a big appetite, he had only left the Specialist an order for 5,000 shares. JS would simply lie and say that he didn't know Tom had more to buy.

I waited about five minutes, then left my small order on the Specialist's book and went to find Tom. When I told him the real story, he immediately

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called Market Surveillance and registered a formal complaint. Surveillance investigated and then forced JS to adjust the price to the seller to 48 $\frac{1}{2}$ and give up the 5,000 he had bought for his own account. They also imposed a substantial fine. Had I not seen the incident, he would have gotten away Scot free.

[a]Originally, the ticker tape—a long, narrow piece of paper on which a ticker machine printed the latest sale and purchase prices for public transmission. In the 1960s the tape was electronified and replaced by computer networks.

Crowd monitoring was supplemented by sixteen roaming floor governors assisted by 119 floor officials. These "floor cops," selected from the ranks of senior brokers and specialists and appointed by the Exchange's governing body, monitored the activities at trading posts. A floor member who noticed anything untoward could alert the cops. Floor governors and floor officials also had the authority to grant temporary exemptions from specialist obligations, provide regulatory guidance or issue quick rulings in sensitive market-making situations, settle certain disputes between members, and even suspend trading in a particular stock when they deemed such action necessary to protect the investing public.

Finally, it is worth repeating that a specialist with an opportunistic bent risked damaging his reputation and thus losing his business. He depended on order flow from brokers with whom he hoped to have a lasting trading relationship, and "if a man cannot be trusted…nobody will deal with him."[19] Trust lay at the heart of any successful relationship. "Market makers…transact[ed] primarily with known participants in daily face-to-face interactive cliques, thereby developing bonds of trust and a reputational network."[20] Historically, when a specialist abused trust once too often, the broker could advise his client against investing in a particular stock[21] or turn to another specialist who competed for broker business in the same stock.[22] Competition among specialists was a powerful "market-based" control mechanism to induce responsible trading behavior—especially in the first half of the twentieth century, when it was common to allocate a stock to two or more specialists. Stocks enjoying high trading activity had as many

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as six competing specialists.[23] In the second half of the century, specialist competition became rare as listings increased.[24] Allocating an increasing number of stocks to multiple specialists risked fragmenting the market in these stocks and thus diluting liquidity, rendering it more cumbersome for a broker with a large order to complete a market transaction.[25] Nevertheless, specialist competition remained, in theory, a sound principle of market control, and the Exchange sought to reintroduce it in a new form in the late 1970s, as discussed below.[26]

The NYSE's administrative "suprastructure" or organizational hierarchy in support of floor trading operations gradually evolved over 200 years, mainly in response to external challenges and the new opportunities offered by breakthroughs in information and communications technologies. Top-down surveillance and enforcement by a professional staff largely independent of the floor community became areas of organizational growth in the second half of the twentieth century.

"There were a few milestones in the evolution of the top-down surveillance and enforcement suprastructure of the NYSE." The merger in 1869 between the NYSE and its main competitor, the Open Board, doubled the membership of NYSE to 1,060. The resulting scaling up of operations necessitated not only greater specialization of broker functions on the trading floor (see chapter 2) but also the steady expansion of the administrative supra structure. By the turn of the twentieth century, the NYSE had a Governing Committee (or board of governors), composed of a president, a treasurer, and 40 members "vested with all…powers necessary for the government of the Exchange, the regulation of the business conduct of its members, and the promotion of its welfare, objects and purposes."[27] As of the NYSE Constitution of 1902, the Governing Committee was assisted by 12 standing committees composed of prominent floor members, including two key bodies dealing with surveillance and enforcement. The seven-member Committee of Arrangements was responsible for "the general care and supervision of the Exchange" and charged with "enforc[ing]…all rules and regulations necessary to the conduct of business, to good order and the comfort of the members, and consider[ing]

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all complaints of violation of said rules";[28] and the nine-member Arbitration Committee was tasked with "investigat[ing]…and decid[ing]…all claims and matters of difference, arising from contracts subject to the rules of the Exchange, between members of the Exchange, or…between members and non-members."[29] More committees were added in the following years, including the Business Conduct Committee, which was mandated with monitoring price movements on the floor and had full authority to investigate cases of erratic or suspicious fluctuations.

By the late 1930s, the sprawling committee system was in need of rationalization to improve organizational efficiency, and the president of the Exchange appointed the special Committee for the Study of the Organization and Administration of the New York Stock Exchange. This committee was headed by a prominent businessman—Carle Conway, chair of the board of the Continental Can Company—and comprised five representatives from NYSE MOs as well as four nonmembers. In early 1938, the Conway Committee issued its final report, noting that "while the recommendations…appear to involve a radical alteration of [the] administrative machinery, the necessary changes really represent merely another step in the long evolutionary development of the Exchange as the Nation's primary securities market."[30] The Board of Governors unanimously adopted the report, and a revised constitution incorporating most recommendations came into effect in May 1938.[31] One month later, the board elected its first salaried president, William McChesney Martin—a member of the Conway Committee and the principal author of its report.

Two aspects of the changes are particularly noteworthy: first, the changes transferred administrative responsibilities from the old standing committees to a full-time professional staff largely independent of the floor members. The report justified this innovation as follows: "Freed of administrative details, the Committees will look with broader perspective at the problems of the Exchange in relation to the public and should be better able to frame appropriate policies as the need for them arises."[32] While this is true, the innovation also strengthened the hand of the president and his administrative staff in dealings with the floor. Second, the changes simplified

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the management structure, reducing the number of standing committees from 17 to 7 and laying the foundation of a streamlined top-down surveillance system that eventually gave rise to the powerful Market Surveillance Division, with its sophisticated organization and modes of operation in the second half of the 20th century.[33]

The Market Surveillance Division. The bulk of monitoring activity within the division was organized into two departments: the Floor Surveillance Department, which focused on the operations of specialists, and the Trading Surveillance Department, which principally monitored transactions involving nonspecialist MOs as well as nonmembers.[34]

The Floor Surveillance Department staff had access to a wide range of specialist trading data collected initially in two main ways. First, specialists were required every year to submit full reports of purchases and sales for their own accounts for eight one-week spot-check periods selected at random by the Exchange (so-called surprise audits). Second, specialists were asked to provide detailed trading data (i.e., specialists' book sheets, records of dealer transactions, copies of market and limit orders, commission receipts, execution reports, clearing sheets, etc.) whenever a price movement looked unusual.

The job of the department's surveillance analysts consisted of checking these records and, where suspicion arose, meticulously reconstructing the trading events in the market for a stock to assess whether the specialist had maintained fair and orderly markets. Market reconstruction involved placing the orders in their proper sequence according to the time they were entered on the floor or received by the specialist and mapping when and how the specialist participated in the trade. The reconstructed sequence was then reviewed for compliance with various Exchange rules. The analyst also had to consider external information that may have influenced prices or order execution, such as the announcement of an important new development affecting the company or the publication of a sector-specific research report. When an unusual trading pattern could be linked to such external information, the analyst's suspicion was allayed.

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In the 1970s, the Exchange introduced two communication channels or "hotlines" to assist the Market Surveillance Division in spotting problems. In 1976 it implemented the Institutional Complaint Service allowing institutional investors to directly communicate with the market surveillance staff; in 1978 a similar line was opened to chief executive officers of listed companies.[35]

The analysts' work of data collection, storage, and retrieval for purposes of examination benefited enormously from the application of powerful new computer technology to market operations beginning in the second half of the 1970s. The Designated Order Turnaround (DOT, later SuperDOT) System received and reported small orders directly from and to member firms' offices; the Limit Order Processing System collected limit orders and reported their execution; the Opening Automated Report Service (OARS) processed orders received before the Exchange's opening transaction; the Trade Comparison and Settlement System ensured the quick comparison of executed trades to minimize discrepancies between buyers and sellers; and the Market Data System processed all sale and quotation data. These and other systems were continually upgraded and expanded under the Facilities Upgrade and the Capacity Increase Programs.

This array of new systems enabled the generation of daily and weekly reports on specialists' trading activities. The reports were delivered to the analysts for review, and suspicious trades could be identified with relative ease. Another innovation was the electronic Audit Trail launched in 1981. It captured and recorded every aspect of an Exchange transaction, from order entry to trade reporting,[36] creating a huge database for automated surveillance programs.[37] In the days before computers, reconstructing a day's trading activity could take weeks. Electronic data systems and computerized surveillance programs reduced the task to a matter of days or even hours.

In short, new computer technologies tremendously improved the speed, efficiency, and effectiveness of top-down surveillance by the 1980s. As noted by one specialist: "The Exchange sees every trade we make.... They can see 'the book' because it's all electronic. They have the whole surveillance system that is constantly looking

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over what we do. They may not look at all that information or compare it every day, but [they can] literally go through all the orders and compare them to the book, [and] rebuild the average day that week.... So if you are going to play games, you are pretty foolish."[38] Another specialist observed: "The audit trail...gives the broker's badge number and the exact time the trade takes place...[en]abl[ing the] recreat[ion of] a day's activity in any stock in a matters of hours.... It seems like [we live]...in the world of Big Brother."[39] Finally, as explained to me by a retired specialist: "[Market] reconstruction...became very elaborate, even to include what brokers were in the crowd, who was approaching the crowd, and who was leaving. This could be reconstructed, for example, if a broker's number was recorded making a trade in say IBM at 12:04:45 and you knew it took 22 seconds to walk from the IBM crowd to the crowd in question. Surveillance could then determine if that broker was involved in a trade being questioned or had not yet arrived."[40]

Rule Enforcement

Surveillance without a proper enforcement system is largely impotent. The nuts and bolts of NYSE's enforcement system show a striking contrast with the situation in today's capital markets, detailed in chapter 4.

A surveillance analyst who concluded, after checking trading reports and reconstructing trading events, that discrepancies and inconsistencies were suggestive of rule violation would forward the preliminary findings to the Trading Investigations Section of the Market Surveillance Division. The Investigations Section broadened the examination by conducting further statistical tests and questioning all participants involved in a trading transaction. It would then present its findings to the vice president of floor surveillance for a final determination of whether a violation had occurred and, if so, what course of action to take. Actions to be taken depended on the severity of the rule violation. Minor violations faced nondisciplinary actions, whereas serious violations triggered formal disciplinary proceedings.

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The division distinguished three *nondisciplinary* actions:

1. *"Spoken to"*: In the case of a minor or "marginal" rule infraction—for example, where a specialist in attempting to maintain a fair and orderly market could have participated in the market to a greater degree as principal or effected a transaction at a smaller price variation, the manager of trading investigations would meet with the specialist for a "chat." This action advised the individual of the surveillance staff's concern and, in effect, put the specialist on notice.
2. *Verbal Caution*: The manager of trading investigations would administer a verbal caution when a specialist failed to improve his performance in providing proper market depth and price continuity despite having been spoken to once before.
3. *Cautionary Letter*: When a specialist repeatedly failed to heed the manager's advice or concern, a cautionary letter was sent.

Formal *disciplinary* proceedings were initiated when a specialist had engaged in trading behavior in clear violation of his positive or negative obligation. The Investigations Section would prepare a Charge Memorandum and present the evidence to a Hearing Panel[41] in trial-type proceedings; that is, both the Exchange and the accused specialist had the right to present documentary evidence and call witnesses, and both sides, as well as the panel members themselves, had the right to cross-examine witnesses. After closing statements by both parties, the panel met in closed session to decide by majority vote. Penalties imposed in disciplinary cases included censure, fine, suspension, and expulsion. It was possible to settle a case by consent judgment before reaching the full trial stage. A defendant had the right to challenge the verdict of the arbitration panel before the Exchange's Committee for Appeal, the SEC, or the Federal Courts of Appeal. Table 3.1 offers a glimpse of the enforcement activities of the NYSE.

I found few other documents with detailed enforcement data in the NYSE archives. One internal document—an undated

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TABLE 3.1. Specialist Surveillance and Enforcement Actions in NYSE's Surveillance Division in 1981

Total number of trading reviews by the Specialist Surveillance Section	28,800*
Investigations opened	403
Investigations closed	436
No action	184
Nondisciplinary Cases:	
"Spoken to"	115
Verbal cautions	78
Cautionary letters	56
Disciplinary Cases:	
Settlement (Pretrial)	9
Panel Hearings held:	11
Not-guilty verdict	1
Fines	4
Suspensions	3
Permanent bars	1
Appeals filed	2

Source: Market Surveillance Services of the New York Stock Exchange, *Report to the Securities and Exchange Commission*, July 20, 1982, pages IV-4 and V-7, NYSE Archives, Mahwah, NJ.
*Estimation based on data offered in the *Report to the SEC* on page III-9.

memorandum from the investigations group of the Surveillance Division—gives aggregate data that is largely consistent with the figures in table 3.1. It covers the years 1970 to 1973 and puts the yearly average number of investigation cases at 306, a number below the 1981 figure but in line with it once adjusted for the lower trading volume in the early 1970s.[42] For the same period, the average annual number of panel hearings was six.[43]

It thus appears that disciplinary cases were generally quite rare. Pondering this low number of cases, the author of the memo suggested: "The mere process of an investigation has a prophylactic effect and it is entirely possible that few enforcement actions are required because of the high standards, capability and/or effectiveness of the specialist." An alternative hypothesis is that enforcement standards were generally quite lax. However, my distinct impression, based on interviews with former floor members, a senior counsel, and a leading regulator, as well as from my reading of

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archived minutes of board of directors' discussions on enforcement matters, is that the former possible explanation is much more likely than the latter. This impression is consistent with the assessment of the Batten Committee (see next section), a special committee of five leaders of corporate America set up in the mid-1970s to investigate the specialist system: "It is clear from the number of investigations that the Exchange has a comprehensive and active surveillance system. We have found no indication that clear-cut violations of the rules are allowed to go unpunished."[44] The concluding observations and illustration in Box C concur with this view.

Box C. A Robust Enforcement System

Observations on enforcement, with illustration, from Robert Seijas

NYSE had developed a very powerful and effective surveillance and enforcement system by the 1980s. The system was so good that cheating was rare. Criminologists will tell you that it is not the severity of the punishment that deters; it is the certainty of it. All of the cases I can remember were performance issues, not dishonesty. The investigations were quiet and internal, but once a verdict was reached it was always reported to the press. This had a strongly deterrent effect. The Exchange always wanted to appear on top of monitoring, and it aggressively policed itself. As a self-regulatory organization it was essential for its good reputation to be able to say: "See? We found it and we fixed it."

Our surveillance and enforcement system was the envy of the Street. In fact, both the SEC and the National Association of Securities Dealers (NASD) wanted the NYSE to take over surveillance of the NASDAQ market. [Chief Executive Officer and Chairman of the NYSE Board of Directors] Grasso refused, saying it was a unique part of the NYSE brand and distinguished us from other markets.

I remember one case in which a stock was falling in response to bad news. The specialist made a superb orderly market for over four hours, absorbing stock and losing a lot of money. Finally, he had to go to the men's room badly and put his young assistant in charge for 8 minutes, telling him: "Don't buy this thing, it's got more to go on the downside." He meant not to try to take a stand. Unfortunately, the kid took him literally, and the stock declined $\frac{3}{4}$ without any specialist participation. When the specialist came back, he resumed making a great market until the stock finally stabilized in the afternoon. Market Surveillance charged him with failure to make an orderly market for the 8 minutes and fined him $50,000.

I sat on the Panel that heard the case. I attempted to make the point that 4 hours of superb performance (and a substantial money loss in doing

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so) mitigated an 8 minute lapse. Another panel member, Edward Kwalwasser [executive vice president in charge of market surveillance, enforcement, and member firm regulation], retorted: "Don't tell me he stopped at 20 red lights and only passed one." It was hard to argue with that, and it speaks to the rigor of the process.

Market Performance and Quality

Major overhauls of governance systems tend to occur against the backdrop of prolonged crises in the wider economic, political, or social environments in which these systems operate. This has certainly been borne out in the case of securities markets. The Conway Committee of the 1930s was established in the wake of an unprecedented meltdown in capital markets during the Great Depression. By the 1950s and 1960s, financial markets were booming. The Dow Jones stock market index[45] grew almost 600 percent in this period. Life was good and markets operated smoothly, so other than the usual fine-tuning of operations, no obvious need existed to restructure the market governance system.

Then, in January 1969, the stock market began its deepest and most prolonged post–World War II decline. By the summer of 1970, the Dow Jones had dropped almost 40 percent, dipping just below levels first reached in 1961. In early 1973, an even more spectacular downturn set in, with stocks falling in value nearly 45 percent over two years, to levels not seen since the late 1950s. Prices tended to drop in a series of sharp declines, each followed by a slight recovery and a deeper drop, wiping out much of the great bull market of the postwar era. The securities industry was in deep crisis,[46] and it remained in crisis for most of the 1970s.[47]

Stock prices mirrored the malaise of an economy mired in stagflation—stagnation combined with stubbornly high inflation. The massive cost of the Vietnam War and the expansion of social programs under President Nixon,[48] without commensurate tax increases, pushed inflation up in the early 1970s. When in 1973 an oil embargo by the Organization of the Petroleum Exporting Countries

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(OPEC) triggered a massive 387 percent hike in oil prices, the economy tanked.

Some observers, however, blamed economic decline and the wild gyrations in stock prices on greed and corruption on Wall Street, at least in part. Short-sellers, "bear raiders,"[49] speculators, criminals, and consorts were said to be fleecing the small investors once more and driving markets into the ground. The NYSE was being tarred with the same broad brush as the rest of Wall Street. The Exchange's reputation—its most valuable asset—was at stake. Alarmed, NYSE management realized it had to act to silence its critics, assure the public, and regain investor trust and confidence. It also needed to deal with urgent new challenges, most notably the intensification of competition from regional exchanges,[50] over-the-counter (OTC) markets,[51] and a new type of actor—automated electronic trading platform providers.[52]

In its first response to these many issues, in early 1971, the NYSE Board of Governors invited William McChesney Martin—the author of the Conway Committee report, reformist NYSE president in the late 1930s, and then four-time chair of the Federal Reserve Board[53]—to "undertake a thorough study of the Constitution, Rules and Procedures of the Exchange to determine how the Exchange can best serve the public, the financial community and the national economy."[54] Over five months, Martin sought the views of all segments of the financial community and wider public. His report, delivered in August 1971, made several crucial recommendations. One such recommendation was the creation of "an organization which, through the *public representation* on its governing board and the authority and independence of its management, will strengthen and answer the prevalent criticism that member firms of the NYSE cannot be expected to discipline themselves."[55] Specifically, he envisaged a governing body consisting of 10 public directors from the corporate sector and investing public, including mutual fund and trust companies, and 10 directors from the NYSE membership. This new board of directors would have a full-time salaried chairman serving as the Exchange's chief executive officer. The board would be the policy-making body with authority

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to propose amendments of the rules and the constitution to the membership for approval. The recommendation was well received by the Exchange for it offered a relatively simple and effective way of appeasing the critics.[56] It also, more generally, responded to a new zeitgeist clamoring for greater transparency and public participation in institutions of national importance. The new board began to operate in July 1972.[57]

A second major recommendation in the Martin report was more daring and original. It addressed the mismatch problem caused by the discreteness of rules and fluidity of markets mentioned at the outset of this chapter. The governance challenge was to devise a means of encouraging high levels of market-making performance beyond rule compliance. Martin's idea was as simple as it was elegant: the Exchange had direct responsibility for allocating specific securities to specialists. And, as we have seen, these specialists were under constant surveillance to ensure that their market-making operations were rule-compliant. Failure to obey Exchange rules was punished. But why not use surveillance to also *reward* specialists who provided particularly effective markets by linking stock allocation to performance? As put by Martin: "Allocations of securities, which are valuable franchises, should be governed by clearly defined performance criteria against which all specialists should be judged. Once such criteria are established, specialists would have the incentive to meet them, and as a result, effective regulation of the specialist system would become an easier task."[58]

The newly constituted board of directors agreed with Martin that specialist performance should be a major factor in stock allocation decisions. There was a growing feeling that lackluster performance by some specialists was taking a significant reputational toll on the entire membership. This sentiment was well expressed by one specialist: "The best specialists are very good, but there are a few who are unsatisfactory. And we are collectively measured by the weakness of the few."[59] In response, the board established a special group, the Committee to Study the Stock Allocation System, in May 1974, to be chaired by William Batten, the retired head of the department store JC Penney.[60]

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The committee delivered its voluminous report to the board in January 1976. It echoed the concern that "allegations of unsatisfactory market-making…do serious harm to the reputation of all specialists and of the Exchange market,"[61] adding that "while not all of [the criticism]…is informed and accurate, failure to recognize and act upon it will create and intensify negative public attitudes toward the Exchange."[62] And, crucially, the committee noted: "We have heard allegations of poor business practices, but we have seen no proof of clear-cut violations of [specialist obligations].… Yet more precise rules do not appear to provide a solution; *ever-changing market conditions would require so many exceptions to precise standards as to defeat their purpose*."[63] Nor did the committee think that a stronger enforcement apparatus would make a difference, for disciplinary proceedings tend by nature to be protracted and time-consuming. Instead, the committee concluded that "it should be possible to reallocate stocks from one specialist…to another, for the sole purpose of improving performance, and without reliance upon the disciplinary system."[64]

To achieve an effective stock allocation system, the committee proposed adding a body to the Exchange's administrative suprastructure that would focus on market quality and performance. This new structure, it was hoped, would improve specialist performance, enhancing the quality and reputation of the NYSE, and thus help maintain the competitiveness of the Exchange. As ultimately agreed, this addition comprised three permanent committees: a board-level Quality of Markets Committee, charged with overseeing the implementation of the Batten Committee recommendations, and two operating committees accountable to it: the Market Performance Committee and the Allocation Committee. The Quality of Markets Committee, which counted eight board members, also advised on matters relating to strategic planning, trading systems, and regulation.

Evaluating Market Performance. The two principal responsibilities of the Market Performance Committee (MPC) were, first, to adopt and improve methods for evaluating specialist performance, and,

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second, to work closely with specialists to improve performance judged to be unsatisfactory. The committee was assisted in these tasks by the staff of the Performance Evaluation Department in the Market Surveillance Division.[65]

The MPC proposed, evaluated, and updated market-making assessment methods that generated both subjective and objective performance data. A principal method was the Specialist Performance Evaluation Questionnaire (SPEQ), a subjective survey instrument administered quarterly to enable floor brokers—the specialists' customers—to rate performance in terms of the specialist's ability to bring buyers and sellers together, cooperate and communicate with floor brokers, control the trading crowd, and maintain a fair and orderly market.[66] The questionnaire was revised on average every three years to improve the relevance and quality of brokers' ratings and comments.[67]

The performance data gathered through the SPEQ was complemented by information corresponding to three types of objective performance measures: first, *quality of market indicators*, such as price continuity,[68] quotation spreads,[69] market depth,[70] the specialist's participation in trading as principal (or dealer),[71] and the specialist's stabilization rate (i.e., the degree to which the specialist participated against the prevailing market trend);[72] second, *systems performance indicators*, including the speed with which a specialist executed a market order received via the DOT system against bids and offers on his book and reported execution details electronically back to the initiating member firm, as well as the specialist's response time to investor queries received via DOT concerning the status of an order;[73] and, third, *competitive indicators*, such as data comparing the specialist's bids, offers, and quotation spreads in a stock with the best bids, offers, and spreads offered for the same stock in competing markets, or market share data showing stocks in which order flow was being lost to the competition. The performance measures were tracked electronically, and failure by the specialist to attain performance guidelines or standards was noted. New objective performance indicators and benchmarks were introduced over the years and old ones refined.[74]

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The MPC's second major responsibility was to organize counseling sessions with specialists who showed areas of weakness in order to discuss ways of improving performance before it deteriorated to levels where rule violation was likely. If repeated counseling and advice failed to achieve the desired results, the MPC had formal authority to initiate reallocation proceedings in any stock in which it believed performance would be improved by transferring it to another specialist. The threat of nondisciplinary reallocation spurred constructive competition among specialists for high overall rankings. Highly ranked specialists stood the best chance of obtaining reallocated stocks as well as gaining new allocations.

Five years after the introduction by the MPC of the various measures to assess and improve specialist performance, the Market Surveillance Division reported to the SEC: "The Exchange has found…[these measures to be] most effective in motivating those specialists, whose questionnaire scores show a tendency toward slacking service, to upgrade their performance…. The authority to reallocate stocks…has greatly strengthened the impact of broker evaluations. In day-to-day business…on the Floor, this impact translates into specialists being accountable to their customers—the brokers representing public orders—and responsive to their needs. This accountability and…responsiveness have resulted in significant improvement in the interaction of market participants on the Floor."[75]

Stock Allocation. The Allocation Committee was responsible for setting and publicizing stock allocation criteria. It invited applications from specialists and made decisions on allocation. In reaching such decisions, the committee considered a wide range of data, including the SPEQ-based "grade" of a specialist, dealer participation and stabilization rates for each of the stocks managed by the specialist, and information on the specialist's firm, such as overall performance ranking, disciplinary or cautionary actions, staffing levels, stocks gained or lost in recent years, and capital levels.

Historically, the Exchange had always had a committee or group charged with allocating stocks to specialists.[76] After the Martin

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report and subsequent reorganization of the Exchange in 1972, for example, the responsibility for stock allocation belonged to the Floor Committee, consisting of nine specialists and six nonspecialist floor members.[77] The fact that specialists formed the majority on the committee seemed justified given their special expertise in judging market-making skills. However, as pointed out by critics, specialists were also the most directly affected by allocation decisions and thus susceptible to a potential conflict of interest. Moreover, critics complained about murky allocation criteria and the Floor Committee's lack of explanation of its allocation decisions. Some suspected that decisions were made on the basis of personal friendships and quid pro quo arrangements.

The Batten Committee echoed many of these concerns, noting that "allocation decisions will continue to be suspect in the minds even of reasonable observers so long as the decision-making process is seen to be dominated by specialists, and the decisions are taken in private, based upon generalized and little known criteria, subject to no formal explanation, and given no meaningful review by the Board."[78] The composition of the Allocation Committee thus became a matter of central importance to the Batten Committee, and it remained an important issue in governance discussions for the next two decades.

The Batten Committee responded to critics by overhauling the allocation system. The new Allocation Committee comprised nine members selected randomly by the Exchange staff from a 36-person Allocation Panel. Crucially, specialists were now in a minority: the Allocation Committee had only two specialists, and the Allocation Panel just eight.[79]

Stock allocations were highly competitive affairs. For example, in 1977, the stocks of 47 newly listed corporations and one reallocated stock were on offer. On average, 11 applications were received for each stock.[80] One year later, a total of 55 stocks were allocated, and the ratio of applications to each stock on offer increased to 35.[81]

In the 1990s, the Quality of Markets Committee acted again, in response to concerns expressed by listing companies about their lack of involvement in the allocation process. The Quality

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of Markets Committee acknowledged: "Companies ha[ve] often pointed out that they ha[ve]…the ability to participate directly in the selection of their investment bankers, lawyers and accountants…[but] the Exchange, in contrast, permitted only limited input in the specialist selection process."[82] It established an Allocation System Review Committee to consider ways of enhancing the allocation mechanism.

The Review Committee made recommendations on four occasions that led to far-reaching changes. As a first step, listing companies were invited to submit letters stating their preferred specialist firms; the Allocation Committee then considered these preferences when deciding on allocations. The next step, remarkably, transferred the authority to make a final selection to the listing company. The Allocation Committee compiled a short list of deserving specialist firms, and the companies then interviewed the finalists to decide on the winner. Unsurprisingly, these changes proved wildly popular with companies.[83]

In sum, within the span of 20 years—between 1976 and 1996—the Exchange moved from an allocation system controlled by specialists to one that gave a previously excluded stakeholder group the final say. The change significantly improved both accountability and responsiveness in a sensitive part of the Exchange governance system.

Evidence of Market Quality Improvement. Did the various governance changes improve market quality over time? The evidence based on four main quality indicators—market share, quotation spreads, price continuity, and market depth—generally suggests an affirmative response.

Figures 3.1 and 3.2 compare the NYSE percentage of all trades in public securities markets with the percentage of its domestic rivals—namely, the Boston Stock Exchange, Chicago Stock Exchange, Cincinnati Stock Exchange, Philadelphia Stock Exchange, Pacific Stock Exchange, and the New York–based NASDAQ. Figure 3.1 lists the market shares of NYSE's competitors individually, and figure 3.2 aggregates them. Figures 3.3 and 3.4 offer the

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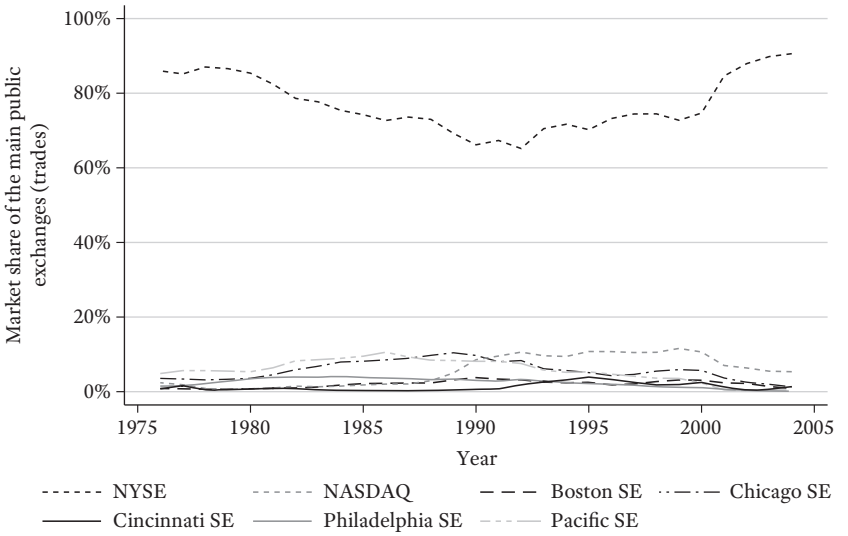

FIGURE 3.1. Market share by trades—all public exchanges. *Source:* "Nysedata" set, NYSE Archives, Mahwah, NJ.

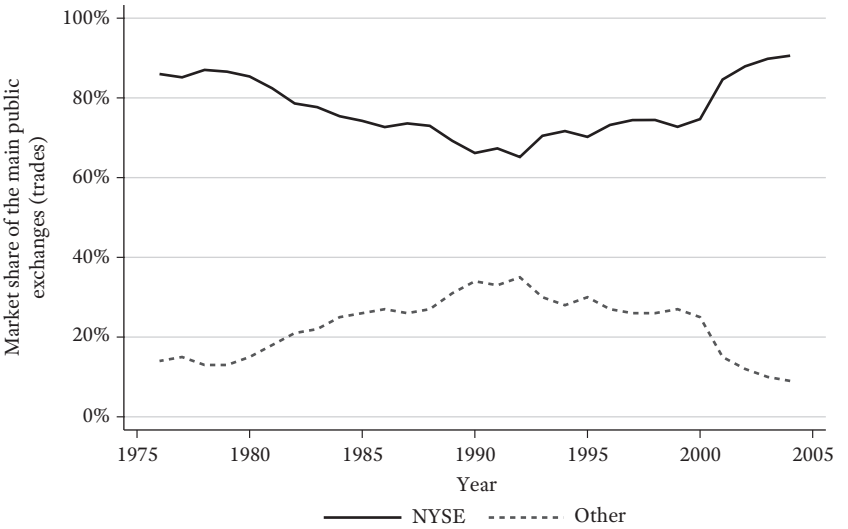

FIGURE 3.2. Market share by trades—NYSE versus the others. *Source:* "Nysedata" set, NYSE Archives, Mahwah, NJ.

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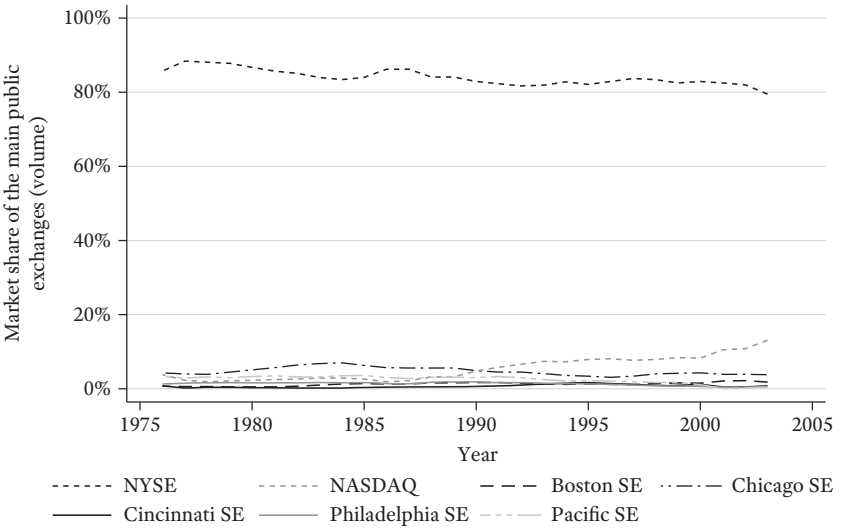

FIGURE 3.3. Market share by volume—all public exchanges. *Source:* "Nysedata" set, NYSE Archives, Mahwah, NJ.

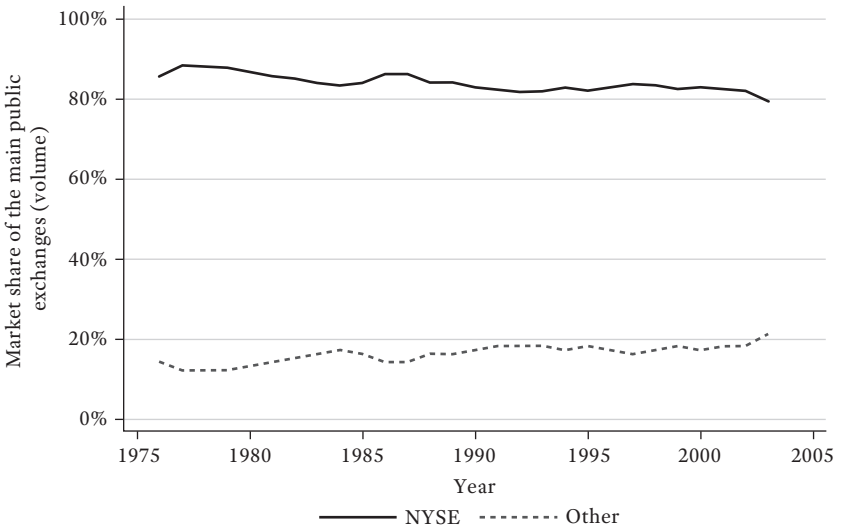

FIGURE 3.4. Market share by volume—NYSE versus the others. *Source:* "Nysedata" set, NYSE Archives, Mahwah, NJ.

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same comparison but consider trading volume (number of shares traded) instead of the number of trading orders. The overall conclusion from these figures is that the Exchange successfully defended its position of market dominance until the mid-2000s, when the adoption of the Regulation National Market System brought about the sudden demise of the old NYSE (see chapter 2).

The NYSE faced persistent pressure from its competitors, however, and success was not a foregone conclusion. This is perhaps most evident in figures 3.1 and 3.2, showing a relative decline in NYSE's market share of total trades from the late 1970s to the early 1990s. This trade diversion was a matter of great concern and continuous debates within the Exchange. For example, the Quality of Markets Committee, which closely tracked and analyzed trade diversion, noted in 1985: "The Exchange's overall market share of volume fell from 85 percent in 1984 to 84.2 percent in 1985. Sharp market losses in small order flow can be attributed to the establishment of specialist operations on regional exchanges by large retail [broker-dealer] firms, and the resulting diversion of order flow to those regional exchanges."[84] These few large firms—all NYSE MOs[85]—established the specialist operations to avoid paying NYSE trading commissions.[86] This trend alarmed the board of directors. It noted: "The loss of small-order market share is significant not so much because of the revenue loss to the Exchange, but because smaller orders play a very significant part both in the…[market price discovery] mechanism and in assuring the maintenance of fair and orderly markets in listed stocks."[87]

In response, the Exchange embarked on a concerted effort to recapture the small-order flow from its public competitors, for example, by improving the small-order-delivery and reporting features of the Super DOT, OARS, and Limit Order Processing System. Other initiatives included the creation of the Competitive Position Advisory Board, charged with reviewing data on market share on a monthly basis and recommending operational improvements to the Quality of Markets Committee and the board.[88] All of these efforts bore fruit and reversed the declining trend around 1993.

The trends in figures 3.5 to 3.7 also indicate steady improvements in NYSE market quality. Figure 3.5 shows the percentage of

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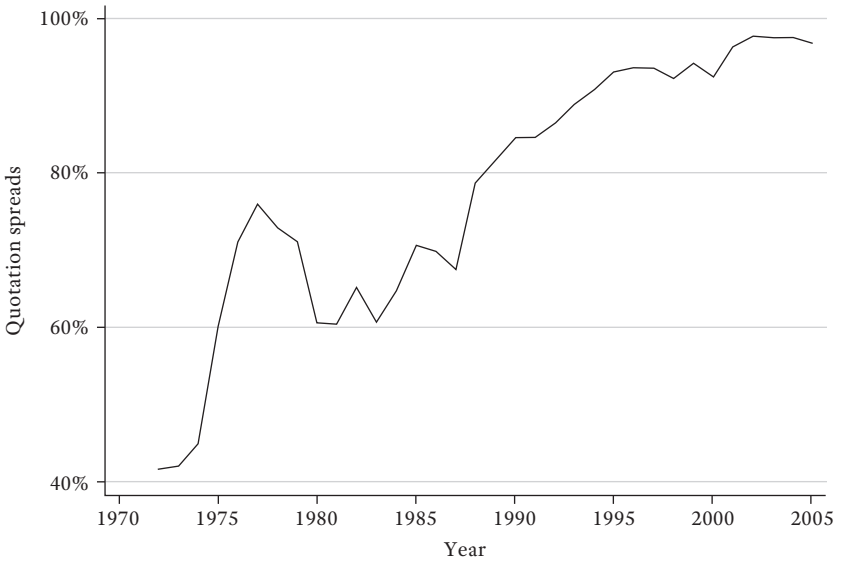

FIGURE 3.5. NYSE quotation spreads, 1972–2005. *Source:* "Nysedata" set, NYSE Archives, Mahwah, NJ.

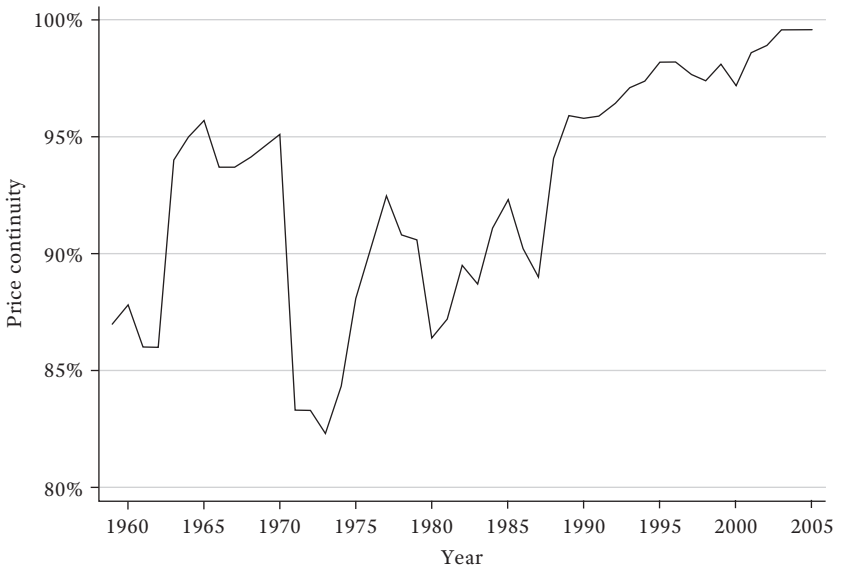

FIGURE 3.6. NYSE price continuity, 1959–2005. *Source:* "Nysedata" set, NYSE Archives, Mahwah, NJ.

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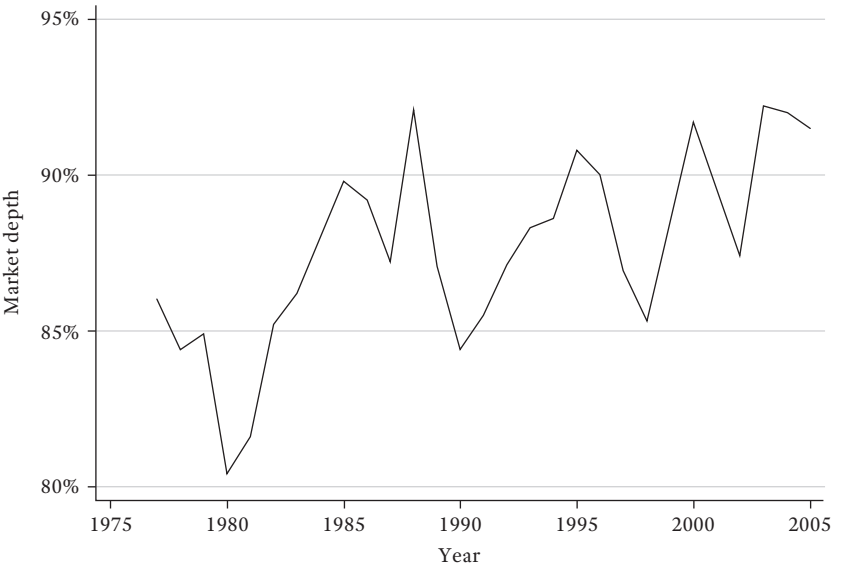

FIGURE 3.7. NYSE market depth, 1972–2005. *Source:* "Nysedata" set, NYSE Archives, Mahwah, NJ.

reported NYSE quotations with a price difference of 25 cents or less between bids and offers from 1972 to 2002, and a bid-offer spread of 15 cents or less from 2003 to 2005. Narrow spreads are considered to be an indication of good market-making performance. Over time, the spreads continuously narrowed. By 2002, 60.3 percent of all NYSE quotations had a spread of 5 cents of less; by 2005, the percentage had risen to 78.5. The average (volume weighted) spread was 3 cents by 2004 compared with 19 cents in 1994.[89] Also significant is that approximately 95 percent of Exchange bids and offers were equal to or better than the best bids and offers disseminated by the other public markets. Finally, it is important to bear in mind that the NYSE market, where specialists in effect conducted "continuous auctions" in specific stocks, allowed for price improvement through crowd participation. For example, a broker in the crowd around the specialist could buy the shares that another broker was seeking to sell by offering a price that was higher than the best bid displayed by the specialist.[90]

An orderly market exhibits trades that are close in price to the previous trades. The specialists achieved such price stability by

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buying and selling as principals (dealers) against the prevailing market trend. Figure 3.6 gives an indication of NYSE's ability to generate price stability. Specifically, it shows the percentage of orders from 1959 to 2001 executed with a price difference of 12.5 cents or less relative to the immediately preceding trades, as well as the share of executed orders from 2002 to 2005 with a price variation of 10 cents or less. The shares rose from 82.3 percent in 1973 to 99 percent by 2005.

A similarly positive trend can be seen in Figure 3.7 on market depth. Market depth is an indication of the buying and selling pressure a stock can withstand before the price changes. The greater the depth, the more likely investors can trade without triggering significant price movements. The Exchange set depth guidelines in terms of desirable maximum price movements (high-low range) for a given volume of trading in a stock. Figure 3.7 shows the percentage of trades of a total of 1,000 shares (up to 1988) and 3,000 shares (thereafter) that did not shift prices more than 12.5 cents (benchmark used until 2000), 12 cents (2001), and 10 cents (2002 to 2005). Here again the general trend suggests an improvement in market depth on the NYSE.

Moving into the Twenty-First Century

At the dawn of the twenty-first century, the NYSE was the world's preeminent global equity market, listing 2,768 companies from 48 countries.[91] Its global appeal was attributable in large part to a comprehensive governance system that had evolved over two hundred years. Its strict regulatory standards, robust surveillance and enforcement, and effective reward system had earned it a reputation for market integrity and efficiency. This is not to deny that, like any complex organization, it also experienced failures and lapses. Yet the evidence strongly suggests that time and again NYSE proved itself adept at learning from such episodes and continued to strengthen its rules and control systems.[92]

The Exchange's investments in good market governance, however, were expensive. Continuous updates of its technological systems and regulatory activities devoured large sums paid for from

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trading and listing fees and other income sources. In 1966, NYSE expenditures were about $40 million. By 1976, they had grown to $84 million.[93] Some 20 years later, costs had reached $490 million—20 percent of which was spent on regulatory activities alone.[94] At the dawn of the twenty-first century, total annual expenses stood at about $1 billion. NYSE's biggest cost items were investments in its operational systems and related technical support.[95] They equipped the Exchange to regain business in the 1990s that had slipped to its rival exchanges in the 1980s. Only NASDAQ, its main domestic competitor, kept increasing market share by attracting start-ups and technology-focused firms.[96] However, NYSE consistently showed better performance metrics than NASDAQ—better prices, tighter spreads, lower price fluctuations, lower trading costs for institutional investors, and greater execution certainty.[97]

Not all was well, however. The profitability of dark trading via broker-dealer internalization was on the rise, and the Exchange's biggest members were increasingly unwilling to pay the cost of trading on the Exchange; in fact, they were plotting to kill the old NYSE (see chapter 2). The leaders of corporate America beyond Wall Street reacted with alarm. In a remarkably prescient report produced in 2000, they foresaw a series of problems with internalization.[98] Their views can be summarized as follows:

The public interest requires a market structure that attracts maximum liquidity for optimal price discovery and best possible order execution. Internalization, however, is a form of *market fragmentation*. Internalized orders do not form part of the central market pool of liquidity and thus are not given the opportunity for the price improvement that becomes available from exposing orders to the crowd on the floor. By trading internally against client order flow, the big broker-dealers buy stocks from clients at or near the public bid quote and sell them to other clients at or near the offer quote, keeping the spread as profit.[99] Internalization creates pools of shallow liquidity and limited competition that adversely affect the execution price as well as market quality and fairness. It also risks undermining price discovery. Internalizing brokers rely on public prices, thus free riding on NYSE's expensive price

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discovery mechanism—just as rival exchanges and off-exchange trading venues (so-called bucket shops) free rode on NYSE prices in the nineteenth century (see chapter 1). The authors of the report concluded: "We are deeply concerned that internalization is becoming more common . . . and will truly fragment the market, reducing overall market transparency, impairing price discovery and harming investors."[100]

The broker-dealer juggernauts were not going to be stopped by these concerns and warnings, however. They had the ear of the regulators. Swayed by the siren song of "greater market efficiency" resulting from the breakup of "complacent monopolies," the SEC joined the plot against the NYSE by adopting Regulation NMS. The Flash Crash of May 2010 shook the belief of the regulators. But it was too late. Market fragmentation had deepened and given rise to bad market governance that was imposing a high cost on investors.

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4

Stratification in Modern Trading

THE HAVES AND HAVE-NOTS

This chapter provides some essential background on modern trading and capital markets. First it explains the importance of speed in trading and traces the astonishing acceleration in the speed of trading in recent years. It then describes how market fragmentation, in combination with developments associated with globalization—in particular, technological progress, tighter cross-market links, and financial innovation—has expanded and transformed the realm of trading. The result of these two trends is that successful trading operations in today's high-speed complex capital markets have become extraordinarily expensive, requiring investments of tens or hundreds of millions of dollars in the latest information and communication technologies and super computing infrastructure. Speed and complexity have thus led to an acceleration and magnification of the stratification of market participants into two classes: the haves and the have-nots. The former include the high-speed market makers or liquidity providers, and the latter, the investing public. This stratification, whose origins were traced in chapter 2, has further skewed the distribution of power in capital markets in favor of a relatively small number of participants.

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Speed

In the long history of trading in capital markets, early possession of economic, political, and social news that is bound to affect market prices has always been highly valued. In the words of one trader: "Winning and losing…relies on information. Market participants who have first access to the best information are the ones who end up winning."[1] The first person to make a trade on early information takes all the profits by buying at a low price and selling high. The trader who comes in second—whether by a minute, a second, or a microsecond—will be out of luck.

The prospect of large profits in this winner-takes-all race has always exerted a powerful incentive on inventive minds to devise clever methods to acquire early information to beat competitors. History is replete with fascinating cases. In early 1791, for example, a reporter in the small town of New Brunswick, New Jersey, reported a peculiar change: "Not less than twenty express [coaches] have passed through this city within one week, from New York to Philadelphia.… They travel with uncommon speed, from which it appears that something of great importance is carrying on."[2] The cause of this change was the opening in 1790 of America's first stock exchange, in Philadelphia—then the financial heart of the nation. Ships carrying news from Europe likely to affect stock prices tended to dock in New York, a more easterly port, before sailing on to Philadelphia. "The speeding coaches that clattered from New York to Philadelphia carried speculators and stock-jobbers, agents of foreign investors, and inside traders with privileged information that could move the market, and make their fortune at the expense of the Philadelphia merchants."[3]

The Philadelphia merchants eventually found an ingenious way to beat the New York–based operators: they set up signal stations on high points across New Jersey. "The signalmen watched through telescopes as coded flashes of light brought news of stock prices…and other information. Relayed from station to station, the information could move from New York to Philadelphia in as little as ten minutes."[4] This remarkable high-speed

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flash system remained in use until the invention of the telegraph in 1844.

The telegraph network took many years to spread along the North American East Coast and westward, and the first transatlantic telegraph was not operational until 1866. In the meantime, creative businessmen developed new schemes to win the speed race. One such person was D. H. Craig of Boston. He conceived of the idea of training pigeons to act as messengers of European news. He regularly traveled with half a dozen of his pigeons to Halifax, the capital of the Canadian province of Nova Scotia and the closest North American port to Europe. There he boarded incoming steamers from Europe en route to Boston. "Once on board…he would secure copies of the latest dates [editions] of the European papers, and from their pages prepare a careful digest of the significant political and commercial news, written upon fine manifolded tissue paper. At the proper moment the pigeons were dispatched from the steamer on their homeward journey, and with fleet wings soon reached their destination, with valuable reports, which were quickly transcribed and distributed to Mr Craig's subscribers in Boston, and by telegraph to other cities."[5] His subscribers profited handsomely in their market operations from possessing early information.

Craig may have been inspired by another pioneer of news reporting, the German-born British entrepreneur Paul Reuter—best known for creating Reuters News Agency.[6] From 1847 to 1851, Reuter used carrier pigeons between Brussels and Aachen to bridge a gap in telegraph stations on the route from Paris to Berlin, thus offering the fastest news service between the two capitals.[7] Reuter, in turn, is likely to have been influenced by the Rothschild banking family, who in the first half of the nineteenth century developed a high-speed private communications system across Europe by substituting carrier pigeons for the much slower postal system. One such communication that is still extant was sent by Nathaniel de Rothschild in Paris to his father, Nathan Mayer Rothschild, in London. Written in August 1846 on a tiny 5×8 centimeter piece of paper that was then folded into a small container attached to the pigeon's leg, it read: "I hope our feathered messengers will have

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brought you in due time our good prices . . . AB . . . means: buy stock, the news is good; CD . . . means sell, the news is bad."[8]

The means of communication and the speed of trading have changed over time, but the logic of the information speed race remains the same: only a *relative* speed advantage will determine the winner. The speed race has moved from minutes and seconds a few decades ago to time units beyond human perception today: milliseconds (thousandths of a second), microseconds (millionths), and even nanoseconds (billionths). By way of comparison, the blinking of the human eye takes about 400 milliseconds and a nerve impulse reaches the brain in about 80 milliseconds—near eternities compared with the speed of modern trading.

Recent advances in the speed of communications have taken place through the development of several different technologies. For example, in September 2015, the American communications firm Hibernia Networks rolled out a $300 million, 6,021-kilometer high-speed subsea fiber-optic cable capable of attaining a round-trip travel time of 59.6 milliseconds between London and New York. This was 5 milliseconds faster than the previous record set only a few years earlier, but in January 2016 Dublin-based Aqua Comms Ltd. announced an even faster fiber-optic round-trip connection of 53.9 milliseconds between the two cities.

Over shorter distances, microwave technology offers even greater speed. While Mississippi-based Spread Networks achieved a one-way speed of 6.79 milliseconds between New York and Chicago in 2010 using the shortest fiber-optic cable connection laid to date, at a cost of about $300 million,[9] just two years later rival American communications firm McKay Brothers installed a $500 million microwave tower system[10] capable of reaching a one-way travel speed of 4.1 milliseconds between these two financial hubs. This was a remarkable 2.69 milliseconds quicker than Spread's fiber-optic cable and only 0.17 milliseconds slower than the speed of light itself.[11] The disadvantage of microwaves is that they carry less data (i.e., have lower bandwidth) than fiber-optic cables and are easily disrupted in bad weather (lower reliability).

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Laser beams, the newest data-transfer technology, have speeds similar to or even faster than microwaves, without microwaves' drawbacks. Employing a combination of laser beams and microwaves, Chicago-based Anova Technologies[12] now offers a record one-way transmission time of 3.99 milliseconds between Chicago and New York.

High-speed trading networks have also been spreading in Europe. British telecommunications giant Perseus Telecom Ltd. was the first to offer microwave communication services between Europe's two largest financial centers, London and Frankfurt, in October 2012, reducing the (round-trip) travel time from 8.35 milliseconds using fiber optics to about 4.6 milliseconds. An even faster microwave network between London and Frankfurt was installed by McKay in January 2015, shortening the travel time to 4.192 milliseconds.

And the race for greater speed continues. Microwave networks rely on tall line-of-sight towers that serve as relay sites. Each site has to regenerate the signal it receives, which requires time. The fewer relay sites, therefore, and the straighter the line of towers between two end points, the faster the travel time. In January 2017, in an effort to shave a few microseconds between London and Frankfurt, two telecom companies owned by three major American high-frequency trading (HFT) firms sought planning permission to build two giant relay towers near the English Channel.[13] At about 300 meters, these towers would be as high as the tallest skyscraper in the United Kingdom, London's 95-story Shard building completed in 2013.[14]

The involvement of trading firms in this proposal is also significant as it exemplifies a new trend of large trading companies racing to gain speed advantages by investing in their own communication networks rather than leasing communication capacity on systems owned and managed by independent providers. Another example is a project announced by a group of high-frequency traders in late 2016 to build a high-speed network between Chicago and Tokyo using wireless towers, fiber-optic landlines, and undersea cables.[15]

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A similar proposed project will connect New York/New Jersey and Sao Paulo, Brazil, in record time.[16]

Of course, these recent staggering advances in the speed of communication between financial centers have been complemented by the recent and similarly astounding progress in the speed of trading order execution mentioned in previous chapters. Progress in the speed of order execution in the 1990s meant moving from about 20 seconds per execution in traditional exchanges, such as the New York and London Stock Exchanges, to 2 or 3 seconds in the new rival trading platforms, the so-called electronic communication networks (ECNs).[17] In 2011, the Singapore Exchange introduced the then-fastest matching engine in the world, with speeds of just under 90 microseconds,[18] but since then microchips have been developed that are capable of executing trades in 740 nanoseconds. There is even talk of soon attaining speeds in picoseconds—in other words, in trillionths of a second.[19] Whatever the means, shape, and form of future communications, one thing is certain: as long as early information yields substantial trading profits, the speed race will continue, until—in the words of the chief executive of one of the rival communications firms—"we reach the speed of light."[20]

This dazzling speed race, however, has produced a significant casualty: its escalating cost has crowded out small investors. Two decades ago, many observers believed that the advent of the internet and World Wide Web would usher in a democratic revolution in financial markets by leveling the informational playing field between professional traders at big broker-dealer banks and small investors. Professional traders had access to vast resources to pay for timely data and expensive proprietary news, such as Reuters and Bloomberg. This gave them a clear informational advantage in trading. Small investors could not compete. Writing around the turn of the twenty-first century, a group of scholars noted: "The Internet, with its capability to communicate at the speed of light and the wealth of information available, has become a global electronic marketplace where individuals can meet and make exchanges. . . . [In this marketplace] information is cheap. Information is everywhere."[21] Real-time information was said to soon be available to all investors

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free of charge. Market democracy proved elusive, however. The furious pace of technological progress over the past decade, combined with the effects of globalization and market fragmentation, has turned markets into playgrounds or hunting grounds of "market oligarchs"—a relatively small number of powerful participants with extraordinary resources to spend on private news and trading data as well as the latest super computing technology. This transformation in power relations, in turn, has had fateful consequences for the governance of global capital markets, as detailed in chapter 5.

Globalization, Financial Innovation, and Stratification

Quantum leaps in the speed with which information travels shrink distances and connect previously discrete and self-contained economies and polities. They also tend to trigger a wide range of innovations that fundamentally transform many areas of economic, political, and social life. The revolutionary changes in communications and transportation in the second half of the nineteenth century, for example, ushered in the first era of modern globalization that lasted until the outbreak of World War I. This era was characterized by unprecedented levels of free trade in goods as well as openness in capital markets. Similarly, revolutionary changes in communication and computing technologies in the second half of the twentieth century gave rise to far-reaching global changes, affecting trade, services, industrial production, and transnational governance. These changes associated with the second era of globalization—particularly tighter cross market links, financial innovation, and speed—have altered trading practices as well as the distribution of power in markets, with deep implications for market governance and societal welfare more broadly.

Before the invention of the telegraph, businesses raised capital on their local exchanges, and the trading of their securities was a local affair. The telegraph removed the barrier of distance that had preserved local markets, and provided for nearly instantaneous communications between different exchanges. As a result, large

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companies now found it advantageous to raise capital on more than one exchange. The *Commercial and Financial Chronicle* noted in 1890: "Many new issues are listed almost simultaneously in New York and London."[22] Some were also listed in Amsterdam, Berlin, Frankfurt, and Paris.[23] The Canadian Pacific Railroad, for example, had about 24,000 investors worldwide by 1910. Sixty-five percent of its shares were held in Britain, 15 percent in continental Europe, 10 percent in the United States, and 10 percent in Canada.

Multiple listings and the growing ease of communications gave rise to a category of brokers called arbitrageurs, who specialized in trading between major exchanges. Arbitrageurs sought to profit whenever price differences arose across exchanges in identical securities, by buying low and selling high. Here again speed was of the essence. The *New York Tribune* observed in 1892 that "in order to benefit [from]…the difference in markets the transactions have…to be done quickly, and to facilitate the operation the brokers [arbitrageurs] use a system of signaling [to clerks] with the fingers from the floor of the exchange."[24] The clerks would then send the information to operators in the exchange's telegraph office with instructions to dispatch cables to the arbitrageurs' partners on other exchanges. The speed of such intermarket communications was remarkable. "An answer from London is expected in four minutes, within which time the telegraph operator in New York has transmitted the original message to the coast, another operator has sent it across the ocean, a third has sent it from the Irish coast to the London Stock Exchange, a transaction has been made on the London Stock Exchange, the report from London has passed through the hands of three different telegraph operators as before, and been delivered on the New York Stock Exchange."[25]

Such was the competition among arbitrageurs that every effort was undertaken to acquire the fastest communication means. "Those firms with private wires had their exclusive use and could keep them open throughout business hours, which gave them a small but crucial time advantage over those firms using the public [telephone and telegraph] system."[26] The arbitrage business was concentrated in the hands of those firms capable of spending the

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largest sums on private communication lines. At the turn of the twentieth century, only 28 of the 563 NYSE MOs were conducting arbitrage business.[27]

In today's era of globalization, arbitrage is no longer an exotic or specialized form of trading; it has become the staple of trading—arbitrage operations of various kinds represent the bulk of trading in capital markets. Markets across North America, Europe, Asia, and other parts of the world are now tightly connected and enmeshed in a global electronic trading grid; and many of the largest corporations are listed in several exchanges, giving rise to cross-market arbitrage.

Trading venues have proliferated within the various regions as a result of market fragmentation; this has further expanded the scope for arbitration. Meanwhile, financial engineering has dramatically increased the number of products traded in and across a growing number of markets, boosting arbitrage trading still further. Such financial innovation, market fragmentation, and tighter cross-market links have deeply transformed trading over the past decade. This transformation has affected the distribution of power in capital markets.

A prominent example of a new financial product is the so-called exchange-traded fund (ETF). An ETF is a pooled investment vehicle (or a fund) that invests in assets (e.g., stocks, bonds, gold, currencies, futures) like a mutual fund but, unlike a mutual fund, divides ownership of those assets into shares that are then traded like stocks on an exchange throughout the day.[28]

The first ETFs were created in the early 1990s, and growth has been explosive. By 2016, 4,779 ETFs existed worldwide with a total capital value of $3.4 trillion.[29] Most ETFs track a stock index and thus are "passively" managed; that is, the ETF manager need not bother with costly research in order to make investment decisions but, rather, simply invests in the stocks included in the index.[30] An index is a number computed to measure the total value of the stocks selected for inclusion in an index portfolio.[31] A particularly well known stock index is the Standard and Poor's (S&P) 500—a market capitalization index of 500 of the largest companies in the

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United States.[32] It is tracked by a popular ETF, the Standard & Poor's Depository Receipts (SPDR) S&P 500 ETF, also known by its trading symbol SPY.[33]

How does ETF arbitrage work? Both ETF shares and the ETF's underlying stocks trade on exchanges throughout the day. Share prices change with changes in demand and supply. When the ETF share price starts to deviate from the (net) asset value of the underlying stocks, an arbitrageur will step in and take profits on the price difference. That is, if ETF shares temporarily trade at a discount to the underlying stocks (a price lower than the stocks' asset value), the arbitrageur buys ETF shares and sells the stocks; and if the ETF shares trade at a premium to underlying stocks, the arbitrageur sells ETF shares and buys stocks.[34]

Three further arbitrage operations exist involving ETFs. First, a popular index, like the S&P 500, is typically tracked by not one ETF but several ETFs created by competing ETF providers, including broker-dealer banks and large asset management companies.[35] As a result, an arbitrageur may buy an S&P 500 ETF that is temporarily underpriced and sell another S&P 500 ETF that is overpriced. Second, market fragmentation makes it possible to trade the same ETF on multiple exchanges. SPY trading on NYSE, for example, can be arbitrated against SPY trading on Nasdaq, BATS (Better Alternative Trading System), or any number of dark pools. Third, and most importantly in terms of volume as well as value, arbitrage trading now takes place between ETFs and corresponding futures contracts. A futures contract is a legal agreement to buy or sell a particular financial instrument or commodity at a predetermined price at a specified time in the future.[36] Futures contracts exist on major stock market indices, currency pairs, interest rates, and commodities, such as oil, metals, seeds, grains, and livestock. Crucially, the prices of index futures correlate highly with those of corresponding ETFs. An upward price movement in an index futures contract, for example, is likely to be followed by a similar upward change in the corresponding ETF. As soon as the price of the index futures contract deviates upward from that of the ETF, the arbitrageur buys the ETF low and sells the futures contract high.

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Trading between ETFs and ETF futures contracts has become big business.

Today, the most widely arbitraged futures-ETF pair is the so-called E-mini S&P 500 Futures (ES) and SPY.[37] But there exist thousands of similarly highly correlated pairs, creating an extraordinarily rich playground for arbitrageurs.[38] For example, there are 14 exchange-traded products that are linked to gold and are thus highly correlated.[39] This creates 91 distinct pairs of arbitrage relationships among these products themselves, plus additional arbitrage possibilities with the underlying gold in the cash and futures markets.[40]

In sum, the mix of financial innovation, market fragmentation, and tight cross-market linkages has created a truly dizzying number of arbitrage opportunities in today's markets—opportunities that close within milliseconds or microseconds. This remarkable development in modern markets has a dark side, however. Successful trading—whether news-based trading or arbitrage—requires enormously powerful computerized trading systems to speedily digest news, monitor price fluctuations of dozens of financial instruments across multiple markets, and act with lightning speed. The cost of these tools runs into the tens or hundreds of millions of dollars, pricing out the majority of investors. Technological progress has thus accelerated and magnified social stratification in the market: a two-class system of market participants, the haves and the have-nots.

Who are the haves? Not surprisingly, they include all the big broker-dealer banks that in the 2000s successfully pushed for market fragmentation and the demise of the old NYSE trading system (see chapter 2): Bank of America, Barclays, Citigroup, Credit Suisse, Deutsche Bank, Goldman Sachs, JP Morgan, UBS, and others. In European equities markets, for example, the proprietary or market-making trading desks of these broker-dealers generate about half of all high-speed trading activity. The other half stems from another group of haves—namely, private high-frequency trading firms. In the United States, dedicated high-speed operators represent about 2 percent of the approximately 20,000 firms dealing

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in capital markets; yet they account for 50 to 70 percent of equity trading volume.[41] Total high-speed trading activity in Europe represents about 76 percent of all orders.[42] The scale of operations of some of these actors is extraordinary. Credit Suisse, for example, has developed a global computerized grid called Advanced Execution Services that trades in stocks, currencies, commodities, futures, and bonds across 40 countries on six continents. The American high-speed firm Virtu similarly trades in about 10,000 securities and related financial products in 210 markets across 30 countries.

The haves possess or lease capacity on the fastest communication lines between markets. When Spread Networks completed its ultrafast fiber-optic connection between Chicago and New York in 2010, it charged each of its 200 high-speed trader clients $14 million up front. This may seem like an exorbitant price to pay for a 1.5-millisecond information advantage (over the next-fastest [older] fiber-optic service between Chicago and New York), but it made sense considering that a one-millisecond speed gain was estimated to generate a net annual trading profit of about $100 million.[43]

The haves also possess the most powerful computers and sophisticated algorithms (algos) capable of speedily analyzing incoming news and trading data and determining optimal trading strategies. These algos draw inferences in microseconds from trade sequences and time patterns, from order cancellations and additions to the books of various trading platforms, and from trading volumes. The algos then decide whether to cancel a trade or enter a (new) trade, and, in the latter case, whether to buy or sell and how much, as well as what order type to use.[44] Finally, the algos send the trading orders to another automated system at the firm, a so-called smart order router (SOR), which determines the best execution strategy for the orders. The SOR may decide to split a big order into multiple so-called child orders and send them to several trading venues for execution.

The haves employ technologists whose job consists of mitigating delays (or "latency") in this internal order-generating process to beat the competition. One such (former) technologist explains: "I could profile my competitors and understand exactly how fast

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they were and I would know exactly how many microseconds I had to take off in order to start beating them again, and this was something you had to pay attention to…every week; it was a race with each other…and [posed] challenging engineering problems."[45] From the moment an incoming message hit his computer server, every potential source of delay in the network equipment had to be considered: the switches, routers, lines, network card settings, network driver settings, and buffer sizes. The software and algorithmic models also needed regular fine-tuning to ensure maximum speed.[46]

The haves receive early news from a wide range of sources, including commercial providers like Bloomberg and Thomson Reuters, public news websites, and Twitter feeds. Most major media outlets sell them machine-readable news that their pattern-recognition supercomputers scan. The most sophisticated haves no longer simply wait for the news to become news. They seek to anticipate news events. They deploy artificial-intelligence techniques to ceaselessly comb through big economic, political, and social data in search of consequential trends or signals; they seek to detect a firm's fortunes even before the firm's executives know what is happening.[47]

Finally, the haves possess vast collections of historical cross-market, cross-asset class, and cross-regional market data. They use such data, for example, to look for historical correlations in price movements of financial instruments within and across markets that could give rise to profitable trading, and to anticipate or detect how and what particular big institutional investors trade. One such high-speed trading company, Chicago-based Citadel, is said to have a data center containing "the rough equivalent of approximately 100 times the amount of data included in the Library of Congress."[48] The storage, management, organization, and analysis of such big data require enormously costly and complex systems that only a small number of large trading firms can afford.

Is social stratification in markets a matter for concern? Is the ability of the haves to trade in microseconds or even faster socially desirable? Some see no problem with stratification and hold that

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fast news-based trading is socially beneficial because it improves "price efficiency"—that is, it ensures that new economic, political, or social information is promptly incorporated into market prices. Similarly, high-speed arbitrage is desirable because it quickly eliminates inefficient pricing by realigning prices with the value of underlying assets.[49] Some critics, however, question the value of hyper-speed. Steve Wunsch, for example, notes: "Ordinary investors…are naturally put off by this frantic focus on speed.… They feel like second-class traders."[50] They are more likely to be focused on the long term. "Beating the market…[is] a trade that outperform[s]…over a period of years, months or weeks."[51] Joseph Stiglitz similarly writes: "Those making real decisions, e.g., about how much to invest in a steel mill, are clearly unlikely to be affected by these variations in prices within a nanosecond. In that sense, [such variations] are fundamentally irrelevant for real resource allocations."[52] Other critics question whether efficiency gains derived from price updates within micro- or milliseconds rather than seconds are worth the hundreds of millions of dollars spent on high-tech trading systems that, in a marginally slower trading world, may be more productively invested in other parts of the economy. Further, it has been suggested that high-speed ETF arbitrage has significantly increased market volatility and fragility.[53]

The issues raised in this debate are important and deserve further investigation. However, the discussion is also quite narrow. Strikingly, it overlooks the importance of power in market relations. It fails to recognize that in the context of market fragmentation, stratification has fundamentally altered the distribution of power in capital markets, and that this change, in turn, has deeply adverse implications for the governance of capital markets and the investing public.

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5

Bad Governance in Fragmented Markets

> The rules of the exchange are designed to prevent fraudulent and manipulative acts and practices, to promote just and equitable principles of trade . . . to remove impediments to and perfect the mechanism of a free and open market and a national market system, and, in general, to protect investors and the public interest, and are not designed to permit unfair discrimination between customers, issuers, brokers, or dealers.
>
> —SECURITIES EXCHANGE ACT OF 1934, SEC 6B(5)(5)

If the means of applying reputation-based incentives to continue acting ethically are disrupted . . . few would . . . expect ethical behavior to continue, and it hasn't [in the era of fragmented markets]. . . . And if the firm's reputation for honest dealing isn't determined by whether fellow traders or customers catch you doing something bad ([as in the past] where getting caught was almost certain and punishment was severe), but

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> whether regulators catch you (which is remote and usually entails comparatively mild punishment even if it happens), why would you not go ahead and abandon customers and just call the dice?
>
> —STEVE WUNSCH, WUNSCH AUCTION ASSOCIATES LLC, DARK POOL COMMENT LETTER TO ELIZABETH MURPHY, SECRETARY, SECURITIES AND EXCHANGE COMMISSION, JANUARY 14, 2010, 19

Good market governance is about managing conflicts of interest for the benefit of both the investing public and the market providers themselves—the exchanges and the alternative trading venues. It ensures fair, orderly, and efficient markets. Bad governance is about exploiting conflicts of interest, thereby arranging wealth transfers from the investing public to market providers and their close allies. It produces discrimination and inefficiency in markets and hides behind the veil of secrecy or in the dark.

Fragmented capital markets of today have many of the hallmarks of bad governance. The reason, I have argued, is that market providers in today's fragmented system face an overriding new mandate to attract liquidity to survive (see chapter 1). Liquidity no longer begets liquidity—for no market is dominant. Instead, new liquidity providers, dubbed the new "market makers"—typically large private high-speed trading firms and high-speed trading desks at big broker-dealer banks—can now shop around in the bazaar of abundant market options and drive hard bargains. They of course have an incentive to send their order flow to those trading venues that offer the most extensive trading privileges and concessions. This encourages market providers to forgo investment in good governance and instead channel their resources to meeting the technical needs and trading preferences of high-powered liquidity providers. The investing public becomes the casualty. This chapter presents evidence of the various bargains that exchanges and off-exchange trading venues have entered into with the haves at the expense of the have-nots. The findings are disturbing. They highlight the cloak-and-dagger nature of many of these deals and the

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callous disregard of their architects for their negative repercussions on society.

My empirical investigation focuses on market-making obligations, transparency, market access, and surveillance. It highlights the secrecy of many of these deals and assesses their consequences for investors and society more broadly. The NYSE figures prominently in the investigation, but evidence relating to other market providers is also examined.

A broad metric relating to the NYSE can be used to establish preliminary plausibility of the "bad market governance" proposition: the number of SEC enforcement cases against the NYSE in different periods. From 1934, the year of the adoption of the Securities Exchange Act establishing the SEC, to 2005, the date marking the end of the NYSE as a dominant member-owned market organization, the SEC brought only two cases against the Exchange—the first in 1999 and the second in 2005. Both dealt with lapses in surveillance. In the 1999 case, the SEC faulted the NYSE for temporarily suspending its routine surveillance of a group of floor members called "independent floor brokers"—agents who executed orders on the Exchange floor, typically for other members if they were overloaded with orders or for other brokerage firms. The NYSE explained that these suspensions had occurred because of the need to "redirect resources to investigat[e]…tips and complaints about Independent Floor Broker misconduct."[1] The SEC was dismissive, arguing that "had the Exchange deployed additional resources to maintain random surveillance while also conducting…reviews [acting on tips and complaints], it would have created an additional deterrent effect by heightening the presence of NYSE officials in policing floor activities."[2]

In the 2005 case, the SEC similarly charged the NYSE with failings in the policing of specialists between 1999 and 2003; while the NYSE had uncovered many instances of improper trading, it was faulted by the SEC for not following through robustly.[3] The SEC simultaneously filed securities fraud complaints against 20 specialists for front running client orders. The ensuing prosecution, however, proved rather ill fated. The government dropped charges

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early against 7 specialists, five were acquitted, and only eight were eventually found guilty and barred from the brokerage profession.[4]

In 2006, NYSE began operating as a for-profit, publicly owned company in a rapidly fragmenting market. Less than a decade later, the new NYSE had become the target of three major SEC enforcement actions. Unlike the 1999 and 2005 cases, which were limited to specific and narrow oversight lapses, the more recent cases, in 2012, 2014, and 2018, have involved an extraordinary catalog of governance failings: secretive or hidden operations devoid of any legal basis; business practices inconsistent with Exchange rules or federal securities laws; deliberate strategies by senior management to keep compliance officials and regulators in the dark through various forms of deception, including lying, concealing, and spinning; failure to take corrective action even when told to do so by the regulators; and ineffective testing protocols and inadequate monitoring procedures to ensure that the functionality of systems complied with Exchange rules and securities regulations.[5] The 2012 and 2014 cases are discussed in more detail below; for information on the 2018 case see note 51.

These failings are in nature and breadth strikingly different from problems in the "old era." And they are far from unique to NYSE; they are pervasive in the industry, implicating exchanges as well as dark markets. Practically all the major broker-dealer firms that provide dark markets have in recent years faced enforcement actions for activities such as systematically misusing confidential client trading data, bypassing or ignoring compliance experts, dismantling or never instituting internal oversight mechanisms, and bamboozling regulators or simply leaving them in the dark. In sum, in the past decade, practically all major market providers have been caught systematically violating securities law and acting contrary to good market governance principles. Caught in a rat race of having to compete for business from powerful new liquidity providers to ensure survival in a fragmented market, NYSE and other trading venues cut regulatory corners to satisfy the trading needs and technical preferences of these important clients, to the detriment of the investing public.

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Weakened Market-Making Obligations

The NYSE specialist system with its market-making obligations had evolved over many decades and achieved remarkable organizational sophistication by the second half of the twentieth century (see chapter 3). These obligations, along with a robust surveillance system, represented the central pillar of the good governance apparatus of the old NYSE. To recapitulate briefly: at its core were two fundamental regulatory principles. First, a *positive obligation* of market makers to maintain a fair and orderly market in the stocks they managed. This involved "leaning against the wind" (i.e., stepping in as significant buyers in a falling market and as sellers in a rising market) and solving the time-discontinuity problem of thin markets by selling from their own inventory when no sellers appeared or using their own capital when no buyers entered the market. Second, a *negative obligation* to refrain from trading for their own account except in cases where such dealer intervention would help minimize the effects of temporary disparities between supply and demand and thus ensure fair and orderly markets. This obligation was designed to manage a potential conflict of interest that arose from the specialists' privileged position at the center of the market, where they had a commanding view of order flows, enabling them to foresee price changes. Otherwise, trading as dealers, the specialists could capitalize on this private information by front running large institutional orders.

Specialists were willing to shoulder the burden of these obligations because they knew that "*in the long run* an orderly market w[ould] encourage commission business in which [they]… participate[d]."[6] The obligations were also complemented by an intricate surveillance and enforcement mechanism.

In 2008, NYSE announced its decision to abolish the negative obligation, offering the following explanation: "Given the real-time availability of market information and resultant increase in market transparency in today's markets…the [NYSE] believes that the imposition of a negative obligation…is unnecessary."[7] This explanation is entirely disingenuous. By 2008, real-time market

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information was no longer affordable for the average investor, and market opacity and darkness were clearly on the rise. NYSE had just started to sell market data to its most important trading clients and released this data ahead of time to give these clients a trading advantage, in violation of securities laws (see discussion on trading data below).[8] The real reason NYSE abolished the negative obligation is that the high-speed liquidity providers—dubbed new "market makers"—that NYSE sought to attract wished to operate free of obligations. Other exchanges followed suit, reducing or abolishing market-making obligations.

This has had predictable consequences. First, market making has become opportunistic and adversarial, much like proprietary trading. Unlike the old specialists, the new market makers are external "merchants of liquidity" with no deeply rooted loyalty to an exchange or agency duty to its traditional investor client base.[9] They are middlemen bent on maximizing *short-term* trading profits. If foiled by one exchange, they simply move on and initiate negotiations with rival exchanges. As put by one market expert: "The movement away from [traditional]…market maker roles at many venues has resulted in an overall market environment where the new 'market makers'…share no responsibility in serving the investing public, [or] maintaining fair and orderly markets."[10] The problem is now widely acknowledged, as reflected in a comment by Rick Ketchum, the then-outgoing CEO and chair of the private-sector Financial Industry Regulatory Authority (FINRA), that "the issue of market making obligations and market making incentives is something that should be looked at."[11]

Second, unlike the old market makers, the new market makers keep only minimal inventories of stocks and capital reserves. At the end of each trading day, they tend to have closed-out positions—that is, stocks bought (sold) during the day are sold (bought back) before the end of the day. Low levels of inventory and capital drastically reduce the new market makers ability to maintain orderly markets when large shocks hit the stocks.[12] Unsurprisingly, the new market makers have been described as "fair weather liquidity providers, making markets when times are calm but leaving

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the market…during turbulent periods";[13] or, as put by Andrew Haldane of the Bank of England, "[They] add…liquidity during a monsoon and absorb…it during a drought."[14]

Systematic empirical evidence consistent with these views is plentiful. For example, "mini flash crashes"—large erratic price swings in individual stocks over milliseconds—are a daily occurrence in today's markets. According to one source, about 18,500 mini flash crashes occurred in U.S. stock exchanges alone over a five-year period starting in 2006.[15] A detailed investigation of the big Flash Crash of May 2010, when the U.S. equity markets mysteriously dropped 9 percent in value only to fully rebound within minutes, concluded that "high-frequency traders behave differently than traditional market makers," exacerbating market volatility instead of mitigating it.[16]

Furthermore, the new liquidity providers are disproportionately drawn to highly capitalized (large cap) stocks rather than less capitalized (small cap) stocks, for which markets tend to be relatively thin. Nicholas Hirschey, for example, notes: "Their median share of total dollar volume is 14% in small-cap stocks, 29.2% in mid-cap stocks, and 40.9% in large-cap stocks. It is conceivable that since HFTs' comparative advantage is reacting quickly to market events, they find more profit opportunities in stocks for which quoted prices and depths update frequently."[17] As a result, liquidity for smaller stocks has deteriorated since the abolition of old market-making obligations.[18] Finally, a recent analysis of the impact of the new market makers on large institutional orders shows compellingly that there is no functional equivalence between old market makers and the new ones. It concludes that high-speed liquidity providers rarely "lean against the wind" but instead tend to "go with the wind" by trading in the same direction as large institutional investors. This significantly increases trading costs for institutional investors because the HFTs can use their superior technology to anticipate their orders.[19] "[HFTs'] superior information technology enables them to better generate signals from big data assembled over multiple hours [during which an institutional investor seeks to complete a big trade by sending child orders[20] into the market]

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and trade on it profitably."[21] This is a radical departure from the traditional responsibility of market makers to support, rather than target, investors.

The relaxation or abolition of market-making obligations was only the first nail in the coffin of good market governance. The new liquidity providers pressed for more. They wanted to have some of the privileges of the old market makers, notably early information on order flows. They insisted, in addition, on getting special market access. Traditionally, the exchanges offered access to their markets on a nondiscriminatory basis. Times have changed. Now, as put by a former high-speed trader, "in pursuit of mutual gain, the exchanges provide…HFTs unfair and discriminatory advantages over public customers through a number of 'innovations'…. The real paradigm shift that HFTs [have thus] brought to…markets…[is] the construction of trading environments tailored for specific trading strategies [of the new high-speed liquidity providers]."[22]

Information Asymmetry: Trading Data

Winning and losing in financial markets depend on information. Traders win if they obtain early information and act on it faster than others. Before the arrival of the telegraph and ticker machines, New York–based brokerages competed for the fastest "runners" or "padshovers"—messengers who speedily delivered trading orders to the NYSE and brought back price information.[23] They also sought to locate their offices as close as possible to the Exchange. Express carriages, pigeon post, flash-signal stations, and microwave towers are all examples of how human ingenuity has produced new ways of conferring a winning edge on some traders through speed.

Exchanges traditionally remained passive or neutral in this speed race; that is, they never favored one group of traders over others, nor did they seek to sell price information to the highest bidder. To do so would have struck old sensitivities within the exchanges as contrary to the fundamental good governance principle of fair and equal market access for all. This all changed in the new era

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of fragmented markets. In 2006, its first year of operation as a for-profit firm, NYSE began to offer to high-speed traders a new service enabling them to receive trading data from the Exchange and send orders to it with reduced delay (or "latency"). This attractive service, termed "colocation," involved placing the clients' servers in physical proximity to the matching engine[24] of an exchange. This proximity gave these favored traders a decisive speed advantage over customers located farther away.

From 2006 to 2010, NYSE operated colocation through affiliates.[25] Charges for colocation at so-called data centers located in Brooklyn and Manhattan were not transparent or publicly available. They were discreetly negotiated with the clients. NYSE offered this new service without permission from the SEC, and it had no internal rules in place that provided for or permitted the operation of the colocation business. For four years, NYSE operated colocation in full breach of securities law.[26] Only in March 2010 did NYSE approach the SEC for permission to offer colocation services by filing a so-called proposed rule change.[27] Permission was granted, and in September of the same year, NYSE moved its colocation business to a new $500 million data center in Mahwah, New Jersey.

This was not the only way in which the new NYSE purposely conferred an informational advantage on high-speed clients, in flagrant violation of the existing federal securities law. A key federal regulatory provision requires exchanges to distribute market data on terms that are "fair and reasonable" and "not unreasonably discriminatory."[28] This requires that exchanges send market data for consolidation and public diffusion to the Security Information Processor (SIP) at the same time that they release the data to private clients. NYSE sends quotes and trade reports in NYSE-listed securities to one of two such processors, where they are combined with quotes and trade reports from other exchanges and then distributed to the public via the SIP data feed. NYSE also has administrative responsibility for this SIP.[29]

In 2008, NYSE started releasing market data for a fee to favorite traders before sending the data to the SIP for public distribution, in violation of securities law. This resulted in an informational

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advantage to these traders ranging from single-digit milliseconds to 100 or more milliseconds, and in some cases even multiple seconds, such as during the Flash Crash of May 2010. The SEC noted: "Improper early access to market data, even measured in milliseconds, can in today's markets be a real and substantial advantage that disproportionately disadvantages retail and long-term investors."[30] NYSE settled with the SEC in 2012.[31] The regulator was damning in its criticism of the Exchange's governance failures: NYSE management shut out the compliance department from the design, implementation, and operation of the early data release scheme; it failed to systematically monitor its data feed and lacked written policies and procedures about data release; and it deliberately deleted computer files containing information about market data transmission details. Despite these serious failings over several years, the SEC fined NYSE an insignificant $5 million.

While early release of market data is illegal, exchanges are permitted to sell such data directly to private clients as long as the release of the data occurs at the same time the exchanges send quote and trade data to the SIP. This simultaneous release of market data, however, does not level the informational playing field between the haves and the have-nots. Exchange clients with direct market data access via so-called proprietary data feeds still enjoy an informational advantage for two main reasons. First, after the quote and trade data from various exchanges arrive at the SIP, the consolidation process takes time; this delays the arrival of the data for public use.[32] And, second, proprietary data feeds not only are faster than the SIP data but also contain much more market information. While SIP feeds have only "top-of-book" information (i.e., best-quoted prices and number of shares available at that price, as well as prices and sizes of executed trades), proprietary data feeds also include "depth-of-book" data (buy and sell orders at different prices on the book of the exchange providing the feed). Depth-of-book data provides a good indication of the liquidity and investor interest in a security, as well as trends in the market more generally.

Exchanges around the world now offer colocation and proprietary data feeds for sale. These products generate large and

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ever-increasing revenues for exchanges.[33] Whether they improve fairness and efficiency in capital markets is another question, however.

Exchanges are quick to point out that access to colocation and proprietary data feeds is nondiscriminatory. Indeed, the services are available to all market participants willing to pay for them. But at what price? In 2017, NYSE charged $5,000 up front and a minimum $4,800 in monthly rental fees for colocation cabinets holding client firms' servers, with total fees easily reaching ten times this amount or more depending on how much space and how many kilowatts a client needs.[34] Proprietary data products are pricey too. NYSE's Integrated Feed, a data product that contains real-time depth-of-book data, for example, has a monthly access fee of $7,500.[35] To get maximum trading benefit, a market participant needs colocation and proprietary data feed arrangements with all or most of the 13 public stock exchanges in the United States, and perhaps also with options and futures markets and major exchanges in Canada, Europe, and Asia. Only aggregated depth-of-book data offer a comprehensive (pre-)view of liquidity and order flow trends in the entire market. Then there is the cost of the hardware and software to standardize raw data feeds and decrypt millions of messages in milliseconds. In the words of a former exchange CEO: "The process of acquiring and using this [market] data…entails significant fixed costs even before any explicit exchange market data fees are paid."[36]

In sum, individual or institutional investors do not typically possess the resources to pay for these services or invest in the telecommunications and computer systems needed to support and benefit from them. Access to colocation and proprietary data feeds may not be formally discriminatory, but the high cost of these services crowds out most retail and institutional investors.

In what ways could such de facto discrimination against these investors weaken market efficiency? The answer depends, in large part, on the response by traditional "informed investors" to opportunistic trading behavior enabled by colocation and proprietary data feeds.

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Informed investors include actively managed mutual and pension funds as well as individuals with actively managed portfolios; they are "informed" because they conduct fundamental research on companies, analyzing sales growth, profit margins, and other factors to estimate the companies' future cash flows. Informed investors help ensure that share prices in markets are mostly accurate because they sell when their estimate of share value implies that a stock is overpriced and buy when their research suggests that the stock is underpriced. Accurate prices enhance market efficiency in several ways: "[They] help…to allocate the economy's scarce capital to the most promising potential real investment projects and…[they] improv[e]…the utilization of the economy's existing productive capacity through optimizing the signals provided to management about investment decisions and the signals given to boards and shareholders about the quality of management decisions."[37]

Colocation and proprietary data feeds undermine market efficiency if they disincentivize investors from conducting fundamental research. This could happen if these services enable high-frequency traders—who tend to compete not on research intelligence but purely on speed—to engage in trading behavior that essentially free rides or "piggybacks" on the costly acquisition of information by investors engaged in fundamental research.[38]

One major example of such behavior is order anticipation. An order anticipator seeks to trade ahead of large informed traders to benefit from near-term price movements in the direction of trade. Consider the following stylized example: A pension fund manager concludes, after extensive research, that IBM's future cash flow will be greater than what the current share price suggests. She thus decides to buy 5,000 shares of IBM. Her broker in downtown Manhattan checks the IBM stock availability at best prices on various trading venues and then decides to send simultaneous orders for 4,500 shares to Nasdaq and 500 shares to BATS. Nasdaq is located in Cateret, New Jersey, about 9 miles from the broker's downtown office; and BATS is in Weehawken, New Jersey, 2.5 miles from the office. The buy order sent to BATS arrives at its destination first

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and is executed. High-speed firm Flash happens to have proprietary data and colocation arrangements at both Nasdaq and BATS. An algo in Flash's colocated server at BATS immediately learns about the trade of 500 shares and infers that an informed investor may be looking to buy more shares elsewhere. It dispatches a buy order via microwave signal technology to Flash's colocated server at Nasdaq for 2,000 shares of IBM. The order arrives a few microseconds ahead of the broker's order for 4,500 shares. Flash then instantly turns around and sells 2,000 shares to the investor at a higher price. Flash's profit from buying low and selling high is the investor's loss, which reduces the pension fund manager's return on fundamental research. If this happens on a wide scale, it may disincentivize fundamental research, which, in turn, would weaken the accuracy of prices and thus lower the allocative efficiency in capital markets.

Several recent studies provide systematic evidence of order anticipation trading in today's fragmented capital markets. Analyzing a comprehensive market data panel, Weller finds that high-speed trading strongly decreases the amount of information in prices.[39] Van Kervel and Menkveld similarly conclude: "HFTs seem to run on the most informed orders.... The worrisome...effect is that, in the long run, prices could become less efficient. Institutional investors could discontinue costly analyst research, since informational rents have to be shared with others in the trading process. Research might no longer be privately profitable. This could become socially costly."[40] Hirschey concurs: "[By] trading ahead of informed non-HFT order flow...HFTs capture some of the informed non-HFTs' profits and, consequently, decrease...investors' incentives to acquire new information. [Therefore]...when evaluating whether HFTs make prices more efficient, it is important to take into account the source of the information they use to trade."[41]

In conclusion, when proprietary data feeds and colocation enable high-speed traders to anticipate informed investor decisions, market efficiency suffers. Order anticipation is today's version of front running, which was illegal in the era of the old NYSE. The entire governance apparatus of the old Exchange was designed to prevent it (see chapter 3). Specialists who violated their positive and

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negative obligations were severely punished. In an effort to attract high-volume traders and generate large profits, the new exchanges have introduced new services, such as colocation and data feeds that deepen the order information asymmetry between high-speed traders and investors. This asymmetry enables the practice of "stepping ahead" of order flow, whose adverse effect is comparable to that of front running. Order anticipation is not illegal, because the exchanges have abolished or reduced market makers' obligations, and the new market makers have no agency duty to investors.[42] Nevertheless, such behavior generates the same adverse effects as front running: a wealth transfer from the investing public to market insiders, as well as a lack of confidence in prices and increasing market inefficiencies.

Information Asymmetry: Market Microstructure

The fragmentation of markets outlined in chapter 1 has led traditional exchanges to jettison their neutrality and commitment to fundamental principles of good governance, including fairness, equality, and transparency. The overriding new mandate is to attract liquidity to survive and prosper. Colocation and enriched data feeds serve this purpose directly by quenching big clients' thirst for speedy privileged trading information. But exchanges have gone beyond simply offering speed advantages to accommodate these clients. Under the pretense of innovation, sometimes even in secret, they have also been altering, rejigging, and fine-tuning critical parts of the inner workings—the microstructure or "plumbing"—of their markets to ensure optimal operational fit with the specific technical and trading needs of high-powered clients. These beneficiaries often assist the exchanges in designing and implementing operational innovations. Prominent among these innovations are so-called special order types (SOTs). SOTs are complex buy and sell orders that define how an order is to be placed in a market, how it is to be shown on the order book of the market, and how it is to interact with changes in the order book. SOTs are most prevalent in U.S. capital markets but are now spreading in Europe and Asia.[43]

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Before the fragmentation of markets and the rise of algorithmic trading, order types were simple and transparent. The two most common types were market orders, which are executed immediately at the current available price, and limit orders, which specify a price limit at which to buy or sell. Most investors still use market and limit orders. In stark contrast to these classic types, SOTs function in opaque ways; they can hide, show only parts of an order, or change both the queue position and the price of an order to ensure advantageous execution.

SOTs have many attributes—indeed, some are benign[44]—but many SOTs serve purely predatory trading aims. One type of SOT, classified as "hide and light" SOTs, undermines a time-honored principle that is fundamental to fair and orderly markets, the so-called price-time priority (see discussion in chapter 3). PTP means that any order arriving at the exchange is prioritized first by price and then by time. In other words, the best price is always first in line for execution, and orders enter the queue as they arrive.[45] This first-come, first-served principle is undermined by a sneaky functionality in SOTs that enables users to invisibly jump the queue and step ahead of investor orders.

This "hide and light" capability may be illustrated through a hypothetical case. Suppose an institutional investor sends a nonroutable limit order to buy 4,000 shares of Cisco Systems for $40.10 to Exchange X. Being nonroutable, the order must be executed only on Exchange X; it cannot be routed to another exchange for execution. The best available offer price in the market is $40.10, and the best bid price is $40.09. Exchange X displays 1,000 shares of Cisco at the best offer. Exchange Y displays 2,000 shares of Cisco on offer at $40.10 as well. Our investor is able to purchase 1,000 shares on Exchange X right away. The rest of the order for 3,000 shares is not routed to Exchange Y and cannot be displayed as the now-highest bid price of $40.10 on the order book of Exchange X because of an SEC regulation banning locked markets. A locked market exists when a limit buy order at the best bid price on one exchange is priced equal to the best offer on another exchange but is nonroutable (as in our example) and therefore cannot be matched

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with the sell order on the other exchange.[46] As a result of the locked-market ban, our investor's remaining order for 3,000 shares will automatically price-slide down one notch (or tick) to $40.09 on the order book of Exchange X. When the sell order for 2,000 shares on Exchange Y is filled or canceled, the investor's order will price-slide up and be displayed at the original price of $40.10.

The "hide and light" SOT comes in when a predatory high-speed trader attentively follows the activities in the market and sees the execution of a buy order for 1,000 shares of Cisco at $40.10 on Exchange X that is immediately followed by a posting of a buy order on the same exchange for 3,000 shares at $40.09. The high-speed trader smells blood—he suspects a big institutional buyer behind these activities and sees an opportunity for an advantageous trade *provided* he somehow manages to step ahead of the investor. With the SOT, the trader posts a "hide and light" order to buy 1,000 shares of Cisco at $40.10 on Exchange X. In other words, the "hide" aspect of the SOT enables the trader to make that order invisible to all market participants. This means that the order does not have to price-slide to $40.09 because the ban on locked markets applies only to displayed orders and the trader's order, being hidden, is not displayed on the order book.

The order hides on Exchange X at $40.10 until the sell order for 2,000 shares of Cisco on Exchange Y is either filled or canceled; when this event occurs, the markets unlock and the trader's bid for 2,000 shares suddenly lights up—*at the front of the queue*—for order execution at $40.10. At the same time, our investor's order for 3,000 shares of Cisco price-slides back up to $40.10, entering the queue behind the trader's order. Thus, even though the trader's order was placed on Exchange X *after* the investor's order, the "hide and light" SOT has enabled the trader to secure an execution place *in front of the investor*—in clear violation of the price time priority principle of good market governance. In short, the trader succeeded in stepping ahead of the investor with the help of a secretive order type created by the exchange for our trader. If a market order to sell 500 shares of Cisco now arrives at Exchange X, half of the predatory trader's limit order will be filled. The exchange will reward this trader by

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paying a rebate for having posted liquidity (that led to an execution). The exchange charges the party sending the market order a fee for "taking liquidity" (i.e., a taker fee). The taker fee is larger than the rebate the exchange pays to the predatory traders. The exchange pockets the difference as profit. Finally, the trader may try to make additional money by quickly selling the 500 shares of Cisco just bought at $40.10 for a higher price. In the meantime, our institutional investor's order may not get (fully) filled for a while.

"Hide and light" orders exemplify the general problem with SOTs. Their frequently opaque and nontransparent features render it impossible for traditional order types used by investors to compete on a level playing field. This results in discriminatory treatment of traditional order types in securing top-of-queue positions, undermining fair and neutral access to exchanges. Execution quality for investors suffers, and confidence in the integrity and orderliness of markets is weakened.

And "hide and light" is only one type of SOT. Exchanges have produced hundreds of SOTs. The NYSE, for example, offers as many as 80 order types.[47] Many SOTs change their modus operandi depending on the order type or trading strategy used by the other party to a transaction, resulting in thousands of transaction combinations. BATS, for example, has 2,000 different combinations of instructions for placing orders on its exchanges.[48] Not surprisingly, the mechanics of how different SOTs interact are often poorly understood by investors, let alone explained or necessarily disclosed by exchanges. In a recent enforcement case by the SEC, for example, NYSE and NYSE American were fined for failing to disclose that one special order type, "pegging interest" orders (PIs), could be used to discover same-side "non-displayed reserve orders" (NDROs), which had been marketed by the Exchange as "fully dark."[49] The SOT phenomenon is significant because it applies to the majority of trading volume on exchanges generated by high-speed traders.

The SOT innovation has created extraordinary complexity in capital markets that neither regulators nor investors comprehend. SOTs have deepened the information asymmetry relating to the

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inner workings of markets, favoring exchanges and alternative trading venues and their allied traders at the expense of millions of largely ignorant investors.[50] The introduction and operation of SOTs also exemplify how far exchanges are willing to go to undermine principles of good market governance and minimize regulatory compliance when such actions guarantee greater order flow and profits.

Perhaps most disturbing is the cloak-and-dagger nature of SOT operations—the deliberate secrecy, obfuscation, misrepresentation, and callous disregard of SOT architects and promoters for the adverse consequences of their actions for society. SOTs have been proliferating since 2007 and remained the industry's best-guarded secret until 2011, when Haim Bodek, a former Wall Street insider at Goldman Sachs and UBS, blew the whistle and went public about his concerns.[51] In 2013 Bodek noted, "It is important to emphasize . . . that not even the most sophisticated [buy-side operator] would have been able to determine how HFT firms employed special order types by scrutinizing an exchange's API manuals[52] and regulatory filings. The most important details (e.g., intended usage cases, intended order interaction sequences, order precedence rules, etc.) are not documented in any adequate manner."[53]

While Bodek's actions have lifted some of the veil of secrecy surrounding SOTs, remarkably little changed on the ground. The powerful status quo forces—the exchanges and big trading clients—responded with some disclosure under pressure from the SEC,[54] but enforcement action has been timid and limited, and highly complex order types remain on the (de facto secret) menu of most exchanges.[55]

Bodek's critical assessment has largely been corroborated in a recent SOT-related enforcement action by the SEC.[56] The SEC case highlights the failure by trading venue Direct Edge to adequately disclose the queue-jumping functionality of its Hide Not Slide SOT.[57] A blind profit motive explains this governance failure. In this case, a high-speed trading firm approached Direct Edge and "advised [it] that implementation of such a . . . [Hide Not Slide] order type would likely cause it to increase the order flow that it

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sent to Direct Edge from 4-5 million orders per day to 12-15 million orders per day. Additional order flow would be beneficial to Direct Edge because it would increase its market volume and its revenue."[58] Direct Edge was fully aware of the detrimental effect of the Hide Not Slide SOT on investors but opted to keep both the investors and the regulator in the dark. At the same time, however, it eagerly revealed the details of the queue-jumping functionality of its SOT in private discussions with potential big trading clients to attract their order flow and boost profits. Direct Edge settled with the SEC and paid a small civil money penalty of $14 million.[59]

Other exchanges have operated in similar fashion, with intimate involvement of programmers and officials of high-speed trading firms in rejigging the exchange microstructure to fit clients' trading needs;[60] misleading, incomplete, or missing filings with the regulator;[61] and quiet selective disclosure of opaque discriminatory market access devices to potential big clients. It is no surprise that the negative consequences of these shenanigans are deep. In Bodek's words: "For all practical purposes, a number of 'innovations' that modified electronic exchange market structure were little more than just a means to shift economics between classes of market participants.... The introduction of HFT-oriented special order types and related order matching engine practices...resulted in an immediate and often severe impact upon the transaction costs associated with different classes of participants, often with the HFTs benefitting at the expense of the rest of the exchange's customer base."[62]

Darkness

Dark trading is a growing trend in equity markets around the world. In the United States, the volume of dark trading has tripled in less than a decade to about 37 percent of all trading in 2017,[63] while dark trading now amounts to about 10 percent of total trading in Europe.[64] In Australia, about 27 percent of all trading is dark,[65] and in Japan the share is around 6 percent.[66]

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As discussed in chapter 2, dark trading steadily began to grow in significance around the turn of the twenty-first century as more and more large broker-dealers opted to bypass exchanges and instead organized in-house markets for client orders. This precipitated market fragmentation. Over the past ten years, exchanges have responded to this competitive pressure for order flow by complementing their lit markets with their own dark markets, thereby spurring even more market fragmentation.[67]

A particularly important segment of the dark trading market are dark pools that are provided by broker dealers. Disturbing recent evidence on the operations of these pool over the last decade is largely consistent with the bad market governance conjecture.

A dark pool is a trading venue that, unlike a lit or public exchange, does not display price or order size information. Properly governed dark pools can fulfill an important function in capital markets: they enable big institutional investors, such as mutual funds and pension funds, to place large orders (also called "blocks") without tipping the market to their intentions, which could trigger adverse price changes. In a lit market, one risk of displaying a large sell order is that buyers may pull their resting orders from the market in the hope of soon buying at lower prices, thereby depressing the price for the seller. Dark pools can provide a solution by offering institutional investors complete anonymity, thereby preventing information leakage about trading intentions and adverse price movements. Like the free-riding bucket shops of the nineteenth century (see chapter 1), dark pools take the prices of public exchanges as benchmarks and then promise price improvements. The largest dark pool providers include Barclays, Credit Suisse, Citigroup, Deutsche Bank, Goldman Sachs, Merrill Lynch, Morgan Stanley, and JP Morgan (see table 2.4 in chapter 2). Their combined dark pool market share in the United States has been about 70 percent over the past decade.

The economics of running a dark pool are simple and compelling: a big broker-dealer that runs an in-house market profits from the fees it charges clients to trade in the dark pool and does not have to incur the cost of paying commissions to exchanges for

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order execution. It can also derive significant additional revenues if its own high-speed proprietary trading desks are given access to the dark pool to transact against client order flow. In addition, by attracting external high-speed liquidity providers, a pool can grow in size and profitability.

The realization of these economic gains, however, is subject to a regulatory obligation to ensure so-called best execution for clients; that is, broker-dealers must ensure that the clients receive the best prices as well as speedy and low-cost executions.[68] In addition, large dark pool providers may have to comply with several good governance principles, such as providing adequate safeguards and procedures to protect clients' confidential trading information and oversight mechanisms to ensure these safeguards and procedures are followed; reporting material changes in the operation of dark pools to regulators in a timely way; and ensuring fair and nondiscriminatory access to services.[69]

When these regulatory obligations clash with the economic aims of dark pools, broker-dealers face a conflict of interest. For example, broker-dealers may be tempted to send all client orders first to their own dark pools even though these orders may receive better execution if routed to other trading venues. Or a dark pool operator could use confidential client trading information to trade ahead of clients. The operator could even sell confidential trading information to predatory high-speed traders lurking in the dark pool, just waiting for a propitious moment to step ahead of institutional order flow.

Is such opportunistic behavior likely? I suggested in chapter 1 that when the total gains from cheating are large, the chance of easy or quick detection of rule violation by the regulator is remote, and the potential reputational damage and monetary penalty are minor, cheating behavior is rational and to be expected. In dark markets, many of these conditions appear to be present: the governance of most dark pools is dark by design. Traditionally, dark pool providers have not publicly disclosed operational details about the process of order matching, the available order types, routing methodology, order fill characteristics, fees, and so on.[70] This has made it hard to

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independently monitor dark trading and assess its impact on overall market quality. Darkness also complicates efforts to establish clear proof of deliberate and systematic fraud.

If, as a result, a settlement with the regulator is the most likely outcome in the event of an enforcement action, any penalty is likely to be relatively minor. Reputational damage can be mitigated by neither admitting nor denying wrongdoing as part of the settlement. And if all or most dark pool providers engage in the same or similar shenanigans, then the market consequence of a sanction may well be trivial since investors have few or no safe alternatives.

What does the evidence tell us? Recent enforcement cases in the United States lift some of the veil that shrouds dark pool operations, and the emerging picture is disturbing but consistent with the stated propositions (see summary table 5.1).[71] Practically all major dark pool providers have engaged in systematic violations of securities regulations, often over many years. They have exploited conflicts of interest under cover of darkness and at the expense of institutional investors, and good governance principles have been sacrificed on the altar of greed. Confidential client trading data was systematically misused, compliance personnel bypassed or ignored, and internal oversight mechanisms never put in place or dismantled, and regulators were bamboozled or left in the dark.

Many of the cheating strategies of broker-dealers are uncannily similar. Particularly for investors, the most salient of these strategies is the "we are different" lie. It provides striking illustrations of opportunism as defined by Oliver Williamson (see book appendix)—namely, "the incomplete or distorted disclosure of information, especially… calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse." Williamson, *The Economic Institutions of Capitalism*, 1985, 47.

All dark pool providers listed in table 5.1 described equity markets as dangerous places for institutional investors to trade in because of the infestation of high-speed trading sharks, and each claimed to be unique in offering effective remedies against predatory trading. The CEO of the Pipeline Trading System's dark pool, for example, claimed to be the only operator to truly serve investors

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TABLE 5.1. Dark Pool Enforcement Actions by the SEC

Dark Pool Owner (Market Share[1])	**Violation Period**	**Outcome**	**Civil Money Penalty**	**Violation:** Inadequate Safeguard and Oversight to Protect Confidential Trading Information[a]	**Violation:** Misinformation and Omissions of Material Facts in Relations with Clients[b]	**Violation:** Reporting and Lack of Transparency in Relations with Regulators[c]	**Violation:** Failing Risk Management Controls and Supervisory Procedures[d]	**Violation:** Unfair and Discriminatory Market Access[e]	**Violation:** Other Federal Securities Violations
SuperX Deutsche Bank (7.2%)	January 2012–February 2014	December 2016 Deutsche Bank settles charges by admitting facts and acknowledging violations	$18.5m		**X**	**X**			
LX Dark Pool Barclays (3.7%)	December 2011–June 2014	January 2016 Barclays settles charges by admitting violations	$35m[2]	**X**	**X**	**X**	**X**		
Crossfinder Credit Suisse (12%)	April 2008–February 2014	January 2016 Credit Suisse settles charges without admitting or denying violations	$20m	**X**	**X**	**X**		**X**	**X**

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TABLE 5.1. (*continued*)

Dark Pool Owner (Market Share[1])	**Violation Period**	**Outcome**	**Civil Money Penalty**	**Violation:** Inadequate Safeguard and Oversight to Protect Confidential Trading Information[a]	**Violation:** Misinformation and Omissions of Material Facts in Relations with Clients[b]	**Violation:** Reporting and Lack of Transparency in Relations with Regulators[c]	**Violation:** Failing Risk Management Controls and Supervisory Procedures[d]	**Violation:** Unfair and Discriminatory Market Access[e]	**Violation:** Other Federal Securities Violations
UBS ATS UBS (13.5%)	May 2008–August 2012	January 2015 UBS settles charges without admitting or denying violations	$12m	**X**	**X**	**X**		**X**	**X**
SigmaX Goldman Sachs (6.8%)	November 2011–August 2013	June 2015 Goldman Sachs settles charges without admitting or denying violations	$7m				**X**		
Posit ITG (4.3%)	April 2010–July 2011	August 2015 ITG settles charges by admitting facts and acknowledging violations	$7m	**X**	**X**	**X**			**X**

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Liquidnet ATS Liquidnet (2.9%)	2009–2012	June 2014 Liquidnet settles charges without admitting or denying violations	$7m	**X**	**X**	**X**
LeveL eBX[3] (3.8%)	2008–2011	October 2012 eBX settles charges without admitting or denying violations	$0.8m	**X**		**X**
Pipeline ATS Pipeline (0%, shut down in 2012)	August 2004–March 2010	Pipeline settles charges without admitting or denying violations	$1m	**X**	**X**	**X**

Sources:

(a) Rule 301(b)(10) of Regulation Alternative Trading Systems (ATS)

(b) Section 17(a)(2) of the Securities Act

(c) Rule 301(b)(2) of Regulation ATS

(d) Section 15(c)(3) of the Exchange Act and Rule 15c3-5(b) and 15c3-5(c)(i)

(e) Rule 301(b)(5)(ii)(A) and (B) of Regulation ATS

Notes:

(1) Dark Pool Market Share as of November 1, 2014

(2) Barclays paid another $35million to the New York Attorney General's office to settle charges in a parallel case

(3) eBX was founded as a joint venture of Citigroup, Credit Suisse, Fidelity Capital Markets, Lehman Brothers, and Merrill Lynch.

because "everyone else is addicted to the volume that comes from high-frequency trading.... High-frequency traders are the natural enemy of the large institutional investor.... Market centers are doing things that disadvantage the ... institutional investor, because they're doing things to advantage the high-frequency trader."[72] Pipeline's screening method allegedly allowed only "natural counterparties" (i.e., institutional investors) access to its dark pool; high-frequency traders were banned. These were misrepresentations. Large broker-dealers similarly duped clients by spreading falsehoods.

Credit Suisse told clients that its Crossfinder dark pool "is the only market center (dark or lit) that ropes off opportunistic clients based on a rigorous, objective methodology. To our knowledge, no other dark pool uses objective [and] transparent criteria to define client flow interaction in the dark pool."[73] Its methodology, called Alpha Scoring, claimed to segment order flow into various categories, from safe and healthy to aggressive and toxic. Alpha Scoring was said to help investors avoid transacting with opportunistic traders.

Deutsche Bank's wonder weapon was the Dark Pool Ranking Model (DPRM). It claimed to objectively assess the execution quality and liquidity of all dark pools "based on transactions cost[s], statistically determined compatibilit[ies] ... client order attributes, and real time conditions."[74] Shark-infested pools would automatically be deselected by the DPRM as potential destinations for execution of institutional orders from Deutsche Bank clients.

The most significant of these cases, certainly in terms of the amount of settlement paid, was the Barclays Liquidity Profiling case. Barclays marketed this product as a "sophisticated [continuous] surveillance framework that protects clients from predatory trading"[75] by categorizing its dark pool clients into five buckets. Barclays's managing director and head of electronic trading, William White, proudly proclaimed, "Transparency ... [i]s the one issue that we really t[ake] ... a stance on.... We always come back to transparency as the key driver—letting [clients] know how we're interacting with their flow and what type of flow they're interacting

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with.... Transparency on multiple levels is a selling point for our entire equities franchise."[76]

These claims were completely refuted by the New York State Attorney General investigating the Barclays case, who summed up Barclays' modus operandi as "acts, practices, and omissions [that] employed deception, misrepresentation, concealment, suppression...and false promises"[77] to win new business. The investigation concluded that "essentially all client orders...were routed to Barclays' own dark pool first, regardless of the probability that a given trade would execute there, would execute at a favorable price, or would cause information leakage;...unfilled orders were then routed disproportionately to other trading venues based on where Barclays itself had been most profitable over the previous twenty days, or which were otherwise economically advantageous to Barclays—not based on what was best for clients' orders."[78]

The investigation also revealed that the bank "allow[ed]...high frequency traders to 'cross-connect' to its servers. Several dozen of the most well-known and sophisticated high-frequency trading firms in the world...[were] cross-connected with Barclays, allowing them to take advantage of Barclays' non-high frequency trading clients, by getting a speed advantage over those slower-moving counterparties." And "while Barclays represented that it used ultrafast 'direct data feeds' to process market price and trade data in order to deter latency arbitrage by high frequency traders in its dark pool, Barclays in fact processed that market data so slowly as to allow latency arbitrage. Internal analyses confirmed that Barclays' slow processing of market data allowed high frequency traders to engage in such predatory activity."[79]

A former senior director within the Equities Electronics Trading Division at Barclays described Barclays's operations as follows: "Barclays was doing deals left and right with high-frequency trading firms to invite them into the pool to be trading partners for the buy side.... The buy side would pay the commissions. The high frequency firms would pay basically nothing. They would make their money off of manipulating prices.... Barclays would make their money off the buy side. And the buy side would totally be taken

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advantage of because they got stuck with the bad trade.... This happened over and over again."[80] Barclays' own trading desks that engaged in high-speed, high-order volume trading were granted similar privileges to those of external high-frequency traders operating in Barclays's dark pool. These internal desks did not, of course, confine their business to in-house dark pools but operated across lit and dark markets.

As exemplified by the Barclays case, the reality for investors in dark pools was starkly different from the "we are different" claims. All of these dark pool claims by broker-dealers were found to be lies in the enforcement cases brought against them (see table 5.1), and so-called objective or statistically determined solutions to predatory trading turned out to be little more than marketing gimmicks and self-serving falsehoods. The evidence from the cases reveals that broker-dealers tended to funnel institutional client orders to their own dark pools first, where they were exposed to predatory high-speed traders—contrary to the promises made about special protection and safeguards. Dark pool providers offered high-speed traders detailed information regarding the structure and composition of dark pools, worked closely with them to implement their aggressive trading preferences, and provided them with technical tools to exploit institutional investors.

Dark pools themselves are not, however, the only participants in these schemes. Other subsidiaries of broker-dealers, such as wealth management firms, have also been found to systematically mislead their customers about the nature of their execution services.[81] In June 2018, for example, the SEC found that between 2008 and 2013, Merrill Lynch systematically lied to its customers—predominantly other asset managers, mutual fund investment advisors, and public pension funds—about where their orders were being routed and executed. The firm, owned by Bank of America, programmed a system that provided automated messages to customers indicating that the execution venue of their trades was Merrill Lynch. In reality, however, these orders were being routed to other broker-dealers, including proprietary trading firms and wholesale market makers. Internally, this deliberate deception was referred to as "masking." In

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total, the masked transactions entailed more than 5.4 billion shares with a notional value of over $141 billion. As part of the settlement with the SEC, Merrill Lynch admitted wrongdoing and agreed to pay a $42 million penalty.

Should we be surprised by this disturbing evidence? Hardly. The structural condition explaining broker-dealers' incentives to engage in the described opportunistic acts is plain and simple: in a fragmented market, dark pool providers—like exchanges—struggle to attract liquidity. To survive, they accommodate high-speed traders who have forum shopping power and can thus demand special deals and privileged market access. Broker-dealers—like exchanges—have one particularly precious commodity to offer high-speed traders operating in their dark pool, namely confidential client trading data. Such information enables these traders to front run institutional order flow or otherwise exploit a trading advantage. Broker-dealers—again like exchanges—also offer privileged access through a variety of special order types in exchange for high levels of order flow or liquidity.

Smaller dark pool providers face particularly severe challenges in attracting external liquidity. Pipeline and ITG, for example, sought to address this difficulty by surreptitiously setting up their own internal high-speed trading desks with access to their own dark pools' confidential trading information. When a desk learned of the arrival of a large buy order in the dark pool, it would quickly buy up the stock cheaply on exchanges and other dark pools and sell the stock at a higher price to the "block" buyer in the dark pool. The existence of such in-house high-speed trading desks was of course not disclosed to clients or regulators, in blatant violation of securities regulations.

Finally, the cost of engaging in shenanigans has been small; it has not deterred broker-dealers from cheating. The civil money penalties paid as part of settlements with the SEC have been minor in most cases. Did the SEC enforcement cases damage broker-dealers' dark pool business? Figure 5.1 indicates no significant lasting negative impact on them in most cases. Several dark pool providers experienced a decline in trading volume shortly before or after the

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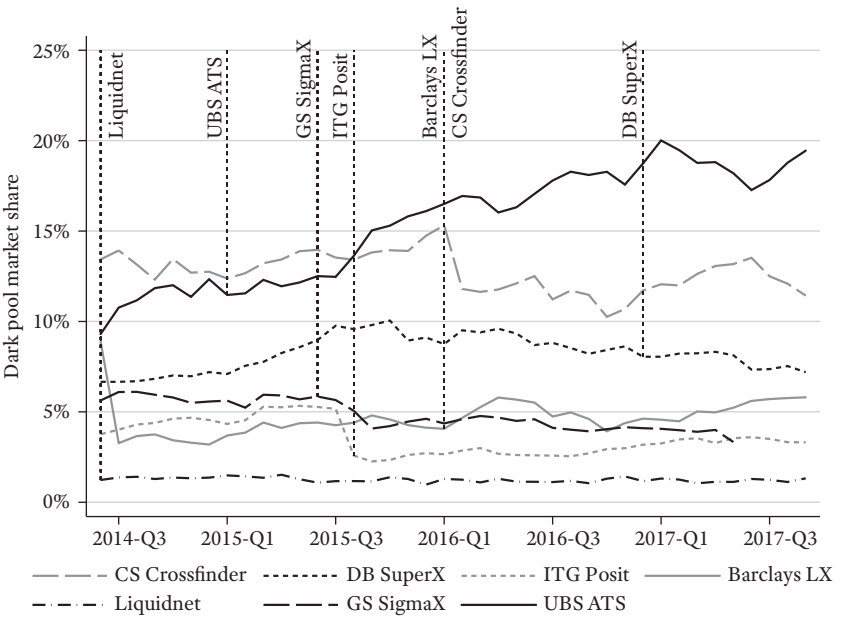

FIGURE 5.1. Dark pool market shares and enforcement actions. *Sources*: Market shares data: based on weekly OTC/ATS "transparency" datasets compiled by Finra, https://otctransparency.finra.org. Enforcement actions data: SEC.

announcement of a settlement, followed by a recovery (see ITG and Credit Suisse). In other cases, the impact is barely noticeable. In the absence of honest brokers, the market's sanction on cheating or otherwise dishonest behavior is likely to be minimal.

It bears repeating that, properly governed and regulated, dark pool trading can serve the useful functions for institutional investors that theory suggests: anonymity to prevent information leakage about big orders, gaming of client orders, and adverse price movements. Nevertheless, it has been suggested that even properly regulated dark trading may adversely affect the overall quality of capital markets. The European Commission, for example, expressed concern in 2011 that "an increased use of dark pools…may ultimately affect the quality of the price discovery mechanism on the 'lit' markets."[82] Similarly, the International Organization of Securities Commissions noted that "the development of dark pools and use of dark orders could inhibit price discovery if orders that otherwise

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might have been publicly displayed become dark."[83] And SEC commissioner Elisse Walter commented that "there could be some truth to the criticism that every share that is…[traded] in the dark is a share that doesn't assist the market in determining an accurate price."[84] In short, the general concern is that as the relative share of dark market trading grows, the accuracy of displayed market prices (as indicators of fair value) may decline because much of the information about the prices at which investors are willing to trade is no longer known to market participants. The information has moved to dark markets, where it is invisible.

In recent years, systematic investigations by academic researchers have found supporting evidence that high levels of dark trading tend to adversely affect overall market quality.[85] The reason is that market participants are disincentivized to send limit orders to a lit market if a substantial amount of trading happens elsewhere, that is, in dark pools. And as order submission to lit markets decreases, spreads increase, resulting in deteriorating market quality.[86] Who wins? Large broker-dealers who operate and trade in dark markets win. They continue to free ride on public prices set in lit markets (by using these prices as benchmarks for their dark pool pricing); in addition, they now benefit from wider public prices that enable them to extract higher rents from investors because they (i.e., their high-speed proprietary trading desks) can deal within wider spreads when transacting against client order flow.[87]

Failing Market Surveillance

Clear and comprehensive market rules are not sufficient per se to deter cheating. Such rules must be combined with effective monitoring of compliance with these rules to achieve good market governance. The old NYSE exhibited extraordinary ingenuity and sophistication in the area of surveillance (see chapter 3). Over many decades, it developed and refined a complex monitoring system that operated in two ways: horizontally, at the level of the trading floor, and vertically, via top-down monitoring by a specially designated staff that operated independently of the floor. Robust

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surveillance was a critical part of its market organization, and much of the Exchange's reputation or brand name depended on it. In the last quarter of the twentieth century, NYSE spent many billions of dollars on computerized surveillance programs and electronic data systems, including an electronic audit trail launched in 1981. It arguably achieved the most advanced market surveillance of any market; it was, in the words of Bob Seijas, "the envy of the Street."[88]

This all came to a sudden halt with the demutualization of the Exchange and the rapid rise of market fragmentation in the second half of the 2000s (see chapter 1). NYSE, now a for-profit business, was forced to rethink its priorities and find "efficiency savings." Its overriding mandate was to attract order flow or liquidity in a market where it no longer had a dominant market share, and this mandate now clashed with traditional good governance principles. As a result, some traditional activities, including robust surveillance, were downgraded in importance. In the words of Yesha Yadav: "The exercise of oversight represents a particularly poor business proposition in fragmented markets.... After all, why would any rational exchange zealously monitor, discipline and exclude those traders that bring it most business?"[89] No longer core to the business of the Exchange, market surveillance was reduced in size and handed to third parties.

In 2007, NYSE announced a staff reduction of its market surveillance division from 730 to 260 as part of an outsourcing arrangement with the newly created private-sector Financial Industry Regulatory Authority (FINRA).[90] Three years later, NYSE decided to transfer all remaining market surveillance operations to FINRA. The *Wall Street Journal* noted: "Along with NYSE's...report...of a 7 percent rise in its first-quarter income, and overshadowed by it, was the exchange operator's announcement of a further retreat from its self-regulation business."[91]

FINRA could hardly have been expected to be as effective a market watchdog as NYSE had been before 2005, when the Exchange still commanded an 80 percent market share. Equities markets were becoming ever more fragmented and opaque after 2005, and FINRA had no holistic view of these markets. It had oversight authority over

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only the NYSE and the Nasdaq OMX Group. New trading venues, like Direct Edge and BATS, founded by high-frequency trading firms, stayed away from FINRA.[92] Further, FINRA lacked the ability to conduct cross-market or dark pool trading surveillance.

Over the following years, FINRA gradually improved its operational capabilities and broadened the scope of its surveillance.[93] Success, however, remained limited or elusive. In 2016, Tom Gira, a FINRA executive vice president, admitted that surveillance for illegal trading practices in a fragmented market was becoming more difficult as technology evolved and manipulators succeeded in staying one step ahead of regulators. "We've found [that predatory traders] are getting more sophisticated[;]…there is sort of a cat and mouse game…[with traders using]…multiple strategies."[94] Similarly, Robert Cook, FINRA's new president and CEO, acknowledged in a 2017 speech: "The speed, complexity and diffusion of the markets have…opened new opportunities for potential misconduct. For example, a bad actor who seeks to momentarily manipulate the market to his advantage might now try to hide this misconduct by spreading orders across multiple trading venues, using different markets or products that are tightly linked."[95]

Two manipulative techniques, quote stuffing and spoofing, offer vivid illustrations of the new difficulties and challenges that surveillance faces in today's fragmented markets.

Quote stuffing consists of gunning a massive amount of buy and sell orders into the market—orders quickly cancelled—to overload or jam up the matching engine of an exchange. These quote bursts reduce the speed at which the exchanges can update market participants about price changes or process other traders' orders. The aim is to create a short-term mispricing of stocks, which gives the quote stuffer the opportunity to engage in profitable arbitrage at the expense of other market participants.[96]

Quote stuffing can involve the placing and canceling of over 25,000 orders of a stock per second—spread either over the entire second or in particularly disruptive bursts within a second. Such intense episodic spikes in quoting activity can be engineered simultaneously in multiple stocks on an exchange, leading to congestion

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and delays in price updates and potentially affecting all stocks trading on the exchange. Alternatively, instead of targeting multiple stocks on one exchange, quote stuffing can target one stock on multiple exchanges. For example, Google stock experienced five quote-stuffing events across three exchanges on August 11, 2010; each event lasted for one minute and entailed placing and canceling an average of 350,000 orders.[97] Quote stuffing is shockingly pervasive. It occurs daily, generally in the absence of any news or observable market signal, and affects the majority of equities.

A recent analysis of quote stuffing across U.S. exchanges over an entire year found an average of 125 quote-stuffing events each day, affecting roughly 75 percent of all U.S.-listed equities (5,292 in total).[98] Similarly, a study of 600 major European stocks found that each stock experienced on average about 19 quote-stuffing events a day, and 42 percent of these stocks averaged 10 events or more per day.[99] Quote stuffing is unequivocally harmful. It creates a false sense of demand and supply—or "phantom" liquidity—widens spreads, and raises volatility, thereby degrading market quality.[100]

Yet quote-stuffing enforcement cases are largely nonexistent. To date, only one high-speed firm, Citadel, has been fined for quote stuffing and related charges. It paid a paltry $0.8 million for sending millions of orders to the exchanges with very few, if any, actually executed.[101]

Another type of price manipulation is spoofing. This technique is a modern variant of an old scam called "momentum ignition" or "pump and dump." It involves sending orders into the market to dupe investors into believing that a stock has real momentum. For example, a trader who wishes to sell a stock at an inflated price can gun a large number of limit orders to buy into the market to create the appearance of substantial buying interest, baiting unsuspecting investors into buying. As a result, prices rise, enabling the manipulator to sell high as intended. Upon completion of this scam transaction, the trader immediately cancels all fake or non–bona fide buy orders—that is, orders the trader never intended to execute but simply used to mislead investors. A closely related manipulation strategy is called "layering" to describe the "layers" of fake orders,

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often at several price points on the public order book, that the manipulator pumps into the market (i.e., the public order book) to mislead.[102]

The modern-day version of spoofing came to public light in 2010 when FINRA fined nine proprietary traders at New York–based Trillium Brokerage Services for spoofing in over 46,000 cases.[103] What surprised many market insiders was not the spoofing but that charges were brought in the first place.[104] Spoofing was pervasive in 2010 and remains so today.[105] In the words of one trader, "I worked for Trillium for a short period of time, during which the . . . problem occurred. Having worked at another prop shop after Trillium, [I can say] that all prop shops use [spoofing]. Most traders I know call the massive orders intended to push the price around without getting filled 'juice'. Getting hit on your juice [in other words, getting one of these orders filled] was bad. Juice the book, get your trade off [in other words, get it executed at an artificially inflated or depressed price], cancel your juice. It is not limited to Trillium."[106] Similarly, a large group of anonymous traders confirmed in a letter to the SEC in March 2016 that "every professional trader can witness [spoofing] happening every day at almost every moment in the market in most equity securities."[107]

Trillium's spoofing case was relatively simple—price manipulation was confined to single products traded on single exchanges. In the meantime, spoofing has become much more complex, involving trading across markets, asset classes, or even jurisdictions, sometimes in combination with other predatory trading strategies such as front running. Unsurprisingly, spoofing/layering enforcement cases are extremely rare (relative to presumed spoofing instances in markets), as summarized in figure 5.2: from 2010 to 2017, 43 enforcement actions were taken—22 in the United States and 20 outside the United States (for a complete list of cases worldwide, see tables 5.2 and 5.3 in the appendix at the end of the chapter). Regulators possess few effective tools and may even lack the requisite broad supervisory authority to monitor such complex trading. For example, FINRA and the SEC have regulatory and oversight responsibilities for stock markets. The U.S. Commodity

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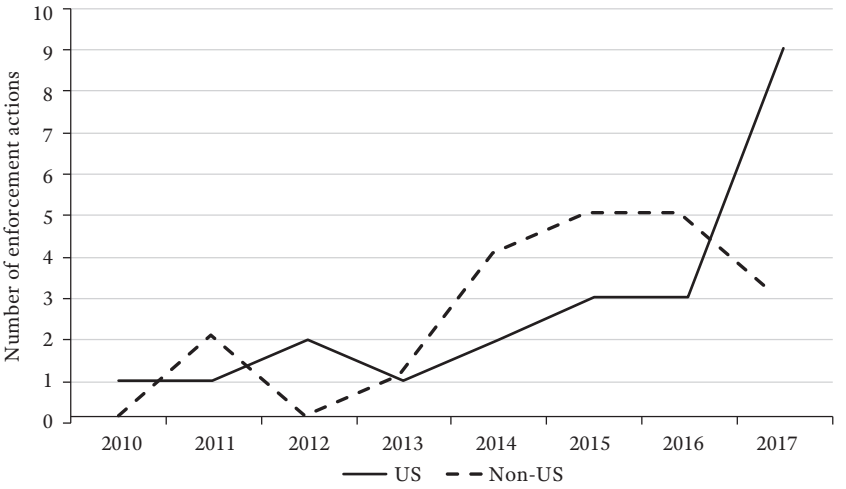

FIGURE 5.2. Number of enforcement actions against spoofing/layering, 2010–2017. *Sources*: Table 5.2 ('U.S. Enforcement Actions against Spoofing/Layering') and Table 5.3 ('Non-U.S. Enforcement Actions against Spoofing/Layering').

Futures Trading Commission (CFTC) focuses on futures markets. In a cross-asset trading world where high-speed traders routinely position multiple asset classes, such a division of labor over supervision is particularly unhelpful. In addition, it is extraordinarily difficult to ascertain whether a particular set of orders was bona fide with billions of orders being placed, canceled, and executed daily across multiple markets.[108]

The practical and technical challenges of effective market surveillance are deeper still. First, while the growth in volume of market transactions has been explosive in recent years, the regulators' investigative resources are limited. FINRA monitors on average about 50 billion market events (quotes, cancellations, and trades) a day across equities, options, and a few other markets.[109] About 1 percent of these events trigger alerts because of some unusual pattern.[110] In other words, about 500 million events daily require further investigations. Some of these investigations can be difficult, time-consuming, and expensive.[111] They may even require dispatching an examination team to a firm suspected of market manipulation. This can strain the finances of any regulator charged

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with multiple tasks.[112] In 2016, FINRA made about 500 referrals to the SEC. In other words, of the daily 500 million alerts, only one or two alerts have resulted in a referral to the SEC for further consideration and potential enforcement action. These referral numbers do not reflect the true extent of market manipulation but rather the severe limitations faced by the regulator.

Second, effective surveillance requires the ability to accurately reconstruct all events relating to an order over multiple trading venues on a consolidated or aggregated level. This reconstruction of the correct sequence of events, in turn, requires precise time information on each event. In a fragmented market system, the regulator must integrate disparate data from dozens of trading platforms into a cohesive giant database to be able to undertake the forensic work of reconstruction to spot market abuse. Each trading venue time-stamps events on its market, including order arrival, modification, cancellation, or execution. Most major venues record these events in micro- or nanosecond time granularity. Effective cross-market surveillance, however, requires not only high time-stamp granularity but also time accuracy. Only the synchronization of the clocks across trading venues permits regulators to establish accurate time sequences throughout the lifetime of an order.

How good is clock synchronization across markets? It is entirely inadequate in a world of high-speed trading; and, as a result, the bulk of cross-market abuse has most likely gone undetected. Until recently, FINRA required its members to synchronize their computer times to be within one second of the atomic clock of the U.S. National Institute of Standards and Technology (NIST). A one-second clock drift is an eternity in computer time, rendering serious cross-market surveillance impossible. In 2017, FINRA reduced the acceptable limit of clock drift to 50 milliseconds of NIST time, allowing for a 100-millisecond tolerance band (50 milliseconds slower and 50 milliseconds faster than NIST time).[113] However, in a world where quotes, cancellations, and executions occur in microseconds, such a band is still too wide to allow regulators to accurately sequence events across trading venues.

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The European Securities Market Authority (ESMA) recently adopted a much stricter clock synchronization standard, asking that all electronic events be captured with a minimum time accuracy of 100 microseconds relative to Coordinated Universal Time (UTC).[114] But even this European standard may soon be inadequate as the speed of trading accelerates. Clocks may then have to be synchronized to nanosecond accuracy to enable regulators to reconstruct market events over multiple trading venues and catch market manipulators. Technical problems and other challenges will persist, however.[115] Time synchronization infrastructures can fail without notice, they can also be tampered with by opportunistic market operators, and so on. Who will check and ensure compliance with synchronization rules?

Finally, politics may stand in the way of true progress in achieving effective market surveillance as long as the powerful have an interest in defending the status quo. Recent attempts in the United States to establish a more comprehensive market surveillance system are instructive. Shortly after the Flash Crash of May 2010, the SEC promoted the idea of creating a Consolidated Audit Trail (CAT). The project was motivated by the realization that the SEC lacked the tools to quickly identify the causes of disruptive market events.

The CAT project will differ from the FINRA surveillance system in three significant ways. First, CAT will mandate the consolidation of trading information by all securities exchanges and FINRA, thereby potentially creating the world's largest market data repository, collecting up to 120 billion events daily from about 2,000 sources. Second, it is envisioned that CAT will gather information regarding the identity of market operators, including personally identifiable information on traders and investors.[116] Finally, CAT would require the submission of more information from market participants than is presently the case, including information relating to orders originated by high-speed market makers, to better tie together the details of how orders travel though complex markets.[117]

The CAT project is eminently sensible and long overdue from the perspective of regulators and investors. Its fate, however, is

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uncertain. In 2012, the SEC conferred the technically challenging task of designing CAT to the well-resourced exchange and broker-dealer community. But this group is clearly conflicted. Why would they want the SEC to have the capability to precisely and accurately observe what is going on in their lit and dark markets? Unsurprisingly, the members of this group have been dragging their feet. Six years passed with little progress on key CAT issues, including data analytics, clock synchronization, and cost sharing for building and implementing CAT.[118] An industry expert explains: "There is a danger of overlooking the realities.... The [exchanges] need to fight for their own survival.... [They] and the [broker-dealer] industry have little incentive to do anything more than the CAT's minimum requirement—i.e., to submit data into a centralized vault.... So the SEC [will] still face...the challenge of figuring out how to reconstruct market events, analyze the data, and improve oversight."[119]

In late 2016, however, under SEC pressure, the lethargic process seemed to suddenly speed up with the selection of the future operator of CAT.[120] The choice fell not on FINRA, as had been widely expected, but on the technology company Thesys. Exchanges and big broker-dealers felt uneasy with the new pace. CAT's requirement to tag and fully disclose the client identity of all orders, including high-frequency orders, worried them. Under the pretext of concerns about the security of the aggregated data, the exchanges resumed their slowdown fight. "What do you do if regulators are about to go live with a system that might identify that your biggest clients could be market manipulators?.... You go crying to Congress and get them to change the law."[121] Two members of Congress obliged by introducing the Market Data Protection Act—a bill intended to temporarily kill the CAT. The Financial Services Committee of the U.S. House of Representatives approved the bill by a vote of 59 to 1 in October 2017, and the following month it passed the full House without amendment. It then moved to the Senate Committee on Banking, Housing, and Urban Affairs for consideration. After a one-year delay on the original timetable, the first phase began in November 2018 with exchanges reporting market information. Despite its progressive features, CAT is far from

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perfect. For example, it does not monitor futures markets, and it lacks real-time scrutiny of the markets.[122]

In sum, effective surveillance in a fragmented and increasingly global market is an elusive goal. Alexander Tabb, a leading capital market expert, noted in 2015 that "the complexity of our market structure and underlying technology surpasses our ability to monitor, analyze, and reconstruct market events."[123] What was true then remains largely true today, but this is not necessarily because technological solutions are unavailable; rather, it is by design. Powerful opposition and lack of political will are foiling attempts to establish truly effective market surveillance for the benefit of investors and society more broadly.

Implications

The features of bad market governance reviewed in this chapter are far from unique to equity markets. Foreign exchange (FX) markets, for example, have exhibited a remarkably similar pattern of structural development in response to advances in electronic execution methods.[124] FX trading is now largely digital, and an increasing proportion of market making is performed by proprietary trading firms utilizing HFT strategies.[125] Further, participants in FX markets are now faced with an increasingly fragmented landscape of execution venues, complicating a market that has historically been dominated by big banks.

And, as explained in detail by Marcus and Kellerman, these changes have given way to a number of worrisome developments.[126] Like equities, FX platforms pay for order flow, offer colocation services, and sell faster access to trade data. "In the era of electronification, the great majority of…venues [facilitating FX trading] have succumbed to a perverse incentive to monetize informational asymmetries."[127] These services have created concern among FX participants and national regulators that brokers may be directing their clients' order flow to whichever venue offers the best rebate rather than the best possible execution price.[128]

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And, also like equities, FX markets are now vulnerable to high-frequency methods of manipulation, including spoofing, layering, and quote stuffing. The extent of such practices is difficult to ascertain without access to expensive proprietary data feeds and sophisticated analytical tools. But recent enforcement actions, as shown in tables 5.2 and 5.3, indicate that spoofing is prevalent in FX, particularly with respect to FX futures. In 2013, the U.S. Department of Justice levied the first ever criminal charges for spoofing in a wide variety of instruments, including foreign currency futures. The list of recent enforcement actions also indicates that nefarious participants have employed spoofing and layering tactics to manipulate a wide variety of derivative instruments covering indices, crude oil, natural gas, gold, silver, wheat, government bonds, U.S. Treasury notes, and contracts for difference.

The same type of flash crashes that plague equities trading have also been witnessed in FX. Pragma Securities, utilizing a new definition of a currency flash crash, found 69 such events in a sample of trading data from 2015 to 2016.[129] These rapid changes in the price of individual currencies have nothing to do with the fundamental economic purpose of FX markets: allowing firms engaged in cross-border industry to pay for foreign goods and services and hedge the risks associated with future currency movements. And our ability to understand these developments is undermined by lax reporting standards. As Marcus and Kellerman note, "Spot FX, and the venues that provide access to it, have historically been lightly regulated and, therefore, do not provide national authorities with transactional data equivalent to that available on equities. Further, FX is a global product traded across venues on a fragmented basis, and hence a golden copy (i.e., an official, master record of data) is required to ensure that results [of analyses] are not misleading."[130] These issues surrounding data access and surveillance are very similar to those observed in equities. But the problems may be even more severe in FX, which is a truly global, continuous, and lightly regulated market.

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Appendix

TABLE 5.2. U.S. Enforcement Actions against Spoofing/Layering

Date	Charged Entity/Individual Associated Legal/Natural Persons (if Relevant)	Total Civil Fine (USD)	Criminal Charges (if Relevant)	Enforcement Agency	Manipulated Instrument
April 9, 2018	Anuj C. Singhal	$150,000		CFTC	Wheat Futures
January 29, 2018	Andre Flotron	TBD	Indicted on one count of conspiracy to commit offenses against the United States (found not guilty)	CFTC U.S. Department of Justice	Various Metal Futures
January 29, 2018	James Vorley Cedric Chanu	TBD		CFTC	Various Metal Futures
January 29, 2018	Jiongsheng Zhao	TBD		CFTC	E-mini S&P 500 Futures
January 29, 2018	Jitesh Thakkar Edge Financial Technologies, Inc.	TBD		CFTC	E-mini S&P 500 Futures
January 29, 2018	Krishna Mohan	TBD		CFTC	E-mini Dow ($5) and E-mini NASDAQ 100 Futures
January 29, 2018	HSBC Securities (USA) Inc.	$1,600,000		CFTC	Various Precious Metal Futures
January 29, 2018	UBS AG	$15,000,000		CFTC	Various Precious Metal Futures
January 29, 2018	Deutsche Bank AG Deutsche Bank Securities Inc.	$30,000,000		CFTC	Various Precious Metal Futures
October 10, 2017	Arab Global Commodities DMCC	$300,000		CFTC	Copper Futures
July 26, 2017	Simon Posen	$635,000		CFTC	Crude Oil Futures; Gold, Silver, and Copper Futures

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July 8, 2017	The Bank of Tokyo-Mitsubishi UFJ, Ltd.	$600,000		CFTC	U.S. Treasury Note Futures, Eurodollar Futures, various other futures contracts
June 29, 2017	Jeremy Lao Daniel Liao Shlomo Salant Citigroup Global Markets Inc.	$0	Nonprosecution agreements for all three individuals	CFTC	U.S. Treasury Note Futures
March 30, 2017	Stephen Gola Citigroup Global Markets Inc.	$350,000		CFTC	U.S. Treasury Note Futures
March 30, 2017	Jonathan Brims Citigroup Global Markets Inc.	$200,000		CFTC	U.S. Treasury Note Futures
March 27, 2017	Lek Securities Corporation Samuel Frederik Lek Vali Management Partners dba Avalon FA LTD Nathan Fayyer Sergey Pustelnik aka Serge Pustelnik		Lek Securities and Samuel Lek charged with aiding and abetting securities fraud (result TBD)	FINRA SEC	U.S. Equities
February 6, 2017	David Liew	$0	Pleaded guilty to one count of conspiracy to commit wire fraud and spoofing (sentencing TBD)	CFTC	Gold and Silver Futures
January 19, 2017	Citigroup Global Markets Inc.	$25,000,000		CFTC	U.S. Treasury Note Futures
December 20, 2016	Igor B. Oystacher 3Red Trading LLC	$2,500,000		CFTC	Copper Futures, Spot Crude Oil Futures, Spot Natural Gas Contracts, Volatility Index Futures, E-Mini S&P 500 Futures

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TABLE 5.2. (*continued*)

Date	Charged Entity/Individual Associated Legal/Natural Persons (if Relevant)	Total Civil Fine (USD)	Criminal Charges (if Relevant)	Enforcement Agency	Manipulated Instrument
November 17, 2016	Navinder Singh Sarao Nav Sarao Futures Limited PLC	$25,743,174.52	Pleaded guilty to one count of wire fraud and one count of spoofing (sentencing TBD)	CFTC	E-Mini S&P 500 Futures
May 4, 2016	Heet Khara Nasim Salim	$2,690,000		CFTC	Gold and Silver Futures
August 10, 2015	Briargate Trading, LLC Eric Oscher	$500,000		SEC	U.S. Equities
March 12, 2015	Behruz Afshar Shahryar Afshar Richard F. Kenny, IV Fineline Trading Group LLC Makino Capital LLC	$325,000		SEC	Equity Options
January 13, 2015	Aleksandr Milrud	TBD	Pleaded guilty to one count of conspiracy to commit securities fraud (sentencing TBD)	SEC	U.S. Equities
October 1, 2014	Eric Moncada BES Capital LLC Serdika LLC	$1,560,000		CFTC	Wheat Futures
April 4, 2014	Visionary Trading LLC Lightspeed Trading LLC Andrew Actman Joseph Dondero Eugene Giaquinto Lee Heiss Jason Medvin	$1,000,000		SEC	U.S. Equities

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July 22, 2013	Panther Energy Trading LLC Michael J. Coscia	$1,400,000	Coscia sentenced to three years in prison	CFTC U.S. Department of Justice	Various Energy, Metals, Interest Rate, Agricultural, Stock Index and Foreign Currency Futures
September 25, 2012	Hold Brothers On-Line Investment Services, LLC Demostrate, LLC Trade Alpha Corporate, Ltd Steven Hold Robert Vallone William Tobias	$5,916,667		FINRA SEC	U.S. Equities
July 31, 2012	Biremis, Corp. Peter Beck Charles Kim	$500,000		FINRA SEC	U.S. Equities
August 18, 2011	Robert Thomas Bunda	$175,000		FINRA	U.S. Equities
September 13, 2010	Trillium Brokerage Services, LLC John J. Raffaele Daniel J. Balber Frank J. Raffaele, Jr. Brian M. Gutbrod James P. Hochleutner Samuel J. Yoon Tal Sharon Rosemarie Johnson Bradley L. Jaffe Tal B. Plotkin Michael S. Raffaele	$2,260,000		FINRA	U.S. Equities

Note: "Total Civil Fine" does not include disgorgement of profits or interest on disgorgement. The fine reflects that imposed for the manipulative activity and any connected violations. "Date" refers to the release day of the relevant enforcement notice, settlement, or external court decision.

Source: Securities and Exchange Commission (SEC), https://www.sec.gov/litigation/); Financial Industry Regulatory Authority (FINRA), http://www.finra.org/sites/default/files/); New York Attorney General (NYAG), https://ag.ny.gov/sites/default/files/); US Commodity Futures Trading Commission (CFTC), http://www.cftc.gov/.

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TABLE 5.3. Non-U.S. Enforcement Actions against Spoofing/Layering

Date	Charged Entity/Individual Associated Legal/Natural Persons (if Relevant)	Total Civil Fine (USD)	Criminal Charges (if Relevant)	Enforcement Agency	Manipulated Instrument
June 29, 2018	Morgan Stanley MUFG Securities Co., Ltd.	$1,972,308.65		Japan Securities and Exchange Surveillance Commission (SESC)	10-year Japanese Government Bond Futures
June 29, 2018	Renmo Costa JitneyTrade Inc.	TBD		Investment Industry Regulatory Organization of Canada (IIROC)	Canadian Equities
June 26, 2018	Individual investor residing abroad	$44,849.15		Japan SESC	Japanese Equities
March 30, 2018	Aidin Sadeghi	TBD		IIROC	Canadian Equities
November 22, 2017	Paul Axel Walter Bank of America Merrill Lynch	$51,496		U.K. Financial Conduct Authority (FCA)	Fixed income bonds issued by the Dutch State Treasury Agency
June 23, 2017	Small proprietary trading company and three of its traders	$0		Swiss Financial Markets Supervisory Authority	Swiss Equities and Derivatives
March 22, 2017	Mr Tey Thean Yang Dennis DBS Bank		Sentenced to 16 weeks in prison	Monetary Authority of Singapore, State Courts of Singapore	Contracts for Difference (CFDs)
March 17, 2017	Caspian Trading Ltd.	$118,215[a]		Japan SESC	Japanese Equities
November 21, 2016	Tang Moubo Tang Hanbo Other unnamed traders	$173,760,000		China Securities Regulatory Commission (CSRC), Securities & Futures Commission of Hong Kong (SFC)	Chinese Equities

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September 1, 2016	Robert Sole	$8,393.42	IIROC	Canadian Equities
June 12, 2016	Morgan Stanley MUFG Securities Co., Ltd.	$1,930,106.64[a]	Japan SESC	Japanese Equities
April 3, 2016	Blue Sky Capital Management Pty Ltd	$65,315.76[a]	Japan SESC	Japanese Equities
February 2, 2016	Evo Investment Advisors Ltd.	$76,488.80[a]	Japan SESC	Japanese Equities
December 14, 2015	Oasis World Trading Inc. Zhen (Stephen) Pang	$218,437.20	Ontario Securities Commission (OSC)	Canadian Equities
December 8, 2015	Da Vinci Invest Limited Da Vinci Invest PTE Limited Mineworld Limited Szabolcs Banya Gyorgy Szabolcs Brad Tamas Pornye	$11,837,413	U.K. FCA	CFDs
July 27, 2015	Zhenyu Li National Bank Financial Inc.	$8,838.14	IIROC	Canadian Equities
June 3, 2015	Select Vantage Inc.	$183,017.24[a]	Japan SESC	Japanese Equities
April 12, 2015	Virtu Financial Europe	$5,436,605	Autorité des marchés financiers (AMF)	French Equities
June 13, 2014	Musashi Securities Co., Ltd.	$53,203.14[a]	Japan SESC	Tokyo Stock Price Index Futures
May 12, 2014	Areion Asset Management Company Limited	$3,548,005.38[a]	Japan SESC	Japanese Equities
May 9, 2014	Anonymous trader	$3,144.57[a]	Japan SESC	10-year Japanese Government Bond Futures

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TABLE 5.3. (*continued*)

Date	Charged Entity/Individual Associated Legal/Natural Persons (if Relevant)	Total Civil Fine (USD)	Criminal Charges (if Relevant)	Enforcement Agency	Manipulated Instrument
February 18, 2014	Select Vantage Inc.	$586.38[a]		Japan SESC	Japanese Equities
March 7, 2013	Michael Coscia	$903,176		U.K. FCA	Various Energy, Metals, Interest Rate, Agricultural, Stock Index and Foreign Currency Futures
December 5, 2011	Kraay Trading I BV	$14,230.54		AMF	French Equities
June 5, 2011	Swift Trade Inc	$13,129,200		U.K. FCA	British Equities

Note: Not all non-U.S. enforcement actions listed in this table explicitly mention the terms "spoofing" or "layering." However, if such an enforcement case describes trading practices that correspond to the generally accepted definition of spoofing/layering, I decided to include it.

"Total Civil Fine" does not include disgorgement of profits or interest on disgorgement. The sole exception is the November 2016 fine imposed by the Chinese and Hong Kong Regulators, which is not broken down in the public enforcement notice. The fine reflects that imposed for the manipulative activity and any connected violations. Civil fines have been converted to USD using historical exchange rates sourced from http://www.x-rates.com/. "Date" refers to the release day of the relevant enforcement notice, settlement or external court decision.

[a] In Japan, the SESC identifies instances of alleged manipulation and recommends fines to the Japanese Financial Services Authority (FSA), which has final say on the imposed penalty.

Source: Non-US cases were provided by the relevant national financial regulatory authorities in Canada, China, Japan, Singapore, Switzerland, and the United Kingdom.

6

Conclusion

THE WAY FORWARD

The logic that underpins the bad market governance propositions presented in this book is eminently rationalist—scammers will scam as long as deception, manipulation, or misrepresentation pays. In dark and highly fragmented algorithmic capital markets, scamming opportunities exist aplenty. "Smart" scamming is not cheap, however. It requires extensive investments in sophisticated technologies and often murky or secretive preferential arrangements or partnerships with other significant market operators or participants. The overall profitability of scamming depends on the return on these investments, the likelihood of getting caught, and the severity of the punishment. I have argued that in today's complex electronic capital markets the returns may be high, the chances of getting caught remote, and the penalties trivial. The exploitation of conflicts of interest that is endemic in market-making operations today is profitable; it is therefore simply to be expected.

Is such an outcome unavoidable? Not necessarily. Reform-minded regulators and market providers have a range of tools at their disposal to alter the cost-benefit calculus of scammers.

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Darkness by design is not inevitable—the mantle of darkness can be lifted through a combination of steps based on several fundamental principles, including market transparency based on stringent disclosure rules and robust market intelligence, a level playing field for market participants, proper accountability for market disruption and bad governance, and, crucially, market consolidation or centralization. The implementation of some of these principles will face considerable practical and especially political challenges, however, not least from powerful defenders of the status quo who will fight change tooth and nail. This is unsurprising since markets are deeply political systems, as I have stressed in this book, where competing groups staunchly and persistently battle for dominance to shape market rules and regulations.

Market Transparency

Two years before being nominated by President Woodrow Wilson to become a member of the Supreme Court in 1916, Louis Brandeis wrote a book titled *Other People's Money and How Bankers Use It*. The book criticized the extraordinary wealth that bankers had accumulated on the backs of ordinary investors. "[A] main cause of these large fortunes is the huge tolls taken by those who control the avenues to capital and to investors. There has been exacted as toll literally 'all that the traffic will bear.' "[1] Specifically, Brandeis lamented the extortionist sums taken by bankers in promoters' fees, underwriting commissions, and profits. The problem, he argued, had two root causes. First, "wealth breeds power" and "power breeds [more] wealth" and so on,[2] thus protecting bankers' ability to charge "monster commissions";[3] second bankers were subject to no meaningful disclosure rules—they preferred to operate in the dark. "The aggregate commissions or profits so taken by leading banking houses can only be conjectured as the full amount of their transactions has not been disclosed."

Brandeis strongly believed that once the secrecy and "darkness" surrounding complex fees, excessive profits, and conflicts of interest were lifted, investors would mobilize to bring about change,

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improving fairness and efficiency in markets and reducing excessive wealth and power of bankers. The solution he famously advocated was "publicity," or full disclosure. "Publicity is justly commended as a remedy for social and industrial diseases. Sunlight is said to be the best of disinfectants; electric light the most efficient policeman."[4] And he added: "But the disclosure must be real. And it must be a disclosure to the investor. It will not suffice to require merely the filing of a statement of facts with the Commissioner of Corporations or with a score of other officials, federal, and state.... To be effective, knowledge of the facts must be actually brought home to the investor, and this can best be done by requiring the facts to be stated in good, large type in every notice, circular, letter and advertisement inviting the investor to purchase."[5]

A century has passed since Brandeis penned these words, but they still ring true and remain relevant. In today's dark markets, "sunlight" would go a long way toward eliminating many of the worst abuses by powerful market operators and their allies. Brandeis saw disclosure through regulation as an enabler of fair competition and free markets.[6] And most academics concur that mandating disclosure and providing for civil liability can be a particularly effective regulatory way to protect investors and foster efficient equity markets.[7] Disclosure rules, however, must keep apace with changes in technology and resulting new market practices.

Regulators have begun to respond; but much remains to be done, especially in the United States, where investors generally do not have adequate information on the handling and execution of their orders by dark pools and internalizers. In addition, the main exchanges keep generating special order types (SOTs) and complex and opaque fee structures without full public documentation or what Brandeis referred to as real disclosure.

The SEC has recently taken a belated step toward addressing these problems by amending the regulatory filing requirements for alternative trading systems.[8] In the past, the main filing requirement that the SEC placed on these systems was to submit a description of the details of their operations, which the SEC kept confidential. Now they will be required to submit a significantly more

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detailed form that will be published on the SEC's website. This form requires dark pools to disclose the existence and operation of their SOTs and, crucially, how these pools interact with their broker-dealer operator(s).[9] This latter disclosure requirement is inspired by the SEC's recognition that many alternative trading systems "are operated by multi-service broker-dealers, whose business activities have become increasingly intertwined with those of the ATS, adding further complexity . . . and creating the potential for conflicts between the interests of the broker-dealer operator and the ATS's subscribers."[10]

These new disclosure requirements are laudable. So too is the SEC's newfound ability to deem such disclosures ineffective if, for example, they are incomplete or incomprehensible or if they reveal noncompliance with federal security laws.[11] But they do not go far enough. The new requirements are limited to alternative trading systems facilitating transactions in National Market System (NMS) stocks. The SEC, citing the need for an incremental approach, has decided not to extend the same rules to pools for fixed income, government bonds, or OTC equities.[12] But it is difficult to understand why an incremental approach is needed when the disclosure of dark pools' operations is so obviously necessary and long overdue.

A few national regulators outside the United States have also taken steps to improve transparency. The Australian Securities Investment Commission (ASIC), for example, enhanced its so-called market integrity rules in 2012, following a comprehensive market review, by demanding greater disclosure about the operation of various types of trading platforms, including dark pools, and about their conflicts of interest.[13] These updated rules have enabled investors to make more informed choices about where and how their orders are managed.[14] Similarly, in 2014 European regulators took a significant step by adopting the Market in Financial Instruments Directive (MiFID) II reforms that came into effect in January 2018.[15] MiFID II places heavy emphasis on improving investor protection by introducing robust disclosure rules, mandating greater transparency about order execution and the prevention or robust

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management of conflicts of interest. In the United States, regulators have recently begun to address improvements in "best execution" and order routing disclosure.[16] FINRA, for example, issued a new Guidance on Best Execution Obligations in Equity, Options and Fixed Income Markets. And in 2016, the SEC proposed more disclosures by broker-dealers to customers about the routing of their orders.[17]

These are helpful first steps. To be effective, however, they will have to be broadened and continually deepened and adapted or recalibrated to keep pace with fast-moving market developments and the furious speed of technological change. The benefits of enhanced and up-to-date disclosure in highly fragmented capital markets are bound to be highly significant. As put by one market expert: "Based on historical data, we should all expect that well-constructed disclosure rules will lead to a much more competitive… trading marketplace, lowering trading costs for…[investors]. And as the competition increases, we may also see a major shakeout in the market, as only the most competitive market centers are able to survive."[18]

Disclosure rules are essential instruments enabling greater market transparency. Market transparency, however, is not fully achievable without good market intelligence. Progress on the market intelligence front will require a concerted collaborative effort involving three constituencies: regulators, of course, but also market insiders as well as academics. Regulators sit on huge aggregate market data from trading platform providers registered with the regulators; market participants, or market insiders, have unrivaled technical expertise and unique insights into markets by virtue of their daily, up-close real-world experience over many years; meanwhile, academics possess robust theoretical and data-analytical skills and can make findings accessible to investors and the wider public.

Market insiders with highly specialized and rich contextual knowledge of markets and trading strategies can be of invaluable help to regulators. It is worth noting that in seven of the nine successful dark pool enforcement cases brought by the SEC

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(see chapter 5, table 5.1), market intelligence came from market insiders willing to collaborate with the SEC as part of a whistleblower program that the SEC established in 2010.[19]

Market insiders who are willing to share their knowledge are also helpful for academic researchers attempting to explain market activities, especially given that academic contributions have been severely limited by other factors. First, most detailed capital market data is proprietary and held by exchanges, alternative trading platforms, and large broker-dealer banks. The few data bits that these businesses have been willing to release to academic researchers on rare occasions may be "conflicted"; in other words, it may be data that is selected, or packaged, by the providers to ensure favorable data-analytical results.[20] Moreover, data providers often do not allow academic researchers to share this data with others, which renders replication of analysis impossible.

There are other data challenges for academic researchers. Existing market data is petabyte-scale (one petabyte equals one thousand million million [10^{15}] bytes). Academics struggle to work with such enormous amounts of data because they typically do not have the proper (super) computational tools and facilities to analyze and store such big data. As a result, they are reduced to working with and making inferences from limited information that is computationally manageable: small slices of data on a few stocks covering short time periods.[21] Another significant handicap is that academics tend to operate in silos or ivory towers. This makes it all the more critical that academics engage with expert practitioners who have deep knowledge of market context, power relations in markets, and trading strategies, given that lack of engagement can lead to improper, biased, or erroneous conclusions in academic studies. Correlational findings in such studies rarely establish causality and reduce the potential value of academic contributions toward understanding markets. This need not and should not be the case.

A first prototype of a collaborative venture involving regulators, (former) high-speed traders, and academics is the Healthy Market Research Institute (HMRI), an American independent not-for-profit organization launched in 2017. The Institute aims to promote

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high-quality market intelligence across a variety of asset classes through cross-cutting professional collaboration. Its Market Analytics Platform is meant to provide academics with a petabyte-scale analytics platform with years of depth-of-book equities and futures data; a framework for providing proprietary data in an unconflicted, centralized platform; and advanced data science and machine learning tools.[22] HMRI has adopted the Center for Open Science's Open Science Framework to make all study codes open-source and reproducible, and most of HMRI's analytics codes and tools will be open sourced.

Initiatives like HMRI will have to be replicated around the world and collaborate with each other to lay the foundation for robust global market intelligence. Such an achievement is at least a decade away. Collective action problems, organizational politics, funding challenges, and determined opposition by powerful status quo forces will stand in the way of progress. An illustration of the scale of the task and challenge is the reluctance even among regulators to cooperate and share market data to improve market intelligence. According to one former head of market surveillance at a national securities regulator, this lack of cooperation is due primarily to regulators' concerns about giving up national sovereignty or control over their markets and fear of losing their own jobs: "It's politics and ingrained interests."[23]

Regulators can and do request market data from colleagues in other countries in the course of ongoing investigations through the use of bilateral and multilateral memoranda of understanding. But these processes of data transfer are slow and subject to countless hurdles, including privacy protection laws and differences in the format and time-stamping of market data. As summarized by Kellerman: "[Most] regulators are operating with blinders on. They are aware that cross-border manipulation exists and has intensified over the last 15 years. And they are aware that the current system is insufficient to capture this activity, particularly with regard to cross-asset manipulation. But despite these acknowledgements, there is remarkably little international cooperation on the direct surveillance of cross-border trading activities."[24]

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In sum, regulators, market experts, and academics all have much to offer, but all three face limitations in doing so. Greater formal and international efforts to engender cooperation between them are needed in order for these actors to achieve their full potential in increasing market intelligence and thus help improve the health of markets and protect the public welfare.

Leveling the Playing Field

A wide range of regulatory measures has been proposed by regulators, industry groups, academics, and others that are aimed at leveling the playing field.[25] Several of these proposals seek to reduce speed and informational advantages that can give rise to predatory trading behavior and thus compromise the integrity of markets. They are of varying practicality. Some are sound as technical or theoretical ideas but likely to face serious implementation hurdles; others have been tested and hold great promise.

One proposal to reduce the speed advantage is to move from the typical "continuous trading" on exchanges to periodic call or batch auctions. Such auctions would consist of uniform-price sealed-bid auctions conducted at discrete time intervals—for example, every 100 milliseconds.[26] This solution would only work, however, if all trading venues held their batch auctions simultaneously. If such coordination failed—a high likelihood in a fragmented national market system—tiny speed differences and electronic front running would persist.[27]

A second proposal is for exchanges to introduce small randomized delays or pauses in processing trading orders (submissions, amendments, and cancellations). A randomized delay introduces an element of execution uncertainty designed to undermine the ability of high-speed traders to engage in predatory behavior such as spoofing and quote stuffing. A related idea is the introduction of so-called speed bumps, pioneered in the United States by the Investors Exchange (IEX) launched in 2013.[28] IEX sees itself as a disruptor of the status quo. In the words of its CEO Brad Katsuyama: "At IEX, we believe that everyone should have the opportunity to compete

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on a level playing field with transparent rules and processes."[29] Specifically, its speed bump—a 38-mile coil of optic cable—slows down access to its market by 350 microseconds. The speed bump creates a tiny delay between the moment IEX matches a buyer with a seller and the moment their transaction becomes visible to other traders.[30] This delay applies equally to all—there is only one lane, a slow lane.[31] This helps counteract predatory trading strategies that hinge on informational advantages.[32] Other exchanges, as discussed in chapter 4, offer two lanes or a two-tier "service" structure, charging a premium for access to the fast lane that comes with colocation and enriched market data. As of November 2018, IEX had a market share of 2.8 percent. This share is likely to grow over time as more institutional investors send their orders to "fair" exchanges—that is, trading platforms that treat all market actors equally.

A third idea to end information speed advantages is to mandate that private data feeds be delayed until public quote and trade information has been disseminated. At present, the U.S. Regulation National Market System (Reg NMS) prohibits exchanges from "unreasonably discriminatory" distribution of markets data. Reg NMS deems dissemination to be "reasonably discriminatory" (i.e., to fall within the law) as long as the trading venue releases private feeds and public data at the same time. However, as legal experts Fox, Glosten, and Rauterberg point out, it would be possible, in theory, to change this interpretation so that the benchmark of what is reasonable no longer refers to the point of release of public information but to the time at which market data is received by the end users. This is already done for some purposes in the United States, such as in reaching judgment on cases of insider trading: "[A] focus on the time at which information reaches end users rather than the time of a public announcement is the approach the courts and the SEC have traditionally taken with respect to when, for purposes of the regulation of insider trading, information is no longer nonpublic."[33] It is all but certain, however, that any attempt to change the present interpretation would unleash a storm of protest as well as determined lobbying efforts by a powerful industry that profitably operates in dark markets.

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Finally, penalties in the form of taxation specific to the operations of high-speed traders is another means by which to curb bad or questionable market behavior and create a fairer, more leveled marketplace. For example, a distinctive feature of high-speed traders is their high rates of order submission and cancellation during a very short time period—seconds, milliseconds, even microseconds. Excessive cancellation rates (or high order-to-execution ratios) may reflect the need to quickly adjust their orders to rapidly changing prices to avoid adverse execution, or they may simply be an expression of predatory "spam and cancel" strategies that seek to manipulate prices or otherwise disadvantage institutional investors. Such strategies create a misleading sense of liquidity known as "phantom" liquidity—the orders quickly disappear when a "slow" market participant seeks to interact with them. Regulatory authorities in several countries have recently passed rules to deal with excessive cancellation rates via taxation. One of the first countries to act was France in 2012. Specifically, the French regulation allows high-speed traders to cancel and modify up to 80 percent of their orders free of charge. Above this threshold, traders pay a tax of 10bps of the value of canceled or modified orders.[34] Similar measures have been adopted, most notably, in Canada, Germany, Italy, and Norway.[35]

Proper Accountability for Market Disruption and Bad Governance

Countless additional measures have been proposed by academics and policy-makers to improve the resilience and quality of capital markets. These include electronic trading safeguards through more robust compliance systems as well as circuit breakers or so-called kill switches—devices that instantly stop trading when an exchange gets flooded with erroneous or disruptive orders. For example, the SEC introduced single-stock circuit breakers, which impose a five minute trading halt if the price of a specific stock moves by more than 10 percent within five minutes. Similarly, the SEC has approved a "limit up–limit down" plan that pauses trading in a stock if transactions move more than a certain amount (typically

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5 percent) away from the security's average price over the past five minutes.[36] Furthermore, stress tests are being mandated at the level of both major trading firms and the exchanges to evaluate their technological and operational ability to cope with major market-wide shocks and disruptions.[37] Other regulatory ideas include reducing market complexity by diminishing the number of allowable SOTs or forcing exchanges to abolish opaque pricing schemes and retire less used trading mechanisms.

All of these measures, combined with much-enhanced transparency and disclosure rules, as well as a more level market playing field, would alter the cost-benefit calculus of scamming and reduce the scope for bad market behavior. And, by adding expanded whistle-blower programs and much more severe penalties for rule violators, including time in jail, the scales would at last tip in favor of investors. A former SEC enforcement officer recently noted: "For the powerful, we are at most a tollbooth on the bankster turnpike. We are a cost, not a serious expense."[38] His point was that only the threat of incurring a "serious expense" will motivate opportunistic actors who violate the public trust to halt their shenanigans.

Consolidation

Arguably some of the most effective regulatory proposals are those that seek to reduce market fragmentation and promote market consolidation. As I have argued in this book, more centralized competitive market systems are more likely to align the interests of major exchanges and those of investors. The reason is that dominant exchanges in such market systems have particularly strong reputational reasons and the requisite financial resources to invest in good governance. Dominance means high public visibility, which brings with it great reputational vulnerabilities (see chapters 1 and 3). In highly fragmented market systems, the many market organizations have an incentive to cut corners. Why focus on delivering high-quality public goods, such as price discovery, if competitors can simply free ride, and, in addition, good money can be made by milking conflicts of interest? Once such behavior becomes permissive

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and the unspoken norm, no significant reputational costs result from engaging in, abetting, or condoning bad market behavior.

Consolidation thus is likely to generate a fairer, simpler, more transparent, and more efficient marketplace than the one created by a fragmented system and characterized by shallow liquidity scattered across a wide range of exchanges, dark pools, and internalizers. Consolidation proposals seek to shift most trading back to traditional exchanges by imposing conditions and limits on dark pools and broker-dealer internalizers. "Expos[ing off-exchange order flow to]…electronic [trading] on-exchange for competitive price improvement…benefits retail customers and enhances the liquidity made available to the public marketplace."[39]

A particularly elegant and simple proposal of this type is the so-called trade-at rule, which would require orders to be executed against displayed quotes on traditional exchanges except if dark pools and broker-dealer internalizers offer prices that clearly and meaningfully are better than those on lit markets.[40] Unsurprisingly, powerful broker-dealer banks in the United States have been lobbying vigorously against the introduction of a trade-at rule, while public exchanges are fully supportive.

A second set of proposals likely to bring about market consolidation involves specific numeric limits on off-exchange trading. For example, the EU's MiFID II caps dark pool trading at 4 percent per financial product and 8 percent on a global basis across all trading venues. Important omissions, however, give cause for concern. For example, MiFID's double volume cap on dark pool trading applies only to transactions taking place on trading venues (that is, regulated markets, exchanges, and multilateral trading facilities); it does not apply to transactions executed through broker-dealer internalizers or over the counter. As noted by one observer: "If the quantity of dark trading should be reduced, imposing a system that ignores large chunks of dark activity would appear to preference one style of dark trading over another, while avoiding the need to improve the quality of dark activity.… We may inadvertently end up with a concentration of [dark] trading activity on a reduced number of venues."[41]

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This rather strange omission or exemption raises a more fundamental question about the ability of regulators to carry out deep structural market reforms. As discussed in chapter 2, fragmentation and darkness are not accidents but the result of a gradual transformation in power relations among market participants. Regulators cannot escape this reality; they do not operate in serene and quiet ivory towers but instead are buffeted daily by the strong winds of power politics. The powerful will defend the status quo and oppose deep market structure reforms—and they have close relationships with the regulators.

In a remarkably frank and insightful speech, former SEC attorney James Kidney noted in 2014, on the occasion of his retirement from the commission after 28 years of service:

> The revolving door is a very serious problem. I have had bosses, and bosses of my bosses, whose names we all know, who made little secret that they were here to punch their ticket. They mouthed serious regard for the mission of the Commission, but their actions were tentative and fearful in many instances. You can get back to Wall Street by acting tough, by using the SEC publicity apparatus to promote yourself as tough, and maybe even on a few occasions being tough, if you pick your targets carefully. But do not appear to fail. Don't take risks where risk would count.[42]

Perhaps, therefore, regulatory intervention in capital markets is rarely the only or necessarily the most effective answer. There is another answer: market solutions to market failures, sometimes nudged or facilitated by regulators. Specifically, greater consolidation and market centralization remain possible—if not through regulatory intervention then perhaps through market processes. Consider the following scenario: exploding technology costs, compliance costs rising rapidly with new regulation, and fierce competition among market providers in a fragmented system are all squeezing profit margins. A likely consequence for the medium and long term is a search for scale economies through mergers and acquisitions as well as vertical integration into adjacent

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businesses, notably post-trade services such as clearing, settlement, and custody of securities. In this case, the resulting emergence of a small number of diversified global market organizations may fundamentally change the cost-benefit calculus of governance investments. Reputational considerations may again be front and center in investment decisions, and profitability may depend on the ability to establish and maintain a trusted brand name.[43] The end result may be a centralized system reconstituted at the global level, with perhaps two or three competing capital market organizations at the top, showing some regional differentiation or operational specialization. Free riding by small competitors may persist, but losses will be compensated by scale economies and diverse revenue sources.

This scenario is not hypothetical nor does it necessarily lie in the very distant future. Exploding technology costs, rapidly rising costs of compliance, and fierce competition among market providers have initiated a slow process of consolidation among market providers: In 2017, the Chicago Board Option Exchange acquired the third-largest U.S. equity market, BATS Global Markets. Around the same time, Deutsche Borse as well as the Atlanta-based Intercontinental Exchange, owner of the New York Stock Exchange, expressed interest in merging with the London Stock Exchange. And it is rumored that Intercontinental Exchange and its rival the CME Group have been in talks to merge to create the world's largest exchange operator. Consolidation, domestically and internationally, will encounter countless legal, political, and cultural challenges. Failures will be frequent. However, it is possible that over the next decade or so enough successful mergers will steadily transform market structure and bring about a simpler and more transparent marketplace that better serves the interests of investors than today's opaque and highly fragmented markets.

This conclusion will undoubtedly surprise—perhaps even appall—readers who have long bought into the conventional view that equates centralization or consolidation with monopoly or oligopoly; they will react to consolidation with alarm and judge it

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as undesirable for investors. I invite such readers to open their eyes to the reality of power politics in markets and reconsider the logic of reputational effects of bad market governance for different market structures. Dominance exposed to relentless "sunlight" and persistent competitive pressure from ambitious newcomers or free riders tends to generate good market governance. Consolidation therefore holds great promise.

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ACKNOWLEDGMENTS

This book has been many years in the making, as my students and colleagues know only too well. I have accumulated a huge debt of gratitude. First, I have been fortunate to receive financial support for this project from the John Fell Fund, the Economic and Social Research Council (ESRC), and the St. John's College Interdisciplinary Research Centre. I am also grateful for a British Academy/Leverhulme Research Trust Fellowship that funded a one-year sabbatical for this work.

I would not have been able to write this book without the insights of dozens of professionals from the finance and related sectors who gave generously of their time. These include Sal Arnuk, Michael Blaugrund, Matthew Cardillo, Bart Chilton, Joseph Christinat, Colin Clark, Robert Colby, Daniel Coleman, Sean Collins, Stacey Cunningham, Bernard Delbecque, Stanislav Dolgopolov, Lisa Donner, Saman Far, Greg Ford, Thomas Gira, Monique Goyens, Judd Gregg, David Humphreville, Vincent Ingham, Nicolas Jeanmart, Matt Jennings, Dennis Kelleher, Michaela Keller, Rick Ketchum, Edward Knight, Jon Kroeper, Edward Kwalwasser, Kenneth Langone, Dave Lauer, Brian Levine, Ben Lewy, Richard Lewy, Darren Littlejohn, Walt Lkken, Nick Maslavets, Robert Mass, Terence Meehan, Leo Melamed, Edward Mierzewinski, Mario Nava, Thierry Philipponat, Guillaume Prache, Beth Redfearn, Lisa Roberts, Ari Rubenstein, Joe Saluzzi, Kevin Seth, William Slattery, Paul Schott Stevens, Susan Tibbs, Rich Tullo, Enrique Velazquez, Mark White, David Wright, John Zecca, and others who preferred to remain anonymous. I don't expect them to agree with all of my

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arguments and interpretations of fact; needless to say, any errors are mine.

Bob Seijas, Haim Bodek, and Stanislav Dolgopolov should be singled out for their extraordinary helpfulness. Bob Seijas tirelessly and with tremendous enthusiasm explained to me in the minutest of detail how the old New York Stock Exchange worked on a daily basis. Bob brought to life the old era of Exchange floor trading, and many of the vivid descriptions are due to his recall of events and the written records that he kept for many years. Though a staunch defender of many of the old time-proven practices, he was willing to concede where flaws and errors had occurred. He was thoughtful and experienced enough to point to areas of operation where the old NYSE fell short. Haim Bodek opened my eyes to the technical sophistication with which some powerful actors in today's dark and fragmented global capital markets operate in questionable ways. Stanislav Dolgopolov was kind enough to read the entire manuscript and provided many clarifications and corrections.

I am also grateful to Peter Ash, Janet Linde, and Steven Wheeler, NYSE archivists, for allowing me access to their materials and for facilitating my investigation of documents relevant to this book.

For very helpful suggestions, advice, and constructive criticisms at various stages of this research, I would like to express my gratitude to John Armour, Ivaro Cartea, Pepper Culpepper, Jenina Dill, Avinash Dixit, Louise Fawcett, Ezequiel González Ocantos, John Ikenberry, Jure Jeric, Karl Kahn, Miles Kellerman, Alexander Kentikelenis, Robert Keohane, Alan Morrison, Fuadi Pitsuwan, Karthik Ramanna, Andrea Ruggeri, Jack Seddon, Duncan Snidal, Anette Stimmer, Maya Tudor, William Wilhelm, and the Nuffield College IR Lunch Group.

I have also benefited enormously from discussions with the authors of papers presented at the Conference on Global Algorithmic Trading, which I organized at the University of Oxford in April 2017, notably Robert Battalio, Haim Bodek, Stanislav Dolgopolov, Larry Glosten, Maureen Jensen, Steffen Kern, Andrei Kirilenko, David Lauer, Sophie Lee, Dan Marcus, Greg Medcraft, Albert Menkveld, Sophie Moinas, Chris Nagy, and Yesha Yadav.

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I must also recognize the exceptional talents of my research assistants over the life of this project: Alena Pivavarava, David Cesar-Heymann, Jeremy Bowles, and, in particular, Miles Kellerman and Karl Kahn. When a bout of ill health threatened my ability to reach a timely conclusion to the project, Miles and Karl went above and beyond to assist me in ensuring the project's successful completion. They have my deepest appreciation.

My sincerest thanks go to my friend of many years, Debbie Davenport, who read the entire manuscript and helped me "jazz it up," as she put it, in my effort to ensure its accessibility to a broad audience, as well as assisting me with final revisions.

Last but not least, I must express my enormous appreciation to Eric Crahan at Princeton University Press for his enthusiasm and support for this project, as well as for his thoughtful comments on the book manuscript and for his encouragement to take the work beyond academia. I also thank four anonymous reviewers for their extraordinarily thoughtful and constructive feedback on selected chapters or on the full manuscript.

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APPENDIX

Market Governance

A THEORETICAL BACKGROUND NOTE

This book was written for a general readership interested in learning how key areas of modern capital markets operate and how these operations may adversely affect investors, with some historical context provided as a benchmark by which to assess today's capital markets. In this appendix, I am more explicit about the book's analytical framework—its main assumptions as well as its theoretical contributions—for the benefit of readers with special knowledge or interest in the social sciences. I explain the framework's commonalities with and differences from other theories in economics, sociology, and political science, and I conclude with a note on its central behavioral assumption.

A Political Organization Approach in Relation to Other Theories

Neoclassical economists are wont to think of markets in contradistinction to firms. Markets are viewed as simple coordination systems, largely devoid of regulation and hierarchical structures, facilitating the efficient exchange of goods and services between buyers and sellers. Firms and other hierarchical forms of organization, by contrast, are said to require complex internal planning and regulation. Paul Milgrom and John Roberts aptly summarize this conventional view as follows: "There is a multidimensional spectrum of institutional arrangements with simple, discrete markets and tightly managed hierarchies at two of the extremes."[1]

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The foundation of this view was laid by Ronald Coase in his famous article "The Nature of the Firm."[2] Coase asked why firms existed if production could be organized through contracting in markets via the pricing system. The answer stems from realizing that the use of the market pricing system may be costly. "Prices… have to be discovered. There are negotiations to be undertaken [between contracting partners], contracts to be drawn up, inspections to be made, arrangements to be made to settle disputes, and so on."[3] These efforts have come to be known as transaction costs. When the costs of transacting in markets are high, Coase argues, the coordination of production through the firm may be preferable.

This deceptively simple insight about the significance of transaction costs in determining forms of production—from "discrete markets" to "tightly managed hierarchies"—has spawned a new field of study, New Institutional Economics (NIE). This branch of economics seeks to explain different firm structures and practices, and, more generally, the role of the firm in the functioning of the economy. NIE holds that governance structures are the organizational frameworks within which the integrity of a contractual relationship is decided and maintained. The key factors that influence the different shapes or forms that governance structures can take are asset specificity (the more specific an asset, the lower its potential resale value or redeployability), uncertainty (i.e., random acts of nature or unpredictable behavior by partners involved in a transaction), and frequency of transactions. The theory posits, for example, that the higher the asset specificity, the greater the institutional complexity needed to promote efficient exchange. Williamson notes that "transactions that are supported by investments in durable, transaction-specific assets experience 'lock in' effects, on which account autonomous trading will commonly be supplanted by unified ownership (vertical integration)."[4]

A consequence, unintended by Coase, of the general acceptance of the view that markets stand in opposition to production hierarchies, and the ensuing research focus on corporate governance structures, has been the relative neglect of empirical studies of markets or, more specifically, the institutional arrangements that

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govern the process of market exchange. It has also reinforced a general belief that markets work best and are most efficient if they are "free"—that is, unencumbered by regulation or most other forms of intervention.[5]

In his 1991 Nobel Memorial Prize lecture more than 50 years after the publication of "The Nature of the Firm," Coase reminded economists of the need to study not imaginary systems but the real world. "What is studied [presently] is a system which lives in the minds of economists but not on earth."[6] He called it "blackboard economics" and lamented, in particular, the "lack of any substance" in mainstream economic analysis of the market.[7] He noted: "It is not without significance that [stock and commodity] exchanges, often used by economists as examples of a perfect market and perfect competition, are markets in which transactions are highly regulated (and this quite apart from any government regulation that there may be). It suggests…that for anything approaching perfect competition to exist, an intricate system of rules and regulations would normally be needed."[8] And he added: "Economists observing the regulations of the exchanges often assume that they represent an attempt to exercise monopoly power and aim to restrain competition. They ignore or, at any rate, fail to emphasize an alternative explanation for these regulations: that they exist in order to reduce transaction costs and therefore to increase the volume of trade."[9]

The argument I have put forth in this book has areas of agreement and disagreement with Coase, NIE, and neoclassical economics (see table A.1). I approach markets as political organizations. First, this "political organization framework," as I conceptualize it, agrees with Coase's rejection of the monopoly interpretation of an exchange and accepts the suggestion that market governance may serve to reduce transaction costs.

Second, by conceiving of markets as complex organizations or governance arrangements, it rejects the dichotomy between markets and hierarchies that exists in NIE.

Third, it holds that the traditional meaning of transaction costs needs to be expanded to fit the context of exchange markets. As

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TABLE A.1 Overview of Main Theories on Markets and Governance

	Dependent Variable (DV)	Conception of the Market	Rules and Regulations	Main Explanatory Variables (IV)	Market Dominance
Neoclassical Economics	Relative market efficiency	Disembodied Intersection of demand and supply	Risk interfering with free markets and weakening market efficiency	Degree of competition among market actors and information asymmetry	Bad; weakens competition (monopoly, oligopoly)
New Institutional Economics	Governance structures (market versus hierarchies)	Disembodied in contrast to governance structures	The essence of governance structures	Asset specificity, uncertainty, frequency (determinants of transaction costs)	Benign if it serves to safeguard the integrity of a contractual relationship
Political organization framework	(DV 1) Relative market efficiency (DV 2) Market structure change	Governance structure (subject to power politics)	The essence of market governance	(IV 1) Market structure and information asymmetry (IV 2) Opportunity cost of market membership	Good; enables price discovery—a public good Does not weaken competition

I mentioned in chapter 1, the main challenge in these markets is not primarily the expense and hazards of forging contracts between buyers and sellers but the opportunistic behavior of the key market operators—the market makers who stand between buyers and sellers (see chapters 3 and 5). Their vantage point at the center of the market gives them access to privileged information about order flow, prices, and market trends that they may be tempted to use for private gain at the expense of their clients. The analysis in this book thus holds that conflicts of interest, rather than traditional transaction costs, pose the main governance challenge for exchange markets.

Fourth, in another significant departure from NIE, the political organization framework posits that governance arrangements need not be socially optimal. In some contexts, exchange owners have a strong incentive to invest in good governance; in others, they benefit more from investing in bad governance. Good governance is about managing conflicts of interest for the benefit of exchange owners and the investing public; bad governance is about exploiting conflicts of interest, thereby arranging wealth transfers from the investing public to exchange owners and their close allies. If designed smartly so as to hide the cost to society, bad governance is sustainable despite its social suboptimality (see chapter 5). The framework is concerned with identifying the conditions under which market operations will be (relatively) efficient, similar to neoclassical theory's preoccupation with understanding the conditions under which markets work best for society.

Fifth, the political organization approach agrees with neoclassical theory that market structure and information asymmetry are key factors in accounting for relative market efficiency. However, it rejects the view that market dominance necessarily equates to monopoly. Most economists' instinctive reaction is that dominance is bad. A dominant exchange, they argue, has monopoly power and will charge higher prices. This standard argument ignores the constraining effect of over-the-counter (i.e., off-exchange) dealer competition. These traders free ride on the governance investments of the dominant exchange and use its public pricing information to

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underprice (or "price-improve" on) the exchange (see chapters 3 and 5).[10]

Finally, unlike neoclassical economic theory, the political organization framework can explain *change* in market structure—that is, the puzzling transformation from market dominance to fragmentation. A key driver of change is power politics or, more precisely, the changing opportunity costs of membership or ownership of a market organization for particular actors (see chapter 2).

In sum, the political organization approach builds on a growing body of works by social scientists that accept a place for efficiency considerations in accounting for change but also emphasize the role played by power and distributional issues in shaping institutional choices and outcomes.[11] As put by Knight, "Institutional development is a contest among actors to establish rules which structure outcomes to those equilibria most favorable for them."[12] March applies a similar political-contest perspective to the study of economic organizations, arguing, for example, that the firm is best understood not as an entity that maximizes long-run expected profits but as a "socio-political conflict system subject to economic constraints."[13] The participants in this system have heterogeneous and sometimes incompatible goals. Change, as March explains, occurs "slowly in response to shifts in the coalition represented in the firm."[14] In a similar vein, Abolafia argues that "market institutions are produced and redefined as a result of the purposeful action and interaction of powerful interests competing for control."[15] Members, owners, and users of market organizations will forge formal or informal coalitions to attain their goals.

These are conceptually stimulating general propositions. But they fall short of providing a full specification of the conditions under which organizational change is likely to succeed. Or as self-critically put by March himself: "Essentially they assert that certain phenomena occur in the firm because of its character as a coalition. They do not attempt to [explain]…shifts in coalitions per se. The latter task…has hardly been touched except conceptually."[16]

Jupille, Mattli, and Snidal recently attempted a fuller theoretical specification to account for a wide range of institutional choices.

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They argue, for example, that "even if most actors are satisfied with the prevailing institutional arrangement, a prime reason for the breakdown of a focal institution is that a few actors are dissatisfied with the distributional consequences and have sufficient capability to reject it."[17] Such disruptive exit options, they argue, are more likely to succeed if taken by powerful members and if the risks and uncertainties of rejecting the institutional status quo and moving to alternative arrangements are small. This set of conjectures informs much of the historical analysis in chapter 2.

Behavioral Assumption: Opportunism

Underlying the theoretical propositions of the political organization approach is a strong behavioral assumption, namely that individuals are opportunistic. The book borrows Oliver Williamson's famous definition of opportunism, which is "self-interest seeking with guile."[18] He explains: "This includes but is scarcely limited to more blatant forms, such as stealing and cheating.... More generally, opportunism refers to the incomplete or distorted disclosure of information, especially to calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse."[19] Elsewhere, Williamson slightly narrows and sharpens the definition: "Opportunism...is an effort to realize individual gains through a lack of candor or honesty in transactions.... The most commonly recognized is the strategic disclosure of asymmetrically distributed information by (at least some) individuals to their advantage."[20]

Williamson puts his faith in private governance structures to keep opportunistic instincts or "predatory propensities"[21] in check. His comparative institutional analysis suggests that different governance structures are created by market operators to optimally address contextually specific contractual problems arising from opportunism. These governance solutions are assumed to be successful; governance failure is not considered.[22] I have argued, by contrast, that governance is not always successful (in a Williamsonian sense)[23] or—more precisely—is not always designed to constrain opportunism. Bad governance, designed to empower

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naked opportunism, is under certain conditions enormously profitable and thus clearly a rational business strategy and worth the investment (see chapter 5).

This chimes with a recent proposition by George Akerlof and Robert Shiller that free markets are a two-edged sword. Economics tends to focus on the healthy working of competitive markets—much as Williamson focuses on the healthy working of governance—and "fails to see that competitive markets by their very nature spawn deception and trickery, as a result of the same profit motives that give us our prosperity."[24] Manipulation, lies, deception, and trickery are not pathologies, aberrations, or irrationalities but general phenomena that occur when individuals have informational or psychological weaknesses that predators can profitably exploit. As long as profits can be made from scamming, rational scammers will scam. "That is the nature of economic equilibrium."[25]

Examples of opportunistic behavior in capital markets abound.[26] The logic of most such tricks and scams, however, is relatively simple and has remained unchanged over time. They are of two basic varieties: front running and price manipulation. And as discussed in chapter 5, in today's era of global algorithmic trading across asset classes, the implementation of these tricks has become relatively easy for those who possess the most advanced trading tools.

One possible objection to the assumption that individuals are opportunistic should be noted. Some readers may understandably take offense at the proposition that individuals are opportunistic or have predatory propensities. My response is as follows: a theory should not be judged by the realism of its assumptions but by their analytical usefulness—that is, their ability to generate hypotheses that survive empirical testing. The issue is, therefore, not whether the assumption is universally true—it clearly is not. Some individuals stand up and fiercely oppose, fight, or denounce opportunistic acts in financial markets (and beyond). They do so not for selfish reasons but because they deem such acts morally wrong or damaging to society (although self-interested motives are also possible, such as when an opportunistic act by someone else hurts the

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business of the person protesting the act). It may not be unreasonable to suggest, however, that heroes are few and far between on Wall Street, in the City of London, and in many other walks of life. Finally, to assume opportunism does not mean that an individual (or all individuals) will always or necessarily act opportunistically. A calculus of the expected costs and benefits of potential opportunistic action will determine actual behavior.[27]

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GLOSSARY

algorithmic trading: a type of trading based on the use of computer algorithms (algos) to automatically submit, cancel, and otherwise manage orders.

alternative trading system (ATS): an ATS operates similarly to a public registered exchange by bringing together buyers and sellers of securities, but is private and available only to its subscribers.

arbitrage: a low-risk trade that involves the simultaneous purchase and sale of an asset to profit from a temporary difference in the price; an arbitrage can involve, for example, a single stock traded on multiple venues, or exchange-traded funds (ETFs—see below) and underlying securities, or any other pair of highly correlated exchange-traded financial instruments.

ask price: the price at which someone is willing to sell a security (also called the "offer price" or "offer").

auction market: a market in which public buy and sell orders can be matched against each other.

bear market: a declining market condition in which the prices of securities are falling.

best execution: the obligation of intermediaries (such as broker-dealers) to achieve the best possible result when executing customer orders.

bid: the price a buyer is willing to pay for a security; the best bid is the highest price at which someone is willing to buy shares—it guarantees the highest possible price for the stock for any seller coming to the market at that particular time.

bid-ask spread: the difference between the highest price bid and the lowest price asked on a given security.

Big Bang: the moment in October 1986 when the London Stock Exchange abolished fixed brokerage commissions—a watershed event comparable in impact to the 1975 "Mayday" on the New York Stock Exchange.

block trading: trading of large blocks of stock, usually of 10,000 shares or more.

bond: a financial obligation representing the issuer's liability to repay debt capital provided by investors.

book: the notebook used by the specialist in a stock to keep a record of the buy and sell orders at specified prices (that is, limit orders) in sequence of receipt of the orders from other brokers; also referred to as "order book."

bull market: a market condition in which the prices of securities are rising or expected to rise.

circuit breaker: a trading curb that occurs at a point at which an individual stock, or in some cases an entire market, will stop trading for a period in response to substantial drops in value.

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clearing: the process of transferring ownership of securities that have just been traded; central clearinghouses handle these functions.

closing price: the price at which a security closed at the end of trading on a given day.

colocation: a service whereby a stock exchange rents space to market participants that enables them to place their servers in physical proximity to a trading center's matching engine; colocation helps minimize latency times between the matching engine of trading centers and the servers of market participants.

commission broker: an agent who handles the public's orders to buy and sell securities, commodities, or other property; a commission is charged for this service.

consolidated tape: the electronic market data feed that reports quotes and trade executions from all registered national stock exchanges in the United States; a consolidated tape does not exist in Europe.

counterparty: the market participant with whom a trade is being transacted.

crossing network: an electronic system for matching bid and offers.

dark pool: a trading platform that matches buy and sell orders but does not display quotations; like exchanges, dark pools report trade price and quantity after executing a trade. According to their providers (brokerage firms, lit exchanges, bank consortia, and others), dark pools enable institutional investors to buy and sell large orders of stock (so-called blocks of shares) away from the "lit" or publicly quoted market with minimal information leakage and price impact.

dealer: an individual or firm in the securities business that buys and sells stocks and bonds as a principal (that is, for the dealer's own account) rather than as a broker or agent (that is, for another market participant); the dealer's profit or loss is the difference between the price paid and the price received for the same security. The same individual or firm may function, at different times, as either a dealer or a broker.

dealer market: a market in which members of the public must buy from or sell to a dealer, rather than trade with each other.

depth: the number of shares available to buy at the ask price or that a trader can sell at the bid price.

depth of book: the amount of buy and sell orders on an exchange for a security at different prices; the depth of book provides an indication of the liquidity and investor interest in a security on that exchange. See "liquidity."

derivatives: financial instruments that derive their values from a specific market reference such as a stock, index, interest rate, commodity, or currency; examples include options, futures, and swaps.

DOT: an abbreviation for Designated Order Turnaround, a computerized order routing and reporting system introduced in 1976 and owned and operated by the New York Stock Exchange; DOT permitted more rapid execution of orders and was the predecessor of the more sophisticated Super Designated Order Turnaround System (or SuperDOT).

efficient capital market: a market that offers transparency, liquidity, low transaction costs, and price movements.

electronic communication network (ECN): a trading platform or alternative trading system (ATS) that electronically matches buy and sell orders much like a stock exchange; the Securities and Exchange Commission regulates ECNs as broker-dealers rather than as exchanges, which results in a lower regulatory burden. ECNs display orders and quotations, unlike dark pools, another type of ATS.

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equity: an ownership right in an asset or property; more commonly known as a "stock."

ESMA: an abbreviation for the European Securities and Markets Authority, an independent European Union authority that seeks to safeguard the stability of the European Union's financial system by ensuring the integrity, transparency, efficiency, and orderly functioning of securities markets, as well as enhancing investor protection.

exchange-traded fund (ETF): a pooled investment vehicle, or fund, that invests in assets (e.g., stocks, bonds, gold, currencies, futures) like a mutual fund but unlike a mutual fund divides ownership of those assets into shares that are then traded like stocks on an exchange throughout the day. Many ETFs seek to match the returns of an index and are thus known as "tracker funds"; some indices track the value of stocks, and others track the value of assets such as bonds and futures.

fixed-income securities: any security, such as a U.S. Treasury note or a corporate bond, that promises its holder periodic fixed money payments throughout the life of the security.

floor broker: historically, a member of a stock exchange who executes orders on the floor of the exchange to buy or sell any listed securities.

front running: a practice in which a trader learns of a large order, typically from an institutional investor, that is likely to have an impact on the share price, then uses this information ahead of the incoming order to profit from that order; the trader will buy or sell on the same side of the trade as the large order but before its execution, thus profiting from the change in price when the large order is then executed.

futures: contracts to receive or deliver a specified amount of a commodity, financial instrument, or index value at a fixed price on a fixed future date.

hedging: taking positions in securities or financial instruments designed to offset a risk elsewhere in one's portfolio.

hidden order: an order type that displays none or only a portion of the order to other market participants.

high-frequency trading (HFT): a subset of algorithmic trading; high-frequency traders move in and out of positions in fractions of a second, thousands of times per day. HFT accounts for 50 to 70 percent of all equity trading volume in the United States.

index: a statistical average of components (such as stock prices) designed to provide an overall picture of the direction of the market or a benchmark against which financial or economic performance is measured; examples include the Dow Jones Industrial Average or Standard & Poor's 500.

index arbitrage: arbitrage of the discrepancies between index futures contracts and the prices of the stocks underlying the index.

index futures: futures contracts based on an index; the most popular stock index future is based on Standard & Poor's 500 composite stock index and is traded on the Chicago Mercantile Exchange.

institutional investors: investing entities that control large sums of money on behalf of other investors; examples include pension funds, mutual funds, investment companies, and universities.

internalization: the practice in which a broker-dealer fills a client's order by trading with the client instead of by routing the order to an exchange or some other trading platform (such as a dark pool) for another trader to fill.

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investor: an individual whose principal concerns in the purchase of a security are regular dividend income, safety of the original investment, and, if possible, capital appreciation.

IPO: an abbreviation for "initial public offering"—the first public issue of a stock from a company or other entity that has not previously been publicly traded.

latency: the time it takes to receive information about a market event, such as a quote update or cancellation from a trading platform, process this information, and react to it by sending new orders (market orders, limit orders, or special order types [SOTs]) based on this information. Some traders are able to react extremely rapidly to market events, that is, within two or three milliseconds; such a quick response rate is referred to as low latency.

limit order: an order to buy or sell at a specific price ("limit price") or better; put differently, an order in which customers specify the highest price at which they are willing to buy or the lowest price at which they are willing to sell. Limit buy orders are executed at or below the specified order price; limit sell orders are executed at or above the specified order price.

liquidity: the ease with which securities can be bought and sold without large price concessions or movements; good liquidity is an important characteristic of a financial market because it assures buyers that they will subsequently be able to dispose of their holdings quickly at a fair price or at a price close to the last sale. When a market does not have a lot of liquidity, it is more difficult to buy and sell, and prices can fluctuate widely depending on supply and demand at the moment.

liquidity provision: the posting of a bid or an offer with a limit price in the order book of an exchange. An order can either provide or remove liquidity; removing (or "taking") liquidity refers to an order that comes into the market and removes an existing (limit) order in the book.

lit market: an exchange or off-exchange trading platform, such as an electronic communication network, that publicly displays its best bid and offer.

market maker: an exchange member or market participant who provides liquidity for securities by frequently buying for and selling from his or her own account.

market order: an order to buy or sell that is executed at the best price obtainable immediately after it is sent to the market.

market price: the price of a security; there are two prices quoted on an exchange: a bid price and an offer price.

Mayday: nickname for May 1, 1975, the day on which the New York Stock Exchange's 193-year-old system of fixed commission rates was abolished by the Securities and Exchange Commission.

mutual fund: an investment vehicle that pools shareholders' capital and invests in a diversified portfolio of stocks, bonds, U.S. Treasury notes, futures, or other investment vehicles. Mutual funds offer small investors the benefit of professional investment management and portfolio diversification that would otherwise be available only to large investors.

NASD: an abbreviation for the National Association of Securities Dealers—historically, the principal organization of dealers who traded stocks among themselves (that is, over the counter) and not through an organized exchange.

NASDAQ: an abbreviation for the NASD Automated Quote system; before becoming a national exchange registered with the Securities and Exchange Commission, NASDAQ was the computerized trading system operated by the NASD.

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National Best Bid and Offer (NBBO): the best (highest) available bid and best (lowest) available offer price for a particular security at a particular point in time; these must be publicly displayed on all U.S. exchanges per Securities and Exchange Commission regulation.

nonmarketable orders: limit orders to sell above the current bid or to buy below the current ask; nonmarketable orders are liquidity-supplying trades, whereas marketable orders take liquidity from the market.

offer: the price at which someone is willing to sell a security (also called the "asking" price); the "best offer" is the lowest price at which someone is willing to sell.

option: the right, but not an obligation, to buy or sell a given security or other financial instrument at a given price within a given period of time; a "call" option is the right to buy a security at a given price within a specified period of time, while a "put" option is the right to sell a security at a given price within a specified period of time.

order: an offer to buy or sell a tradable instrument with a variety of conditions attached; see "limit order" and "market order."

order book: a listing of all displayed limit orders that gives a picture of the market.

over-the-counter (OTC) market: the trading of securities outside of a stock exchange registered with the Securities and Exchange Commission, such as the New York Stock Exchange.

pool: any venue where trading takes place, including an exchange.

price-time priority: the notion that all bids or offers for a given stock at a given price will be handled on a first-come, first-served basis.

primary market: the market for the issue of new securities or underwritings, in which companies offer shares directly to investors.

quote: an offer to buy or sell a security.

quote stuffing: a price manipulation strategy that consists of sending a massive number of buy and sell orders into the market and then quickly canceling them in order to overload or jam up the matching engine of an exchange; these quote bursts reduce the speed at which the exchanges can update market participants about price changes or process other traders' orders. The aim is to create a short-term mispricing of stocks, which gives the quote stuffer the opportunity to engage in profitable arbitrage at the expense of other market participants.

SEC: an abbreviation for the U.S. Securities and Exchange Commission, the regulatory agency charged with overseeing securities markets in the United States.

secondary market: the market where investors purchase existing securities or assets from other investors on an exchange rather than from the company itself.

securities: standardized, marketable, and tradable capital instruments, such as stocks and bonds, that provide investors with a particular return for a given level of risk.

settlement: the process of transferring stock from seller to buyer and arranging the corresponding movement of money between the two parties.

share: the capital a company is authorized to raise is divided into a number of equal parts; each part is called a share. See "securities" and "stocks."

special order types (SOTs): complex buy and sell orders that define how an order is to be placed in a market, how it is to be shown on the order book of the market, and how it is to interact with changes in the order book.

specialists: market makers of the old New York Stock Exchange charged with making and maintaining a fair and orderly market in their stocks; being a specialist entailed a positive obligation to buy for or sell from their own account when there was a temporary disparity between supply and demand. Specialists also acted as the

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brokers' brokers by taking limit orders from commission brokers (that is, entering these orders into their books) and executing them when the market reached the orders' specified prices.

speculators: market participants who are willing to assume relatively large risks in the hope of gain, given that their principal concern is to increase their capital rather than their dividend income; they may buy and sell on the same day or buy stocks of a company that they do not expect to be profitable for years.

spoofing: a price manipulation strategy that involves sending orders into the market to dupe investors into believing that the stock has real momentum. For example, a trader who wishes to sell a stock at an inflated price can send a large number of limit orders to buy into the market to create the appearance of substantial buying interest, baiting unsuspecting investors into buying. Upon completion of this scam transaction, the trader immediately cancels all non–bona fide buy orders—that is, orders the trader never intended to execute but simply used to mislead investors.

stock: a share, or piece, of ownership interest in a particular company or corporation that pays the investor periodic dividends.

trader: a market participant who buys and sells for his or her own account for short-term profit.

transparent market: a market that provides timely and accurate information regarding all transactions.

volatility: a measure of the amount of movement in the price of a financial instrument.

volume: the number of shares traded during a given period.

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NOTES

Chapter One. Introduction

1. *Citadel Investment Group, LLC v. Teza Technologies, LLC*, Appellate Court of Illinois, 924 N.E.2d 95 (February 24, 2010), 97–98n1.

2. This statistic refers to NYSE's market share in domestic trading of all securities (i.e., not only NYSE-listed securities); see "Market Share Charts," Cboe, accessed September 17, 2018, https://markets.cboe.com/us/equities/market_statistics/venue/market/all_market/.

3. An internalizing broker-dealer fills a client order by trading with the customer internally or in-house instead of by routing the order to an exchange or some other external trading platform.

4. ConvergEx, *U.S. Equity Market Structure Survey*, April 2014.

5. Duboff, "The Telegraph and the Structure of Markets in the United States, 1845–1890," 1983, 261.

6. Michie, *The London and New York Stock Exchanges, 1850–1914*, 2011, 169–170.

7. Duboff, "The Telegraph and the Structure of Markets in the United States, 1845–1890," 1983, 262.

8. The offer price is also referred to as the ask price (see glossary).

9. Patterson, *Dark Pools*, 2012, 169.

10. Michie, *The London and New York Stock Exchanges, 1850–1914*, 2011, 169–170.

11. NASDAQ (National Association of Securities Dealers' Automated Quotations) was launched in 1971 by the National Association of Securities Dealers (NASD) as an electronic quotation system, with trade and volume reporting later added, as well as automated trading systems. The NASDAQ stock market was spun off as a publicly traded company in 2000. In 2007, NASDAQ purchased the Boston Stock Exchange and in 2008, the Philadelphia Stock Exchange. NASDAQ is operated now by the NASDAQ OMX Group, which also owns several small northern European stock exchanges. BATS (Better Alternative Trading Systems) was launched in 2005. BATS Global Markets operates four stock exchanges and

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two options markets in the United States. It also runs a major equities market in Europe, including Chi-X Europe. BATS Global Markets was acquired by the Chicago Board Options Exchange Holdings, Inc., in February 2017. The Trade Reporting Facility reports total trading in broker-dealer dark pools.

12. Blume, Siegel, and Rottenberg, *Revolution on Wall Street*, 1993, 254, 256.

13. Aggarwal, "Demutualization and Corporate Governance of Stock Exchanges," Spring 2002, 108. See also Zanotti, "Demutualization and the Globalization of Stock Markets," 2012; Hart and Moore, "The Governance of Exchanges: Members' Cooperatives versus Outside Ownership," 1996; Pirrong, "A Theory of Financial Exchange Organization," 2000; Damowitz and Steil, "Automation, Trading Costs and the Structure of the Securities Trading Industry," 1999; Steil, "Changes in the Ownership and Governance of Securities Exchanges," 2002; Serifsoy, "Stock Exchange Business Models and Their Operative Performance," 2007; Oesterle, Winslow, and Anderson, "The New York Stock Exchange and Its Outmoded Specialist System: Can the Exchange Innovate to Survive?" 1991; Fleckner, "Stock Exchanges at the Crossroad," 2006; O'Hara and Mendiola, "Taking Stock in Stock Markets: The Changing Governance of Exchanges," October 14, 2003; Markham and Harty, "For Whom the Bell Tolls: The Demise of Exchange Trading Floors and the Growth of ECNs," 2008; and Karmel, "Turning Seats into Shares: Cause and Implications of Demutualization of Stock and Futures Exchange," 2002.

14. Garvy, "Rivals and Interlopers in the History of the New York Security Market," 1944; and Nelson, *The Consolidated Stock Exchange of New York*, 1907.

15. Karmel, "Turning Seats into Shares: Cause and Implications of Demutualization of Stock and Futures Exchange," 2002, 383.

16. *Hearing on Public Ownership of U.S. Stock Markets before the Senate Banking Committee*, September 28, 1999, 3–4 (statement of Richard Grasso).

17. *Hearing on Public Ownership of U.S. Stock Markets*, 2 (September 28, 1999).

18. The New York Stock Exchange, *Annual Report 2004*, 8, NYSE Archives, Mahwah, NJ.

19. Fox, Glosten, and Rauterberg, "The New Stock Market: Sense and Nonsense," 2015; Kondgen, "Ownership and Corporate Governance of Stock Exchanges," 1998; and Bond, Edmans, and Goldstein, "The Real Effect of Financial Markets," 2012.

20. Meeker, *The Work of the Stock Exchange*, 1922, 347.

21. Michie, *The London Stock Exchange: A History*, 1999, 38.

22. Sobel, *Inside Wall Street*, 1977, 20.

23. Sobel, 27.

24. Special Committee on Bucket Shops, NYSE, *Digest of the Preliminary Work of the Special Committee*, June 25, 1913, NYSE Archives, Mahwah, NJ.

25. Clews, *Fifty Years in Wall Street*, 1908, 90.

26. Cited in Garvy, "Rivals and Interlopers in the History of the New York Security Market," 1944, 130; see also Nelson, *The Consolidated Stock Exchange of New York*, 1907, 80.

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27. The problem persists. Twenty-first-century free riders are broker-dealer internalizers and dark pool providers. They take stock prices from the public exchanges as benchmarks and then offer "price improvements" to attract business away from the exchanges (see chapter 4).

28. Mayer, *Wall Street: Men and Money*, 1962, 84.

29. Michie, *The London and New York Stock Exchanges, 1850–1914*, 2011, 189; and Huebner, *Stocks and the Stock Exchange*, 1910, 2–5.

Chapter Two. The Puzzling Transformation of Capital Market Structure

1. For details, see book appendix.

2. Markham, *A Financial History of the United States*, 2002.

3. Markham, 13–17.

4. The constitution is reproduced in Stedman, *The New York Stock Exchange*, 1905, 63–66.

5. Garvy, "Rivals and Interlopers in the History of the New York Security Market," 1944, 129.

6. Michie, *The London and New York Stock Exchanges, 1850–1914*, 2011, 171.

7. Sobel, *The Big Board: A History of the New York Stock Market*, 1965, 44.

8. Stedman and Easton, "History of the New York Stock Exchange," 1905. Some kept referring to the Exchange colloquially as the Old or Big or Regular Board, even after the merger.

9. In the early years of the Exchange, members sat in chairs arranged around the auction room, facing the rostrum, where the president read off the list of stocks. A chair came to be known as a "seat on the Exchange" and meant Exchange membership.

10. Meeker, *The Work of the Stock Exchange*, 1922, 44–45.

11. Michie, *The London and New York Stock Exchanges, 1850–1914*, 2011, 186.

12. Huebner, *Stocks and the Stock Exchange*, 1910, 2–5.

13. Sobel, *Inside Wall Street*, 1977, 32.

14. Michie, *The London and New York Stock Exchanges, 1850–1914*, 2011, 197.

15. Statement by Cincinnati-based brokerage firm P.J. Goodhart & Co. from 1913, quoted in Michie, *The London and New York Stock Exchanges, 1850–1914*, 2011, 178.

16. Sobel, *Inside Wall Street*, 1977, 100.

17. Eames, *The New York Stock Exchange*, 1894, 42. In later years, admissions were decided by the Admissions Committee.

18. Eames, 42.

19. Platt, "Annals and Statistics," 1905, 473. In 1942, a seat traded for $17,000; in 2005, it reached a record price of $3.2 million. See "Membership Prices" in Factbook, nyxdata base, NYSE Archives, Mahwah, NJ.

20. Table 2.5 in the appendix lists the precise numeric values of solvency rates for NYSE member organizations (MOs) and U.S. banks from 1919 to 1938.

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21. Chandler, *America's Greatest Depression, 1929–1941*, 1970.

22. William McChesney Martin served as NYSE president from 1938 to 1942. Appointed at the young age of 31, he was called the "Boy Wonder of Wall Street." He gained a reputation as an effective reformer.

23. William McChesney Martin, *The Securities Markets: A Report, with Recommendations*, submitted to the Board of Governors of the New York Stock Exchange, August 5, 1971, 13–14, NYSE Archives, Mahwah, NJ.

24. Hawkins, "The Development of Modern Financial Reporting Practices among American Manufacturing Corporations," 1963, 145; also Means, "The Diffusion of Stock Ownership in the United States," 1930.

25. Sobel, *Inside Wall Street*, 1977, 101. In the years after the Great Crash, trading volume fell to 425 million shares per day.

26. Calculations by author based on information on "Member Organizations, Sales Offices, and Personnel, 1899–2002" in Factbook, nyxdata base, NYSE Archives, Mahwah, NJ.

27. The NYSE "retired" nine seats through buybacks in 1953, reducing the total to 1,366 until the end of the old Exchange in the mid-2000s.

28. The bull market of the 1950s brought growth to most brokerages, slightly increasing the average number of partners per MO.

29. Mayer, *Wall Street: Men and Money*, 1962, 86–87.

30. Meeker, *The Work of the Stock Exchange*, 1922, 45.

31. Meeker, 335–341.

32. Nordhaus, "The Progress of Computing," September 27, 2001.

33. Morrison and Wilhelm, "The Demise of Investment Banking Partnerships: Theory and Evidence," 2008.

34. Morrison and Wilhelm, 348. Wholesale-oriented MOs, such as Goldman Sachs or Morgan Stanley, went public in the 1980s and 1990s.

35. The number of individual member brokers dropped from 409 in 1934 to 34 in 1981. Calculations by the author based on data in the New York Stock Exchange Directories for the years 1934 and 1981, NYSE Archives, Mahwah, NJ.

36. The director count includes top management officers. In treating directors and top officers as the public firm's analog to partners, I follow the example in ibid., 335.

37. Author calculations based on data in the New York Stock Exchange Directories for the years 1934 and 1981, NYSE Archives, Mahwah, NJ.

38. For an additional representation of the growing inequalities, see Gini coefficients and Atkinson indices for the years 1934 and 1981 in table 2.6 in the appendix.

39. The Glass-Steagall Banking Act was motivated by a desire to stamp out highly speculative banking activities that contributed to the 1929 stock market crash and subsequent failures of many banks (see figure 2.1). Commercial banks had taken customer deposits and made loans to companies in which the banks had invested, and clients were encouraged to buy stocks in the same companies. The Act no longer allowed commercial banks to underwrite or deal in securities. Separation was expected to lead to a healthier financial system.

40. Sobel, *Inside Wall Street*, 1977, 212.

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41. Quoted in Sobel, 215.

42. In the 1980s, commercial banks encountered unexpected headwinds from largely unregulated new financial service providers, such as finance companies and money market mutual funds. Banks eventually responded by redoubling their efforts to diversify into brokerage and investment banking. See Boyd and Gertler, "US Commercial Banking: Trends, Cycles, and Policy," 1993; Edwards, "Financial Markets in Transition—or the Decline of Commercial Banking," 1993; and Krippner, "The Financialization of the American Economy," 2005.

43. Sobel, *Inside Wall Street*, 1977, 215.

44. Universal banks combine commercial and investment banking and have been particularly popular in Europe, where no Glass-Steagall–equivalent legislation existed. Universal banks may offer credit, loans, deposits, asset management, investment advisory, payment processing, securities transactions, underwriting and financial analysis. See Benston, "Universal Banking," 1994.

45. Asked why NYSE decided to change its rules, my interviewees (all former NYSE officials) replied that management thought the prestige of the Exchange would be enhanced by having highly capitalized foreign banks as members; it was also hoped that such members would encourage listings of foreign companies.

46. A complete accounting of the fate of the MOs listed in the 1981 NYSE directory is offered in table 2.7 in the appendix.

47. Table 2.8 (Panel A) in the appendix shows that even though the majority of acquisitions happened before 1999, Glass-Steagall may have accelerated the pace of acquisitions.

48. The banks acquired not only firms registered as members in 1981 but also new members (i.e., firms that became members after 1981). Table 2.2 (Panel B) shows that large banks also eagerly bought these new members.

49. The acquisitions included F.S. Smithers & Co, Abbott, Proctor & Paine, Mitchum, Jones & Templeton, Mitchell Hutchins, and Blyth, Eastman Dillon & Co.

50. The Gini coefficient and Atkinson index for 1999 are reported in table 2.6 in the appendix.

51. I am grateful to Alan Morrison of the University of Oxford and William Wilhelm of the University of Virginia for sharing their data on capitalization. For details on the data sources, see Morrison and Wilhelm, "The Demise of Investment Banking Partnerships: Theory and Evidence," 2008, 325, note 14.

52. Blume, Siegel, and Rottenberg, *Revolution on Wall Street*, 1993, 48.

53. Blume, 182.

54. Srinivasan et al., *Electronic Commerce and the Revolution in Financial Markets*, 2001; Hendershott, "Electronic Trading in Financial Markets," August 2003.

55. Ellis, *The Partnership: The Making of Goldman Sachs*, 2008, 78.

56. Blocks are very large numbers of shares.

57. For a time series of institutional ownership between 1950 and 2004, see Gordon, "The Rise of Independent Directors in the United States, 1950–2005," 2007, 1568, table 4 and figure 4.

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58. Institutions preferred to trade blocks away from the floor of the Exchange (i.e., over the counter), effectively hiding these transactions from public view. They feared that selling or buying large numbers of shares might trigger adverse price swings.

59. Quoted in Blume, Siegel, and Rottenberg, *Revolution on Wall Street*, 1993, 255.

60. Wolfson and Russo, "The Stock Exchange Specialist: An Economic and Legal Analysis," 1970, 745–746. An internalizer or wholesale member could withhold the information concerning the size and price of an off-exchange transaction from other exchange members while retaining access to price information emanating from the Exchange trading floor. If many large members engaged in such behavior, the quality of price information—a public good—would be much impaired; that is, the price would less accurately reflect the true value of a security.

61. Quoted in Blume, Siegel, and Rottenberg, *Revolution on Wall Street*, 1993, 198–199.

62. Securities and Exchange Commission, Regulation NMS at www.sec.gov /rules/final/34-51808.pdf.

63. The top ten investors in these alternative electronic trading firms were Deutsche Bank, Merrill Lynch, Morgan Stanley, UBS, Citigroup, Goldman Sachs, JP Morgan, ABN Amro, Chase Manhattan, and Credit Suisse. See Prigge, "Recent Developments in the Market for Markets for Financial Services," 2003, 59.

64. A detailed analysis of all 681 comment letters and meeting memoranda received by the SEC during the NMS regulatory process reveals an enormous asymmetry of lobbying power between Regulation NMS proponents (the largest broker-dealers and their electronic trading allies) and opponents (traditional small members). For example, the average comment letter by a member of the former group contains 3,158 words; the average letter from the latter group has 669 words. "A Lobbying Analysis of Regulation NMS," on file with author.

65. These market organizations include the leading commodity exchanges in coffee, rubber, sugar, cocoa, wool, grain, and animal feed, and nonferrous metals. See Mattli and Seddon, "A Historical Mapping of the World's Leading Market Organizations," 2018.

66. Michie, *The London Stock Exchange: A History*, 1999, 104; and Attard, "Making a Market," 2000.

67. Mattli and Seddon, "A Historical Mapping of the World's Leading Market Organizations," 2018.

68. Michie, *The London Stock Exchange: A History*, 1999, 644.

Chapter Three. Good Governance in Centralized Markets

1. For an overview of the historical context that gave rise to a class of "specialist" traders, see chapter 2. By the late 1970s, 22 such trading posts existed. Each post comprised a seven-foot space along the perimeter of an oval counter, and each oval housed over a dozen specialists. The layout of the trading posts changed over time. The last major overhaul occurred in 1981.

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2. Initially, each specialist had responsibility for one or two securities. Over time, listings increased significantly while the number of specialists rose only modestly. As a result, the average number of securities per specialist grew to about five by the 1960s and seven by the 1990s.

3. The commission brokers collected buy and sell orders from the investing public and charged a commission for their services. They passed on a small percentage of this commission to the specialist as payment for the order execution.

4. The NYSE modernized the "book" in the 1970s by introducing an electronic system with a television-like display of limit orders.

5. A technically more precise definition is as follows: "An 'orderly' market is one with regularity and reliability of operation manifested by the presence of price continuity and depth exhibited by the avoidance of large and unreasonable price variations between consecutive sales, and the avoidance of overall price movements without appropriate accompanying volume." Market Surveillance Services of the New York Stock Exchange, *Report to the Securities and Exchange Commission*, July 20, 1982, 111–112, NYSE Archives, Mahwah, NJ. See also Vernon, *The Regulation of Stock Exchange Members*, 1941, 132–135; Wolfson and Russo, "The Stock Exchange Specialist: An Economic and Legal Analysis," 1970, 744–745.

6. For example, if the highest public bid on the specialist's book was at $20 and the lowest public offer was at $24 (making the spread four points rather than the more typical one-eighth or one-sixteenth of a point), the specialist would be obliged to enter the market as a dealer and narrow the spread by offering a higher bid and/or lower offer.

7. Personal communication from Robert Seijas, March 16, 2016.

8. On the day the story of the president's heart attack broke, specialists' dealings involved 2,923,170 shares in total trading of 7,761,000 shares; that is, about 38 percent of all trading on that day. See *Report of Special Study of the Securities and Exchange Commission, Part 2*, 1963, 113.

9. *Report of the Presidential Task Force on Market Mechanisms*, January 1988, 49. The report also notes a few exceptions to this exemplary behavior, however; the specialists who failed to "lean against the wind" incurred severe sanctions by the Exchange. See Donald Solodar, *Brady Commission—Commentary on Specialist Dealer Participation*, February 24, 1989, 3, NYSE Archives, Mahwah, NJ.

10. Personal communication from Robert Seijas, April 20, 2016.

11. Abolafia, *Making Markets*, 1996, 118.

12. Robert Stott, quoted in Mayer, *Wall Street: Men and Money*, 1962, 69.

13. Abolafia, *Making Markets*, 1996, 117.

14. Mayer, *Wall Street: Men and Money*, 1962, 29.

15. Meeker, *The Work of the Stock Exchange*, 1922, 109.

16. Coleman, *Foundations of Social Theory*, 1990, chapters 10 and 11; and Ellickson, *Order without Law*, 1994; Curtin, *Cross-Cultural Trade in World History*, 1984.

17. Erastus Tefft in an address before the Convention of Out-of-Town Stock Exchange Members, April 15, 1921, quoted in Meeker, *The Work of the Stock Exchange*, 1922, 114.

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18. Mayer, *Wall Street: Men and Money*, 1962, 126.

19. Mayer, 29.

20. Abolafia, *Making Markets*, 1996, 34.

21. Meeker, *The Work of the Stock Exchange*, 1922, 67.

22. Mayer, *Wall Street: Men and Money*, 1962, 116.

23. SEC., *Report on the Feasibility and Advisability of the Complete Segregation of the Functions of Dealer and Broker*, 1936, 26.

24. The Special Study of 1963 found that of the 360 NYSE specialists, only "a few are registered in the same stock and compete with each other." *Report of Special Study of the Securities and Exchange Commission, Part 2*, 1963, 67.

25. The number of stocks grew from 1,077 in 1957 to 1,560 in 1986 and 2,825 in 2000. For the same years, the number of specialists increased from 348 to 410 and 475, respectively.

26. Competition was not necessarily limited to specialists. In theory, a dissatisfied broker could also trade with independent NYSE floor traders, who bought and sold for their own accounts, or the broker could seek to buy or sell a stock in the over-the-counter market (i.e., through off-exchange dealers) or regional exchanges. In practice, these alternatives were not always reliable sources of liquidity. See Demsetz, "The Cost of Transacting," 1968, 42; and Blume, Siegel, and Rottenberg, *Revolution on Wall Street*, 1993, 45. It also is worth recalling that in the late nineteenth and early twentieth centuries, the LSE listed many large U.S. (and other) companies and thus could function as an alternative trading venue.

27. NYSE Constitution of 1902, Article 3, in Stedman, *The New York Stock Exchange*, 1905, 486.

28. NYSE Constitution of 1902, Article 11, Section 1, in Stedman, *The New York Stock Exchange*, 488.

29. NYSE Constitution of 1902, Article 11, Section 1, in Stedman, *The New York Stock Exchange*, 489. Other parts of the organizational suprastructure included the Committee on Admissions, Committee on Constitution, Finance Committee, Committee of Insolvencies, Law Committee, Committee on Commissions, Committee on Stock List, Committee on Securities, Committee on Clearing House, and the Committee on Unlisted Securities.

30. New York Stock Exchange, *Final Report of the Committee for the Study of the Organization and Administration of the New York Stock Exchange*, January 27, 1938, NYSE Archives, Mahwah, NJ.

31. Sobel, *NYSE: A History of the New York Stock Exchange 1935–1975*, 1975, 30–45.

32. New York Stock Exchange, *Final Report of the Committee for the Study of the Organization and Administration of the New York Stock Exchange*, January 27, 1938, 3, NYSE Archives, Mahwah, NJ.

33. For a brief history of the evolution of the top-down surveillance system from the 1930s to 1975, see "History of the Exchange's Specialist Surveillance Program," in New York Stock Exchange, *Report of the Committee to Study the Stock Allocation System*, 1976, Exhibit A-4, 57–60, NYSE Archives, Mahwah, NJ.

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34. The Trading Surveillance Department's primary task was to detect insider trading, market manipulation through the spread of unsubstantiated rumors, acquisition or liquidation of large positions, fictitious trades, and similar offenses.

35. *Annual Review of the Quality of Markets Committee, 1978*, June 1, 1979, 24–25, NYSE Archives, Mahwah, NJ.

36. The main data elements of the audit trail included the security identifier, price of trade, number of shares, time of trade report to transaction tape, executing brokers (buy and sell sides), and clearing forms (buy and sell sides). See Market Surveillance Services of the New York Stock Exchange, *Report to the Securities and Exchange Commission*, 1982, page VI-1, NYSE Archives, Mahwah, NJ.

37. These programs flagged transactions that exceeded, for example, predetermined price or depth guidelines for any given stock.

38. Quoted in Abolafia, *Making Markets*, 1996, 123–124.

39. Abolafia, *Making Markets*, 1996, 124.

40. Personal communication from Robert Seijas, February 6, 2017.

41. Hearing Panels included at least three Exchange members appointed by the chair of the board.

42. Another report puts the total number of investigations during the six-year period from 1970 to 1975 at "nearly 5,000," suggesting a slight increase in the number of cases in the last two years. See New York Stock Exchange, *Report of the Committee to Study the Stock Allocation System*, 1976, 83, NYSE Archives, Mahwah, NJ.

43. Data on early enforcement actions is rare. According to one source, the Exchange withdrew, suspended, or canceled over 45 specialists for failure to fully comply with positive obligations during the 1940s and 1950s. See New York Stock Exchange, *Report of the Committee to Study the Stock Allocation System*, 1976, 42.

44. New York Stock Exchange, *Report of the Committee to Study the Stock Allocation System*, 1976, 5.

45. The Dow Jones, or Dow Jones Industrial Average, is an index that shows how 30 large publicly owned companies listed on the NYSE trade during a standard trading session in the stock market.

46. From January 1969 to April 1974, employment in the securities industry in New York declined from 105,200 to 75,000, a drop of 28 percent. See Sobel, *NYSE: A History of the New York Stock Exchange 1935–1975*, 1975, 365.

47. The rally that catapulted the Dow Jones to new heights in the 1980s did not start until late in 1978.

48. Richard Nixon, Republican president from January 1969 until his resignation over the Watergate scandal in August 1974, dramatically expanded federal funding for Social Security, Medicare, Medicaid, and the Food Stamp program.

49. A bear raid is the illegal practice of ganging up to push the price of a stock lower through concerted short selling and the spreading of adverse rumors about the targeted company.

50. In 1965, the regional exchanges accounted for little more than 10 percent of the trading volume in listed shares and 13 percent of their dollar value. By 1972,

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they represented 15 percent of volume and 18 percent of total value. See Sobel, *NYSE: A History of the New York Stock Exchange 1935–1975*, 1975, 361.

51. In 1965, OTC markets (also referred to as "the third market") accounted for about 2.7 percent of total trading volume in NYSE-listed stocks and 3 percent on a dollar value basis. By 1972, they represented 7.3 percent of volume and about 9 percent of total value. The significance of the third market began to shrink again in 1975. *Third Market Volume in NYSE Common Stocks, 1965 to 1975*, nyxdata base, NYSE Archives, Mahwah, NJ.

52. In 1971, the National Association of Securities Dealers launched NASDAQ, initially a quotation system that quickly grew into the world's first electronic stock market. Another competitor was Institutional Networks (or Instinet). In 1969, Instinet launched the first automated system to enable institutional investors to trade directly with each other. In 1977, Instinet introduced a quote system, the so-called green screen, featuring NYSE-listed stocks.

53. Martin served as NYSE president from 1938 to 1941 and as Fed chair from 1951 to 1970.

54. Letter by NYSE Chairman Ralph DeNunzio and President Robert Haack to the Exchange members, dated August 5, 1971, NYSE Archives, Mahwah, NJ.

55. William McChesney Martin, *The Securities Markets: A Report, with Recommendations*, submitted to the Board of Governors of the New York Stock Exchange, August 5, 1971, 5, NYSE Archives, Mahwah, NJ (italics added).

56. *Report of the Committee of Exchange Reorganization*, December 29, 1971, 2–5, NYSE Archives, Mahwah, NJ.

57. In January 1986, the board of directors expanded to 24 directors, 12 public members, and 12 Exchange members.

58. Martin, *The Securities Markets: A Report, with Recommendations*, submitted to the Board of Governors of the New York Stock Exchange, August 5, 1971, 10.

59. Anonymous specialist, quoted in New York Stock Exchange, *Report of the Committee to Study the Stock Allocation System*, 1976, 104.

60. The other committee members were Walter Frank of Frank & Co, Cornelius Owens of American Telephone & Telegraph Company, Robert Sarnoff of RCA Corporation, and Joseph Thomas of McDonald & Co.

61. New York Stock Exchange, *Report of the Committee to Study the Stock Allocation System*, 1976, 2.

62. New York Stock Exchange, vi.

63. New York Stock Exchange, 5 (italics added).

64. New York Stock Exchange, 5.

65. The Market Performance Committee began with 19 members and grew by the early 1990s to 27 members: 3 board directors, who were also active on the floor; 8 specialist floor governors; 8 nonspecialist floor governors; 4 allied members (partners or directors of member organizations who were not individual Exchange members); and 4 representatives of financial institutions. By 1999, the total number reached 34 and included 5 institutional investor representatives. Service on the committee was for one-year terms subject to reappointment for no more than six consecutive years.

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66. A precursor of the SPEQ was a floor broker survey used for the first time in 1972.

67. See *Report of the Quality of Markets Committee to the Board of Directors*, NYSE Archives, Mahwah, NJ 1981; and the *Quality of Markets Committee Annual Report* for 1987, 1989, and 1992, NYSE Archives, Mahwah, NJ.

68. The size of price variation from one trade to the next in the same stock.

69. The difference in price between the bid and the offer in a stock. Narrow spreads were considered to be an indication of good market-making performance.

70. A measure of the amount of buying or selling pressure a stock can withstand before its price changes significantly. The greater the depth of the market in a stock, the more likely an investor is able to buy or sell shares without causing prices to move significantly. The Exchange's depth guidelines for specialists were indications of what the Exchange considered to be desirable maximum price changes for 1,000 shares. Depth guidelines varied for each stock depending on the price level and average daily volume. New guidelines were introduced in 1989 based on 3,000 shares.

71. The dealer participation rate was calculated as a percentage of the specialist's purchases and sales to total purchases and sales effected in his specialty stocks.

72. The specialist's stabilization rate was calculated by determining the percentage of specialist dealings that were purchased at prices below or sales at prices above the last different price.

73. For example, in the mid-1980s, the MPC required that at least 80 percent of all (postopening) DOT market orders be turned around in two minutes or less. In 1992, the limit was reduced to 60 seconds.

74. In 1988, for example, the Quality of Markets Committee and the board approved new guidelines for specialists with respect to openings, participation, price continuity, and quotations as well as for dissemination of information on delayed openings, trading halts, and order imbalances. *Annual Report of the Quality of Markets Committee, 1988*, June 1, 1989, 2–4, NYSE Archives, Mahwah, NJ.

75. Market Surveillance Services of the New York Stock Exchange, *Report to the Securities and Exchange Commission*, 1982, page VII–11.

76. For a concise history, see New York Stock Exchange, *Report of the Committee to Study the Stock Allocation System*, 1976, 47–52.

77. Three of the specialists were floor directors (that is, members of the board of directors who spent a substantial part of their time on the floor), and six of the specialists were floor governors. The nonspecialists were also floor governors.

78. New York Stock Exchange, *Report of the Committee to Study the Stock Allocation System*, 1976, 4.

79. Five of the remaining members on the Allocation Committee were nonspecialist floor members, and the other two were allied members. Twenty of the other panel members were nonspecialist floor members, and the remaining eight allied members. Panel membership increased to 48 by 1993.

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80. *Annual Report of the Quality of Markets Committee, 1977*, March 2, 1978, 8, NYSE Archives, Mahwah, NJ.

81. *Annual Report of the Quality of Markets Committee, 1978*, n.d., 21–22, NYSE Archives, Mahwah, NJ.

82. *Annual Report of the Quality of Markets Committee, 1996*, June 1, 1997, 3, NYSE Archives, Mahwah, NJ.

83. *Annual Report of the Quality of Markets Committee, 1997*, June 1998, 2, NYSE Archives, Mahwah, NJ.

84. *Annual Report of the Quality of Markets Committee, 1985*, May 28, 1986, 2, NYSE Archives, Mahwah, NJ.

85. In 1990, the Quality of Markets Committee took the unusual step of publicly naming some of the culprit member organizations: "The NYSE experienced market share losses attributable to Shearson's and Dean Witter's off-board market-making." *Annual Report of the Quality of Markets Committee, 1990*, June 1, 1991, 13, NYSE Archives, Mahwah, NJ.

86. By trading away from the NYSE floor, the large broker-dealer firms also made money by transacting as principals against their customer orders and thus pocketing the spread as profit.

87. Board of Directors, *1983 Annual Report*, 21–22, NYSE Archives, Mahwah, NJ.

88. *Annual Report of the Quality of Markets Committee, 1992*, June 1, 1993, 4, NYSE Archives, Mahwah, NJ.

89. The unweighted average spread was 5 cents in 2004 and 23 cents in 1994.

90. According to one report in the early 1980s, about 40 percent of all NYSE transactions were executed inside the specialists' best displayed quotes when the quotation spread was more than one-eighth of a point. See *The Report of the Quality of Markets Committee to the Board of Directors 1981*, March 1982, 13, NYSE Archives, Mahwah, NJ.

91. New York Stock Exchange, *Annual Report 2004*, 8, NYSE Archives, Mahwah, NJ.

92. This conclusion is consistent with the findings of a systematic empirical investigation by Paul Mahoney into claims that market manipulation was common on the NYSE, especially in the pre-SEC era. Mahoney writes: "Critics in the 1930s and since have argued that the NYSE's rules against fraudulent trading, like its disclosure rules, were enforced haphazardly if at all.... As always, however, we should not accept without verification the factual assertions of those who have an ax to grind.... The notion that manipulation was rampant on the NYSE in the leadup to the 1929 market crash collapses under careful scrutiny." See Mahoney, *Wasting a Crisis: Why Securities Regulation Fails*, 2014, 102–103.

93. Abolafia, *Making Markets*, 1996, 58.

94. *Hearing on Public Ownership of U.S. Stock Markets before the Senate Banking Committee,* September 28, 1999, 13 (statement of Richard Grasso). A full third of the NYSE staff was involved in regulatory activities.

95. See NYSE annual reports from 2000 to 2004.

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96. In 2004, the total market capitalization of firms listed on NASDAQ was $3.7 billion.

97. See Barclay, "Bid-Ask Spreads and the Avoidance of Odd-Eighth Quotes on NASDAQ," 1997; Bennet and Wei, "Market Structure, Fragmentation, and Market Quality," 2006; Bessembinder, "Trade Execution Costs on NASDAQ and the NYSE," 1999; Bessembinder and Kaufman, "A Comparison of Trade Execution Costs for NYSE and NASDAQ-Listed Stocks," 1997; Boehmer, "Dimensions of Execution Quality: Recent Evidence for US Equity Markets," 2005; Christie and Huang, "Market Structures and Liquidity: A Transactions Data Study of Exchange Listings," 1994; Huang and Stoll, "Dealer versus Auction Markets: A Paired Comparison of Execution Costs on NASDAQ and the NYSE" 1996; Jones and Lipson, "Execution Costs of Institutional Equity Orders," 1999; Kadlec and McConnell, "The Effect of Market Segmentation and Illiquidity on Asset Prices: Evidence from Exchange Listings," 1994; LaPlante and Muscarella, "Do Institutions Receive Comparable Execution in the NYSE and Nasdaq Markets? A Transaction Study of Block Trades," 1997.

98. NYSE Special Committee on Market Structure, Governance and Ownership, *Market Structure Report*, March 23, 2000, NYSE Archives, Mahwah, NJ. The authors of the report included Geoffrey Bible, chair and CEO of Philip Morris; Stephen Case, chair and CEO of America Online; Maurice Greenberg, chair and CEO of American International Group; Mel Karmazin, president and CEO of CBS; Gerald Levin, chair and CEO of Time Warner; Alex Trotman, former chair, president, and CEO of Ford Motor Corporation; Linda Wachner, chair, president, and CEO of the Warnaco Group; and Clifton Wharton, former chair and CEO of the Teachers Insurance and Annuity Association-College Retirement Equity Fund (TIAA/CREF).

99. As noted earlier, orders exposed to the crowd do not trade directly with the specialist when the crowd itself is supplying sufficient liquidity, and in such a situation no spread is paid by the buyer or seller. Orders are executed *between* the bid and offer prices (i.e., at better prices than the ones announced by the specialist).

100. NYSE Special Committee on Market Structure, Governance and Ownership, *Market Structure Report*, March 23, 2000, 36.

Chapter Four. Stratification in Modern Trading

1. Vaananen, *Dark Pools and High Frequency Trading*, 2015, 151.

2. Quoted in *Philadelphia Stock Exchange Papers: 1746–2005*, 2006, 1.

3. Quoted in *Philadelphia Stock Exchange Papers: 1746–2005*, 1.

4. Quoted in *Philadelphia Stock Exchange Papers: 1746–2005*, 1.

5. Hotchkiss, 438. Hotchkiss was the treasurer of the Gold & Stock Telegraph Company, founded in 1867 by E. A. Calahan, the inventor of the stock telegraph printing instrument (a stock quotation instrument) called the "ticker."

6. Reuters News merged with the Thomson Corporation in 2008 to became the Thomson Reuters media conglomerate.

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7. Laughlin, Aguirre, and Grundfest, "Information Transmission between Financial Markets in Chicago and New York," 2014, 284.

8. Rothschild archives, accessed June 2017, https://www.rothschildarchive.org.

9. This fiber-optic cable between Chicago and New York was laid in nearly a straight line, by cutting through mountains with rock saws and dynamite rather than following the more usual fiber-optic cable route along railroad right-of-ways. It thus clipped 1.5 milliseconds from the one-way travel time offered by its competitors. See Patterson, *Dark Pools*, 2012, 287.

10. Remarkably, McKay Brothers' microwave network between Chicago and New York/New Jersey is also almost straight, only three kilometers longer than a 1,180-kilometer straight line between the two financial centers. By 2016, about 15 separate custom-built microwave networks supported high-speed trading between Chicago and New York/New Jersey. See O'Hara and Cox, "Making Waves: Breaking Down Trading Barriers with Ultrafast Networks," May 15, 2015; Laughlin, Aguirre, and Grundfest, "Information Transmission between Financial Markets in Chicago and New York," 2014.

11. Light travels 1 kilometer in 3.33564 microseconds (in a vacuum) and 300 kilometers (roughly the distance between Boston and New York) in one millisecond. It travels the distance between Chicago and New York (1,146 km) in 3.82 milliseconds. It is physically impossible for communications to travel faster than light. See Einstein, "Zur Elektrodynamik bewegter Korper," 1905.

12. See "Hybrid Laser Metro Wireless," Anova Technologies, accessed September 18, 2018, anova-tech.com/sample-page/laser-wireless-connectivity.

13. The two telecom companies are New Line Networks and Vigilant Global. Vigilant is owned by DRW Trading, and New Line was launched as a joint venture between KCG Holdings and Jump Trading. Virtue Financial acquired KCG Holdings in July 2017.

14. In January 2017, Dover District Council rejected planning permission, arguing that the towers would harm the "heritage significance, landscape character and appearance" of the area. Vigilant and New Line have the right to appeal to the national government. See Murphy, "A Dover Council Rejects Plans for Shard-Sized HFT Towers," January 22, 2017.

15. See Louis, "Traders Said to Plan Supercharged Chicago-to-Tokyo Data Network," November 11, 2016.

16. Seaborn Networks, "Seaborn Networks Launches New Lowest Latency Route between Carteret and Sao Paulo," December 12, 2016.

17. Hendershott, "Electronic Trading in Financial Markets," August 2003, 12. Examples of ECNs included Attain, Archipelago, Bloomberg Tradebook, Brut, NexTrade, and Tradepoint. Some of these ECNs later merged with each other; others were bought by traditional exchanges or developed into exchanges.

18. Patterson, *Dark Pools*, 2012, 291.

19. Ye, Yao, and Gai, "The Externalities of High Frequency Trading," March 18, 2014.

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20. Francois Tyc quoted in McKay Brothers, "McKay Brothers Microwave Sets New Latency Record between UK and Frankfurt," January 22, 2015. If the speed of light is ever reached, competition would continue on other dimensions of communications, including bandwidth and link reliability.

21. Fan et al., *Electronic Commerce and the Revolution in Financial Markets*, 2002, 16.

22. *Commercial and Financial Chronicle*, sections on the London Stock Exchange and international securities markets, July 5, 1890, cited in Michie, *The London and New York Stock Exchanges, 1850–1914*, 1987, 186.

23. Michie, *The London Stock Exchange: A History*, 1999, 128.

24. *New York Tribune*, September 20, 1892, cited in Michie, *The London and New York Stock Exchanges, 1850–1914*, 1987, 187.

25. Eames, *The New York Stock Exchange*, 1894, 90.

26. Michie, *The London and New York Stock Exchanges, 1850–1914*, 1987, 176.

27. Calculation by the author based on information on NYSE membership organizations in NYSE Archives, Mahwah, NJ. See also Michie, *The London Stock Exchange: A History*, 1999, 202.

28. Mutual funds trade only at the end of the day at the net asset value price.

29. By 2016, the total value of U.S. ETFs was $2.47 trillion, European ETFs had a value of $0.544 trillion, Asian-Pacific ETFs $0.314 trillion, and others $0.094 trillion (source of data: www.statistica.com). Remarkably, ETFs now account for about 30 percent of all U.S. trading by value and 23 percent by share volume. Three ETFs were in the top 10 most actively traded securities, in terms of volume, in 2013; by 2016 7 of the 10 most actively traded securities on U.S. stock markets were ETFs rather than company shares. See Wigglesworth, "ETFs Are Eating the US Stock Market," January 24, 2017.

30. An ETF manager simply seeks to replicate the performance of an index. Passive management results in charges that are much lower than fees of actively managed funds (e.g., most mutual funds). This is one reason for the popularity of ETFs.

31. Some indices track the value of stocks; others track the value of assets such as bonds and futures.

32. The S&P 500 represents about 75 percent of the market capitalization of the total U.S. equity market. Other indices include the Dow Jones Industrial Average (comprising the 30 largest U.S. companies), FTSE 100 (100 largest UK companies), DAX (30 largest German companies), Nikkei 225 (225 largest Japanese companies), the S&P Midcap 400 (400 middle-sized U.S. firms), Nasdaq 100 (100 largest Nasdaq stocks), Russell 2000 (small-cap U.S. firms), Nasdaq Composite Index (stocks listed on Nasdaq), and Wilshire 5000 (stocks traded in the United States).

33. SPY is a mammoth $247 billion ETF. By volume, it is currently the second most actively traded security in the United States. By trading value, however, SPY reigns supreme—even beating Apple, the world's most valuable company. SPY is managed by State Street Global Advisors, a major provider of ETFs, though not the largest (that distinction belongs to Barclays, the British multinational bank).

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34. Put another way, if a trader can buy (sell) an ETF for effectively less (more) than the underlying securities, she will buy (sell) the ETF shares and sell (buy) the underlying stocks, booking the price difference as a profit.

35. For example, two competitors to SPY are BlackRock's iShares Core S&P 500 ETF (IVV) and the Vanguard S&P 500 ETF (VOO).

36. In a cash market, the exchange of goods and money between sellers and buyers takes place immediately, whereas in the futures market the exchange takes place at a specified date in the future.

37. The E-mini S&P 500 futures contract is an outgrowth of the original S&P 500 stock index futures contract which was first introduced on the Chicago Mercantile Exchange (CME) in 1982. By 1986 the S&P 500 futures contract had become the second most actively traded futures product in the world, encouraging the launch of many more index futures contracts. CME introduced the E-mini S&P 500 futures contract in 1997 when the value of the original S&P 500 contract (then valued at 500 times the index) became too large for small traders. The E-mini S&P 500 has become the most popular stock index futures contract in the world.

38. Budish, Cramton, and Shim, "The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response," 2015, esp. 1549–1553.

39. Exchange-traded products linked to gold include Gold Futures, miNY Gold Futures, E-micro Gold Futures, SPDR Gold Trust, and iShares Gold Trust.

40. Berman (associate director, SEC), "What Drives the Complexity and Speed of Our Markets?," April 15, 2014.

41. *City of Providence, Rhode Island, et al. v. BATS Global Markets, Inc., et al.*, United States District Court, Southern District of New York, Second Consolidated Amended Complaint, Civil Action No. 1:14-cv-02811-JMF (November 24, 2014), 27. In the United States, the Volcker Rule, which went into effect in July 2015, imposes certain restrictions on (high-speed) proprietary trading by broker-dealer banks. However, the rule has numerous loopholes. For example, it restricts proprietary trading but allows for market-making trading activity. The difference between the two is often difficult to discern. High-speed traders routinely claim to act as market makers. President Trump has vowed to lift the restrictions on proprietary trading.

42. Kern and Loiacono, "High-Frequency Trading and Circuit Breakers in the EU—Recent Findings and Regulatory Activities," 2018.

43. Vincent, "Speed Fails to Impress Long Term Investors," September 22, 2011; Lewis, *Flashboys*, 2014, 15.

44. Order types include market orders, limit orders, and a variety of complex or special order types; these are discussed in detail in chapter 5.

45. Dave Lauer, interview by Aaron Fifeld, *Chat with Traders*, YouTube, September 4, 2016, https://www.youtube.com/watch?v=1ah7XokvcwA.

46. The software contains the code instructions that operate the "boxes," or hardware; that is, the computer servers, signal amplifiers, and switches.

47. Patterson, *Dark Pools*, 2012, 302.

48. *Citadel Investment Group, LLC v. Teza Technologies LLC*, Appellate Court of Illinois, 924 N.E.2d 95 (February 24, 2010), 97–98n1.

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49. Hendershott, Jones and Menkveld, "Does Algorithmic Trading Improve Liquidity?" 2011; Zhang, "Need for Speed," 2017.

50. Wunsch, Dark Pool Comment Letter to Elizabeth Murphy, January 14, 2010, 11.

51. Wunsch, 11.

52. Stiglitz, "Tapping the Brakes: Are Less Active Markets Safer and Better for the Economy?," 2014, 9. For a comprehensive discussion of the benefits and costs of hyper-speed in trading, see Foucault and Moinas, "Is Trading Fast Dangerous?," 2018.

53. Ben-David, Franzoni, and Moussawi, "Do ETFs Increase Volatilty?," June 17, 2014. Ben-David et al. find that an increase of one standard deviation in ETF stock ownership is associated with an increase of 16 percent in price volatility of the stocks owned by the ETF. See also Bhattacharya and O'Hara, "Can ETFs Increase Market Fragility? Effects of Information Linkages in ETF Markets," June 10, 2016; and Krause, Ehsani, and Lien, "Exchange-Traded Funds, Liquidity and Volatility," 2014. Similarly, Arnuk and Saluzzi observe: "Is all HFT statistical arbitrage inherently bad? We would argue that some of this is indeed healthy. However, we can't help but wonder whether many ETFs have been developed for the express purpose of computerized arbitrage trading because that generates volume for the exchanges, and big fees for the ETF creator[s]. Unfortunately, the exponential rise of these instruments has increased the correlation between many asset classes. This hurts long-term investors: It makes presumably 'safe' portfolios, with a traditional mixture of assets designed to offset each other, increasingly risky." Arnuk and Saluzzi, *Broken Markets*, 2012, 30. Finally, Jack Bogle, founder of the Vanguard Group, expressed similarly negative views: "ETFs often are just great big gambling, speculative instruments that have definitely destabilized the market." Quoted in Zweig, "Why a Legendary Market Skeptic Is Upbeat about Stocks," September 10, 2011.

Chapter Five. Bad Governance in Fragmented Markets

1. In the Matter of New York Stock Exchange, June 29, 1999.

2. In the Matter of New York Stock Exchange, June 29, 1999, 6. The SEC also blamed NYSE for insufficiently policing profit-sharing and other performance-based compensation schemes of independent floor brokers. NYSE settled the case with the SEC, agreeing to take steps to strengthen the surveillance and regulation of the independent floor brokers. No penalty was imposed.

3. In the Matter of New York Stock Exchange, April 12, 2005. NYSE settled with the SEC. In its decision, the SEC noted: "In light of the NYSE's commitment to set aside a reserve fund of $20m for the establishment, retention and payment of a Third Party Regulatory Auditor to conduct bi-annual regulatory audits of NYSE Regulation's surveillance, examination, investigation and disciplinary programs, the Commission has determined not to seek a civil penalty from the NYSE. In addition, the Commission has also taken into consideration the NYSE's

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enhancements to its governance and regulatory programs" (In the Matter of New York Stock Exchange, April 12, 2005, 14).

4. In the Matter of David Finnerty, Donald Foley, Scott Hunt, Thomas Murphy, Kevin Fee, Frank Delaney, Freddy DeBoer, Todd Christie, James Parlosi, Robert Luckow, Patrick Murphy, Robert Johnson, Patrick McGagh, Joseph Bongiorno, Michael Hayward, Richard Volpe, Michael Stern, Warren Turk, Gerard Hayes, and Robert Scavone, July 13, 2009.

5. See In the Matter of New York Stock Exchange LLC, NYSE Arca, Inc., NYSE MKT LLC f/k/a NYSE Amex LLC, and Archipelago Securities LLC, May 1, 2014; and In the Matter of New York Stock Exchange LLC, and NYSE Euronext, September 14, 2012.

6. Funston (president of the NYSE), letter to the editors, 7–12, 10 (emphasis added).

7. Order Approving a Proposed Rule Change by New York Stock Exchange LLC to Create a New NYSE Market Model, October 24, 2008, at 64, 389.

8. See In the Matter of New York Stock Exchange LLC, and NYSE Euronext, September 14, 2012.

9. The term "merchants of liquidity" is borrowed from Dolgopolov, "Regulating Merchants of Liquidity: Market Making from Crowded Floors to High-Frequency Trading," 2016.

10. Bodek, *The Problem of HFT: Collected Writings on High Frequency Trading & Stock Market Structure Reform*, 2013, 70.

11. Rick Ketchum in response to a question put to him during a hearing titled *Hearing on Regulatory Reforms to Improve Equity Market Structure before the Subcommittee on Securities, Insurance, and Investment of the Committee on Banking, Housing, and Urban Affairs, before the Subcommittee on Securities, Insurance and Investment of the Committee on Banking, Housing, and Urban Affairs of the United States Senate*, March 3, 2016. Ketchum retired in the fall of 2016.

12. Brainard (governor, Board of Governors of the Federal Reserve System), speech given at the Policy Makers' Panel on Financial Intermediation: "Banking, Securities Markets, or Something New?" July 1, 2015, 2.

13. Peterffy (chair and CEO of Interactive Brokers Group), comments before the Joint CFTC-SEC Advisory Committee on Emerging Regulatory Issues, June 22, 2010, 3.

14. Haldane (executive director, Financial Stability, Bank of England), "The Race to Zero." July 8, 2011, 14. For a wider discussion on the new market makers, see Dolgopolov, "Regulating Merchants of Liquidity: Market Making from Crowded Floors to High-Frequency Trading," 2016; Dolgopolov, "Providing Liquidity in a High-Frequency World: Trading Obligations and Privileges of Market Makers and a Private Right of Action," 2013.

15. Glub, Keane, and Poon, "High Frequency Trading and Mini Flash Crashes," November 29, 2012.

16. Kirilenko et al., "The Flash Crash: High-Frequency Trading in an Electronic Market," 2017, 995; see also Brogaard et al., "High-Frequency Trading and Extreme Price Movements," February 9, 2017; Anand and Venkataraman,

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"Market Conditions, Fragility, and the Economics of Market Making," 2016; Dichev, Huang, and Zhou, "The Dark Side of Trading," 2014; Hasbrouck and Saar, "Technology and Liquidity Provision: The Blurring of Traditional Definitions," 2009; and Raman, Robe, and Yadav, "Electronic Market Makers, Trader Anonymity and Market Fragility," May 29, 2014.

17. Hirschey, "Do High-Frequency Traders Anticipate Buying and Selling Pressure?," May 26, 2016, 13–14; see also Menkveld, "High Frequency Trading and the New Market Makers," 2013; and Brogaard, "High Frequency Trading and Its Impact on Market Quality," September 20, 2010.

18. See Boehmer, Fong, and Wu, "International Evidence on Algorithmic Trading," September 18, 2015.

19. Kervel and Menkveld, "High-Frequency Trading around Large Institutional Orders," February 24, 2016. The authors write: "We find that HFTs initially [briefly] lean against orders but [then]…turn around and go with them for long-lasting orders. This pattern explains why institutional trading cost is 46% lower when HFTs lean against the order (by one standard deviation) but 169% higher when they go with it" (ibid., 1). Another study similarly concludes "that there is little to no firm evidence that modern market makers truly lean against the order flow." Malinova and Park, "Modern Market Makers," March 21, 2016, 5; see also Korajczyk and Murphy, "High Frequency Market Making to Large Institutional Trades," May 25, 2016; and Raman, Robe, and Yadav, "Electronic Market Makers, Trader Anonymity and Market Fragility," May 29, 2014.

20. A "child order" is a small portion or a slice of a big (or "parent") order. For example, a parent order of 100,000 shares may be sliced into child orders of 5,000 shares each, executed with specified time intervals over several hours or even days to minimize the possibility of an adverse price movement in the market.

21. Kervel and Menkveld, "High-Frequency Trading around Large Institutional Orders," February 24, 2016, 7.

22. Bodek, *The Problem of HFT: Collected Writings on High Frequency Trading & Stock Market Structure Reform*, 2013, 3.

23. "Pads" referred to the pieces of paper carried from place to place on which were written the latest prices at which shares could be bought or sold. Sobel, *Inside Wall Street*, 1977, 36.

24. An exchange's matching engine matches orders and keeps limit orders on the exchange's order book for future executions. It also generates market data as a result of this activity, including trade reports (price and size of executed trades), quotes (best price available and the number of shares bid and offered at that price), and depth-of-book messages (order-by-order changes in the order book at all price points, including order cancellations and modifications).

25. The affiliates were NYSE TransactTools Inc. and NYSE Technologies.

26. In the Matter of New York Stock Exchange LLC, NYSE Arca, Inc., NYSE MKT LLC f/k/a NYSE Amex LLC, and Archipelago Securities LLC, May 1, 2014.

27. The Exchange Act of 1934 requires every exchange wishing to introduce a change in its operational status quo to file a proposed rule change with the SEC. The SEC then publishes a notice about the proposal, giving the public an

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opportunity to submit written views and arguments in favor of or opposed to the proposal. This due process is designed to protect investor interests.

28. Regulation NMS, Rule 603 (a).

29. Formally, the Consolidated Tape Association, whose members include the exchanges, oversees the dissemination of real-time quote and trade information in securities listed on NYSE ("Tape A") as well as on NYSE Arca, NYSE American, BATS, and regional exchanges ("Tape B"). The SIP, for which NYSE has administrative responsibility, processes Tapes A and B. The dissemination of data on Nasdaq-listed stocks ("Tape C") takes place via the Nasdaq SIP, governed by the Nasdaq/UTP Plan.

30. Robert Khuzami, director of the SEC's Division of Enforcement, quoted in SEC press release, "SEC Charges New York Stock Exchange for Improper Distribution of Market Data," September 14, 2012, https://www.sec.gov/news/press-release/2012-2012-189htm.

31. In the Matter of New York Stock Exchange LLC, and NYSE Euronext, September 14, 2012.

32. See Ding, Hanna, and Hendershott, "How Slow Is the NBBO? A Comparison with Direct Exchange Feeds," 2014; and, especially, Healthy Markets Association, *US Equity Market Data: How Conflicts of Interest Overwhelm an Outdated Regulatory Model and Market Participants*, November 16, 2017.

33. For example, Nasdaq's Access Services business, which includes colocation services, had revenues of $217 million in 2011, $234 million in 2012, $235 million in 2013, $239 million in 2014, and $239 million in 2015; and Nasdaq's data business, which includes proprietary data products, generated $327 million in 2011, $337 million in 2012, $362 million in 2013, $384 million in 2014, and $399 million in 2015. Nasdaq, investor presentation, February 2016. Intercontinental Exchange (ICE), the parent company of NYSE since 2013, reported in 2016 that 41 percent of total revenues came from Data Services, which break down as follows: 20 percent from colocation/connectivity, 70 percent from real-time trading data, and 10 percent from analytics. See Intercontinental Exchange/NYSE "First Quarter 2016 Earnings Supplement," May 4, 2016.

34. Large clients may rent as many as 100 cabinets or more.

35. NYSE "Market Data Pricing," January 2018. NYSE's other two stock exchanges, NYSE Arca and NYSE American, have their own proprietary data feeds. See also Healthy Markets Association, *US Equity Market Data*, 2017.

36. Former Direct Edge CEO William O'Brian, prepared remarks delivered at a hearing titled *Market Structure: Ensuring Orderly, Efficient, Innovative and Competitive Markets for Issuers and Investors" before the Committee on Financial Services Subcommittee on Capital Markets and Government Sponsored Enterprises*, US House of Representatives (June 19, 2012), cited in *City of Providence, Rhode Island, et al. v. BATS Global Markets, Inc., et al.*, United States District Court, Southern District of New York, Second Consolidated Amended Complaint, Civil Action No. 1:14-cv-02811-JMF (November 24, 2014), 45.

37. Fox, Glosten, and Rauterberg, "The New Stock Market: Sense and Nonsense," 2015, 234–235. See also Foucault, Pagano, and Rell, *Market Liquidity:*

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Theory, Evidence, and Policy, 2013; and Bond, Edmans, and Goldstein, "The Real Effect of Financial Markets," 2012.

38. Biais and Foucault, "HFT and Market Quality," 2014, 12; Baldauf and Mollner, "High-Frequency Trading and Market Performance," August 31, 2017; Yang and Zhu, "Back-Running: Seeking and Hiding Fundamental Information in Order Flows," July 4, 2017; Stiglitz, "Tapping the Brakes: Are Less Active Markets Safer and Better for the Economy?," 2014; and Yadav, "How Algorithmic Trading Undermines Efficiency in Capital Markets," 2015.

39. Weller, "Efficient Prices at Any Cost: Does Algorithmic Trading Deter Information Acquisition?," May 23, 2017. The study analyzes a panel of 54,878 stock quarters of SEC market data.

40. Kervel and Menkveld, "High-Frequency Trading around Large Institutional Orders," February 24, 2016, 43.

41. Hirschey, "Do High-Frequency Traders Anticipate Buying and Selling Pressure?," May 26, 2016, 6–7. Weller also writes: "[The literature has] left unasked whether improved price efficiency with respect to acquired information comes at the expense of discouraging acquisition of new information." See Weller, "Efficient Prices at Any Cost: Does Algorithmic Trading Deter Information Acquisition?," May 23, 2017; see also Saglam, "Order Anticipation around Predictable Prices," September 23, 2016.

42. For a related discussion, see Yadav, "Insider Trading and Market Structure," 2016.

43. Dolgopolov, "High-Frequency Trading, Order Types, and the Evolution of the Securities Market Structure," 2014.

44. Some SOTs were created to assist market participants in managing fragmentation, adapting to the speed of the market, and maintaining compliance with Regulation NMS, although some benign SOTs have subsequently been hijacked by high-speed traders for predatory purposes. See, for example, In the Matter of Latour Trading LLC, September 30, 2015.

45. Each price level has its own queue.

46. The ban is motivated by concerns that locked markets could encourage problematic practices, such as cross-market buying and selling for the sole purpose of collecting rebates paid by exchanges to liquidity-providing traders.

47. See Sprecher (chair and CEO of ICE), remarks given at the 15th Annual Credit Suisse Financial Services Forum, February 13, 2017.

48. *City of Providence, Rhode Island, et al. v. BATS Global Markets, Inc., et al.*, United States District Court, Southern District of New York, Second Consolidated Amended Complaint, Civil Action No. 1:14-cv-02811-JMF (November 24, 2014), 70.

49. In the Matter of New York Stock Exchange, NYSE American LLC, and NYSE Arca, Inc.

50. Popular algorithmic trading strategies used by institutional investors to limit the market impact of large orders, such as order slicing and weighted averaging strategies, can backfire when they interact with high-speed traders using SOTs.

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51. Bodek filed his concerns about SOTs with the SEC's Enforcement Division in July 2011. He then informed a writer for the *Wall Street Journal*, Scott Patterson, who, in 2012, cowrote the first article mentioning SOTs in a major media outlet; see Patterson and Eaglesham, "SEC Probes Rapid Trading," March 23, 2012. This was followed by a more detailed report on SOTs; see Patterson and Strasburg, "For Superfast Stock Traders, a Way to Jump Ahead in Line," September 19, 2012.

52. API stands for application programming interface; this is a set of functions and procedures that allow the creation of applications that access the features or data of an operating system or other services. An API manual describes what services an API offers and how to use these services.

53. Bodek, *The Problem of HFT: Collected Writings on High Frequency Trading & Stock Market Structure Reform*, 2013, 48.

54. In a seminal speech in 2014, Mary Jo White, chair of the SEC, asked the exchanges to conduct a comprehensive review of their order types and how they operate in practice. This led to a spate of regulatory filings by the exchanges. Bodek and Dolgopolov have concluded, however, that "some of these order type-related filings are problematic, as they look like efforts to obtain the regulators' approval after the fact and with limited disclosure.... Overall, it is an open question as to how many order types from the arsenal of HFTs will be impacted as opposed to being left alone or just subjected to enhanced disclosure." Bodek and Dolgopolov, *The Market Structure Crisis*, 2015, 58.

55. No private lawsuit relating to SOTs had been successful until 2017. Part of the reason is that U.S. exchanges have long benefited from absolute immunity conferred on them as self-regulatory organizations. However, in a surprising amicus curiae brief in 2017 to the U.S. Court of Appeals for the Second Circuit, the SEC took the view that absolute immunity should apply only in relation to an exchange's self-regulatory functions and not its market operating practices, which include SOTs. This view is a radical departure from the traditional broad interpretation of the scope of regulatory immunity by the federal courts. See Brief of the SEC, Amicus Curiae 15-3057 (November 29, 2016), *City of Providence, Rhode Island, et al. v. BATS Global Markets, Inc., et al.*, U.S. Court of Appeals for the Second Circuit, on appeal from the U.S. District Court for the Southern District of New York, https://www.sec.gov/litigation/briefs/2016/providence-BATS-global-makrets-1116.pdf). In December 2017, the U.S. Court of Appeals issued its decision, agreeing in effect with the SEC. It noted: "When an exchange engages in conduct to operate its own market that is distinct from its oversight role, it is acting as a regulated entity—not a regulator. Although the latter warrants immunity, the former does not." *City of Providence, Rhode Island, et al. v. BATS Global Markets, Inc., et al.*, US Court of Appeals for the Second Circuit, No. 15-3057-cv (December 19, 2017), 24. The case may now go to the Supreme Court.

56. In the Matter of EDGA Exchange, Inc., and EDGX Exchange, Inc., January 12, 2015.

57. The Hide Not Slide SOT is a specific example of the "hide and light" SOT.

58. In the Matter of EDGA Exchange, Inc., and EDGX Exchange, Inc. January 12, 2015, 7.

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59. It is worth noting that this small fine is the largest SEC fine to date against any exchange in U.S. history.

60. SOTs with "hide and light" functionality were released by exchanges under various names: Hide Not Slide (Direct Edge), Price to Comply (Nasdaq), Display-Price Sliding (BATS), and Post No Preference Blind (NYSE ARCA). Exchanges frequently modified SOTs to give their most important clients more edge. Other SOTs in the arsenal of high-speed traders include Day Intermarket Sweep Orders (ISOs) offered by most exchanges, BATS's Only Post Only, Nasdaq's Post Only with Automatic Re-Entry Enabled, NYSE ARCA's Post No Preference Blind Adding Liquidity Only (ALO), and many derivatives of these order types.

61. In the Matter of New York Stock Exchange LLC, NYSE Arca, Inc., NYSE MKT LLC f/k/a NYSE Amex LLC, and Archipelago Securities LLC, May 1, 2014.

62. Bodek, *The Problem of HFT: Collected Writings on High Frequency Trading & Stock Market Structure Reform*, 2013, 5.

63. See Rosenblatt Securities, BATS trading, and TABB Group.

64. Aquilina et al., "Aggregate Market Quality: Implications of Dark Trading," October 2017.

65. Australia Securities and Investments Commission, *Review of High-Frequency Trading and Dark Liquidity*, October 2015, 43.

66. Japanese Securities Dealers Association, monthly data.

67. For example, Turquoise, which is majority owned by the London Stock Exchange, and BATS Europe are dark markets.

68. See, for example, FINRA "Best Execution: Guidance on Best Execution Obligations in Equity, Options and Fixed Income Markets," November 2015; and FINRA "Rule 5310: Best Execution and Interpositioning." For Canada, see "National Instrument 23-101, Trading Rules, Part 4.2"; and the "Universal Market Integrity Rules." For Europe, see "Markets in Financial Instruments Directive (MiFID)."

69. U.S. regulation of alternative trading systems (Regulation ATS), for example, requires dark pool providers to offer fair market access if during at least four of the preceding six calendar months the dark pool had 5 percent or more of the daily average trading volume in a security. Dark pools that do not reach such a threshold can offer discriminatory market access with impunity.

70. The SEC, for example, changed its dark pool disclosure rules only in July 2018; see concluding chapter.

71. Not included in table 5.1 is the SEC enforcement case against Citicorp in relation to its alternative trading venue LavaFlow of July 25, 2014. LavaFlow has many of the operational characteristics of a dark pool but is classified as an electronic communications network (ECN). The main difference between a dark pool and an ECN is that an ECN displays pre-trade (top of the order book) price information. Dark pools and ECNs are regulated in the United States under Regulation ATS of 1998 and the Securities Exchange Act of 1934. In the LavaFlow case, Citigroup fell foul of Rules 301(b)(10) and 301(b)(2) of Reg ATS and Section 15(a) of the Exchange Act. It settled with the SEC without admitting or denying violations and paid a civil penalty of $2.85 million. Also excluded from the

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table is the FINRA enforcement action against Goldman Sachs. FINRA found that Goldman Sachs's SIGMA-X dark pool failed to establish, maintain, and enforce procedures or to conduct regular surveillance in compliance with the Regulation National Market System to protect institutional client orders. The violation period lasted from November 2008 to August 2011. Goldman Sachs settled, neither admitting nor denying the charges. Its cost to settle was an even more insignificant $800,000.

72. In the Matter of Pipeline Trading Systems LLC, Fred Federspiel, and Alfred Berkeley III, October 24, 2011, 10.

73. In the Matter of Credit Suisse Securities (USA) LLC January 31, 2016, 10.

74. In the Matter of Deutsche Bank Securities Inc., December 16, 2016, 3.

75. In the Matter of Barclays Capital Inc., January 31, 2016, 3.

76. William White, quoted in *The People of the State of New York by Eric T. Schneiderman, Attorney General of the State of New York v. Barclays Capital, Inc., and Barclays PLC*, Supreme Court of the State of New York County of New York, Amended Complaint, Index No: 451391/2014, 10.

77. White, quoted in *The People of the State of New York by Eric T. Schneiderman, Attorney General of the State of New York v. Barclays Capital, Inc., and Barclays PLC*, 52.

78. White, 22.

79. White, 49. For evidence of the pervasive nature of the practice of deliberate slowing down of the data processing in dark pools to give privileged customers a trading advantage, see Alexander, Giordano, and Brooks, "Dark Pool Execution Quality: A Quantitative View," August 26, 2015.

80. Quoted in *The People of the State of New York by Eric T. Schneiderman, Attorney General of the State of New York v. Barclays Capital, Inc., and Barclays PLC*, 47.

81. In the Matter of Merrill Lynch, Pierce, Fenner and Smith Incorporated.

82. European Commission, "Executive Summary of the Impact Assessment Accompanying the Document 'Proposal for a Directive of the European Parliament and of the Council: Markets in Financial Instruments,'" October 20, 2011, 3.

83. International Organization of Securities Commissions, *Issues Raised by Dark Liquidity: Consultation Report*, October 2010, 19.

84. Speech by SEC commissioner Elisse Walter, "Opening Remarks Regarding Dark Pools," October 21, 2009, quoted in Zhu, "Do Dark Pools Harm Price Discovery?," 2014, 748.

85. Preece, *Dark Pools, Internationalization, and Equity Market Quality*, 2012; DeGryse, De Jong, and Kervel, "The Impact of Dark Trading and Visible Fragmentation on Market Quality," 2015; Comerton-Forde and Putnins, "Dark Trading and Price Discovery," 2015; Nimalendran and Ray, "Informational Linkages between Dark and Lit Trading Venues," 2014; Kwan, Masulis, and McInish, "Trading Rules, Competition for Order Flow and Market Fragmentation," 2015; Preece, "Dark Trading and Equity Market Quality," 2014; Weaver, "Internationalization and

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Market Quality in a Fragmented Market Structure," July 7, 2011; Hatheway, Kwan, and Zheng, "An Empirical Analysis of Market Segmentation on US Equities Markets," 2017; and Aquilina et al., "Aggregate Market Quality: Implications of Dark Trading," October 2017.

86. Put in more detailed technical language: if the majority of order flow is filled away from pre-trade transparent (or lit) markets, market operators placing large amounts of limit orders in lit markets will likely quote in smaller sizes or at wider spreads to compensate themselves for the greater risk of adverse selection, reduced ability to gauge market activity, or greater difficulty of maintaining inventory at target levels. Preece, *Dark Pools, Internationalization, and Equity Market Quality*, 2012, 59.

87. Preece, 2012, 34. Recall from chapter 3 that investors using market orders or marketable limit orders "pay the spread" for immediate order execution. The wider the spread, the higher the cost to these investors.

88. Quoted from chapter 3.

89. Yadav, "Oversight Failure in Securities Markets," forthcoming.

90. FINRA is the successor to the National Association of Securities Dealers (NASD). NASD was given the FINRA name in July 2007 after taking on parts of NYSE's self-regulatory functions, including member regulation, as well as enforcement and arbitration operations.

91. Kutler, "Re-arranging the Self-Regulators," May 5, 2010.

92. BATS was launched by high-frequency firm Tradebot in 2004. Direct Edge was the name given to the electronic trading platform Attain when it was bought by Knight Capital Group in 2005. BATS and Direct Edge soon became the third- and fourth-largest trading venues for stocks in the United States. See Patterson, *Dark Pools*, 2012, 244.

93. In 2012, FINRA rolled out a cross-market surveillance system. A year later, it began to migrate its market surveillance platforms into the Amazon Web Services Cloud, increasing both processing capacity and data storage space. And by 2017, FINRA had so-called Regulatory Services Agreements with 19 exchanges that operate 26 stock and option markets. Through these agreements, FINRA's surveillance now canvasses 99 percent of the U.S. stock market trading volume and about 65 percent of the U.S. listed-options market. Trading in futures, however, remains outside FINRA's regulatory and supervisory remit.

94. Quoted in Mikolajczak, "Market Surveillance a Constant Challenge: FINRA" May 17, 2016.

95. Cook, "Equity Market Surveillance Today and the Path Ahead," September 20, 2017.

96. The arbitrage can involve a single stock traded on multiple venues, or ETFs and underlying securities, or any other pair of highly correlated exchange-traded financial instruments.

97. Gao, Mizrach, and Ozturk, "Quote Stuffing and Market Quality," March 2015, 11, 25.

98. Egginton, van Ness, and van Ness, "Quote Stuffing," 2016, 590. Most quote-stuffing events occurred on the NYSE, ARCA, Nasdaq, and BATS. For evidence

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consistent with multi stock same-venue quote stuffing, see Gai, Yao, and Ye, "The Externalities of High-Frequency Trading," August 7, 2013.

99. See Tse, Lin, and Vincent, "High Frequency Trading—Measurement, Detection and Response," 2012. The stocks analyzed in this study are the ones included in the STOXX Europe 600 index, which tracks large companies across 18 European countries that make up about 90 percent of the market capitalization of the European stock exchanges. The reported findings cover the third quarter of 2012.

100. See Egginton, van Ness, and van Ness, "Quote Stuffing," 2016; and Gai, Yao, and Ye, "The Externalities of High-Frequency Trading," August 7, 2013. Not all quoting bursts are triggered for manipulative purposes. Egginton, van Ness, and van Ness note: "It is…possible that [some]…large episodic spikes in quoting activity may be generated for technological reasons where two algorithms interact with each other and fail to converge. For example, one algorithm submits a quote that causes another algorithm to reply, causing the first algorithm to respond. If this process of multiple algorithms 'chasing' each other continues, a large burst of quotes will be generated." Egginton, van Ness, and van Ness, "Quote Stuffing," 2016, 584. Such quoting episodes may be innocent, but they still degrade market quality.

101. The NASDAQ Stock Market LLC Notice of Acceptance of Letter of Acceptance, Waiver and Consent, No. 20100223345-02, June 16, 2016, 5. A major hurdle to successful prosecution of quote stuffing is the requirement to prove manipulative intent. Such proof is difficult without access to the holy grail—the closely guarded secret computer codes and algos.

102. In the case of spoofing, the layering is focused around the best offer, whereas in a typical layering case the layering refers to large orders deep in the book at multiple levels. As an example of spoofing in a fragmented market, let us say that stock ABC is trading at a (best) bid of $30.60 and a (best) offer of $30.65. A trader wanting to sell immediately could dispose of the stock by sending a market order to sell; this order would hit the best bid and the trader would receive $30.60. Alternatively, the trader could place a limit order to sell at a new best offer of $30.64, but the trader would have to wait for a buyer to show up and there is no guarantee that anyone will take him or her up on the $30.64 offer. Spoofing can help the trader as follows: first, the trader places the limit order to sell at $30.64 in a dark pool where no one can see it; second, the trader sends a large number of limit orders to buy to the public or lit market at prices such as $30.58 and $30.59. Other traders looking at the public order book may think there suddenly is great buying interest, so they start putting in their own bids at $30.61, $30.62, and $30.63. And as soon as one of the duped traders places a bid at $30.64 in the market, the sell order hiding in the dark pool gets filled. The manipulator then immediately cancels the large non–bona fide orders at $30.58 and $30.59, and the price of the stock quickly declines.

103. Trillium settled, neither admitting nor denying the spoofing charges, and the various individuals implicated in this case paid fines ranging from $12,500 to $220,000—which amounted to little more than a slap on the wrist.

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104. Why was Trillium caught? One observer speculated: "History tells us that it is not so much the rules you break that get you in trouble but the folks you cross. Somewhere along the line, the wrong people were wronged." Sussman, "In FINRA vs. Trillium, Score One for John Henry," September 16, 2010. The spoofing victims in this case may not have been hapless small investors but traders at powerful broker-dealer firms who tipped off FINRA.

105. Cartea et al., "Ultra-Fast Activity and Market Quality," April 7, 2016.

106. Anonymous trader who goes by the pseudonym Hansel, entry on www.zerohedge.com, September 13, 2014, 12:41 p.m.

107. Letter to Brent Fields at the SEC in relation to the IEX application, March 18, 2016, 2.

108. Sussman, "In FINRA vs. Trillium, Score One for John Henry," September 16, 2010.

109. FINRA surveillance also covers unlisted equities markets and trading in corporate and municipal debt and other fixed-income instruments.

110. The 1 percent figure was reported by Tom Gira at FINRA; see Mikolajczak, "Market Surveillance a Constant Challenge: FINRA" May 17, 2016. About 65 percent of FINRA's surveillance alerts involve activities from more than one market, and about 50 percent of alerts involve activities from more than one broker-dealer. See *Hearing on Oversight of the Financial Services Industry Regulatory Authority before the Financial Services Subcommittee on Capital Markets, Securities, and Investment,* September 7, 2017, 11 (statement of Robert Cook).

111. An investigation may involve many steps, including creating a comprehensive view of the investment product in question, understanding the actions and interactions of market participants, and classifying the behavior of those participants.

112. For example, besides conducting market surveillance, FINRA is tasked with regulating trading in equities, corporate bonds, securities futures, and options. It also licenses individuals and admits firms to the securities industry, periodically conducts regulatory exams of its members, and operates a large arbitration service for the resolution of disputes between customers and member firms, as well as between brokerage firm employees and their firms. FINRA membership comprises about 3,770 brokerage firms with 160,000 branch offices and approximately 635,000 registered securities representatives. FINRA has about 3,500 employees in Washington, DC, and New York and 16 regional offices in the United States. FINRA's surveillance group counts a staff of about 630.

113. FINRA Rule 4590.

114. See Market in Financial Instruments Directive (MiFID) II, Article 50 and ESMA's Regulatory Technical Specifications (RTS) 25. The UTC and NIST time standards are essentially identical. NIST is the United States' "local version" of the UTC standard and is typically referred to as UTC (NIST). Michael Lombardi, head of the remote time and frequency calibration program at NIST, explains: "During the year, UTC (NIST) never varies from UTC by more than 20 nanoseconds.... The difference is miniscule and for all practical purposes can be

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ignored." Quoted in Stone, "How Does Clock Synch Really Work?," September 16, 2016.

115. See, for example, Angel, "When Finance Meets Physics," 2014; and Yodaiken, "MiFID II: 10 Things You Need to Know about Time Synchronization," October 30, 2015.

116. CAT will require identification of the firm routing an order to another venue, identification of the venue or firm to which the order is routed, information on whether the order is routed internally, and identification of the department or desk to which it is routed. Both the routing firm and the market participant receiving the order will have to provide such information, allowing surveillance staff to compare detailed trading records on multiple events in the transaction life cycle from multiple perspectives.

117. Cook, "Equity Market Surveillance Today and the Path Ahead." Speech given at the Exchequer Club, Mayflower Hotel, Washington, DC, September 20, 2017.

118. The SEC has estimated that building the CAT central repository will cost $92 million, and operating it will cost $135 million annually. It also estimated that the CAT project will cost $2.1 billion for the industry to implement and $1.7 billion to meet reporting requirements.

119. To, "Is Clock Synch the CAT's Fatal Flaw?," March 3, 2017. A minimal version of CAT would leave it to the regulator to undertake the costly and arduous task of parsing raw CAT data, building metrics for use in data analysis, and conducting the analytical work. Strapped for significant resources, the SEC would likely fail in this task.

120. Thesys Technologies was given 10 months to build the CAT. Exchanges began to report their data by November 2017, large broker-dealers were expected to report their data by November 2018, and small broker-dealers were given until November 2019 to begin reporting.

121. Saluzzi and Arnuk, "Congress Works to Slow Down the CAT" October 17, 2017.

122. Regulators will have access to CAT data only with a five-day delay (T+5 provision), thus greatly hindering any effort to apprehend any rogue traders who operate in nanoseconds. See To, "Is Clock Synch the CAT's Fatal Flaw?," March 3, 2017.

123. Bali and Tabb, "The Consolidated Audit Trail: Stitching Together the US Securities Markets," March 4, 2015.

124. For a more detailed comparison of equities and FX markets, see Mattli and Kellerman, "Changing Capital Market Structure and Regulatory Challenges: Trends in Equity and Foreign Exchange Markets," 2018.

125. Mattli and Kellerman, 2018.

126. Kellerman and Marcus, "The FX Race to Zero: Electronification and Market Structural Issues in Foreign Exchange Trading," 2018.

127. Kellerman and Marcus, 2018.

128. Kellerman and Marcus, 2018.

129. Pragma Securities, *Defining the FX Flash Crash*, 2017.

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130. Kellerman and Marcus, "The FX Race to Zero: Electronification and Market Structural Issues in Foreign Exchange Trading," 2018.

Chapter Six. Conclusion

1. Brandeis, *Other People's Money and How Bankers Use It*, 1914, 94. The book influenced both Woodrow Wilson's New Freedom agenda (by allowing Congress to take away banks' control over currency and by banning interlocking directorates in which banker representatives controlled other corporations) and Franklin Roosevelt's New Deal. The New Deal laws, particularly the Glass-Steagall and the Securities Acts, imposed new regulations on the banking system, requiring the separation of banking from stock brokerage and establishing the Securities and Exchange Commission to regulate the stock market.

2. Brandeis, 94.

3. Brandeis, 95.

4. Brandeis, 92.

5. Brandeis, 104.

6. Orofsky, *Louis Brandeis*, 2012.

7. La Porta, Lopez-de-Silanes, and Shleifer, "What Works in Securities Laws?," 2006; and Mahoney, *Wasting a Crisis: Why Securities Regulation Fails*, 2014, 166.

8. Final rule: Regulation of NMS Stock Alternative Trading Systems.

9. Final rule: Regulation of NMS Stock Alternative Trading Systems.

10. Final rule: Regulation of NMS Stock Alternative Trading Systems, 10.

11. Final rule: Regulation of NMS Stock Alternative Trading Systems, 96–109.

12. Final rule: Regulation of NMS Stock Alternative Trading Systems, 54–58.

13. See "Market Integrity Rules," ASIC, last modified June 7, 2018, http://asic.gov.au/regulatory-resources/markets/market-integrity-rules.

14. Medcraft, "Regulatory High-Frequency Trading and Dark Liquidity in Australia," forthcoming 2019.

15. ESMA describes the purpose of MiFID II as follows: "MiFID II…will ensure fairer, safer and more efficient markets and facilitate greater transparency for all participants. New reporting requirements and tests will increase the amount of information available, and reduce the use of dark pools and OTC trading. The rules governing high-frequency-trading will impose a strict set of organisational requirements on investment firms and trading venues, and the provisions regulating the non-discriminatory access to…trading venues…are designed to increase competition." "MIFID II," ESMA, accessed April 12, 2018, https://www.esma.europa.eu/policy-rules/mifid-ii-and-mifir.

16. See Nagy and Gellasch, "Better 'Best Execution': An Overview and Assessment," 2018.

17. SEC, Disclosure of Order Handling Information, Release No. 34-78309, accessed January 12, 2018, https://www.sec.gov/rules/proposed/2016/34-78309.pdf.

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18. Halloran, "Competition and Consolidation Are Coming—the Impact of Potential SEC Institutional Transparency Requirements," February 8, 2017.

19. Personal note to me from a key person involved in these cases.

20. See, for example, "Be Wary of the Data," Themis Trading LLC, November 2014, http://blog.themistrading.com/2014/11/be-wary-of-the-data/.

21. See also conclusion in Foucault and Moinas, "Is Trading Fast Dangerous?," 2018.

22. According to one of its founders, HMRI is presently in discussions with a major U.S. university to finalize a partnership arrangement.

23. Quoted in Kellerman, "The Political Economy of Market Surveillance," February 6, 2018.

24. Kellerman, 2018.

25. For good overviews, see chapters 5 and 6 in Bodek and Dolgopolov, *The Market Structure Crisis*, 2015; and Mahoney and Rauterberg, "The Regulation of Trading Markets," April 19, 2017. See also Yadav, "Algorithmic Trading and Market Regulation," 2018.

26. Budish, Cramton, and Shim, "The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response," 2015.

27. Biais and Foucault, "HFT and Market Quality," 2014, 16; and Fox, Glosten, and Rauterberg, "The New Stock Market: Sense and Nonsense," 2015, 269.

28. Launched as an off-exchange market or alternative trading system (ATS), IEX was approved by the SEC as a national stock exchange in 2016.

29. "About," IEX Group Inc., https://iextrading.com/about. https://iextrading.com.

30. The speed bump applies to communications arriving at and departing the IEX matching engine. When an order arrives, IEX waits 350 microseconds to post and/or execute it, and information about the execution is also delayed by 350 microseconds. This undermines the ability of high-speed traders to quickly discover an IEX execution and react by front running any unfilled part of a big order that IEX may have decided to route to other exchanges for execution.

31. IEX does not exclude high-frequency traders from having access to its market. It simply treats them like all other traders. Some reformers are encouraging the establishment of exchanges for "slow" traders only. High-speed traders would be barred from such slow markets. Not all high-speed traders are predatory, however. Slow markets may thus miss out on a significant source of liquidity provided by certain high-speed traders.

32. See Wah et al., "A Comparison of Execution Quality across US Stock Exchanges," forthcoming 2019.

33. Fox, Glosten, and Rauterberg, "The New Stock Market: Sense and Nonsense," 2015, 271; see also *SEC v. Texas Gulf Sulphur*, 401 F. 2d 833, 854 (2d Circuit 1968); and Investors Management Co., Exchange Act Release, No. 9207, 1971 WL 120502, at *8 (July 29, 1971).

34. Biais and Foucault, "HFT and Market Quality," 2014, 15. An alternative way of reducing the high cancellation-to-trade ratio is to mandate minimum resting times for limit orders; that is, limit orders cannot be cancelled before a certain amount of time has passed.

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35. See Chung and Lee, "High-Frequency Trading: Review of the Literature and Regulatory Initiatives around the World," 2016.

36. See U.S. Securities and Exchange Commission, "SEC Announces Filing of Limit Up-Limit Down Proposal to Address Extraordinary Market Volatility," press release, accessed September 18, 2018, https://www.sec.gov/news/press/2011/2011-84.htm. and U.S. Securities and Exchange Commission, "SEC Issues Order Modifying and Extending the Pilot Period for the National Market System Plan to Address Extraordinary Market Volatility," press release, accessed September 18, 2018, https://www.sec.gov/news/pressrelease/2016-75.html.

37. For a recent U.S. example of a regulatory effort to strengthen the technological infrastructure of securities markets, see SEC Regulation Systems Compliance and Integrity of 2015, www.sec.gov/rules/final/2014/34-73639.pdf. This regulation was enforced in the 2018 SEC enforcement case mentioned in chapter 5. In this case, NYSE, NYSE American, and NYSE Arca were fined a total of $14 million for a range of operational failures related to market disruptive events. See In the Matter of New York Stock Exchange, NYSE American LLC, and NYSE Arca, Inc.

38. Kidney, retirement speech given at the Securities and Exchange Commission, 2014.

39. Bodek, *The Problem of HFT: Collected Writings on High Frequency Trading & Stock Market Structure Reform*, 2013, 67.

40. See Securities and Exchange Commission, Concept Release on Equity Market Structure, 2010, 70–71, www.sec.gov/rules/concept/2010/34-61358.pdf.

41. Healy, "MiFID II Double Volume Cap: Slam Dunk or Air Ball?," November 24, 2015.

42. Kidney, retirement speech given at the Securities and Exchange Commission, 2014, 5–6.

43. See chapter 1. This argument relates to the general point about large versus small players in a prisoner's dilemma game. Each member is tempted to act opportunistically, leading to a loss of collective reputation that hurts all. A large player's share of the loss is higher than that of a small player, so the former has a larger incentive (even at some cost) to reduce the force of the prisoner's dilemma. Olson and Zeckhauser offer a nice illustration in "An Economic Theory of Alliances," 1996. I thank Avinash Dixit for pointing this out.

Appendix. Market Governance

1. Milgrom and Roberts, "Economic Theories of the Firm: Past, Present, and Future," 1988, 456.

2. Coase, "The Nature of the Firm," 1937.

3. Coase, *Essays on Economics and Economists*, 1994, 7–8.

4. Williamson, *The Economic Institutions of Capitalism*, 1985, 53; see also Williamson, *Markets and Hierarchies*, 1975. For good overviews, see Eggertsson, *Economic Behavior and Institutions*, 1990; and Shelanski and Klein, "Empirical Research in Transaction Cost Economics: A Review and Assessment," 1995.

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5. Most neoclassical economists accept that for markets to function properly, they must be embedded in an institutional structure that defines and respects property rights and offers dispute resolution through a court system. They hold that the responsibility to forge property rights and enforce them lies with the "minimalist" state, but intervention beyond the provision of these basic public goods would curtail the freedom of markets and weaken their efficiency.

6. Coase, *Essays on Economics and Economists*, 1994, 5.

7. Coase, 5.

8. Coase, *The Firm, the Market and the Law*, 1988, 9. See also Richardson, "The Organisation of Industry," 1972; and Telser, "Why There Are Organized Futures Markets," 1981.

9. Coase, *The Firm, the Market and the Law*, 1988, 9; see also Mulherin, Netter, and Overdahl, "Prices Are Property: The Organization of Financial Exchanges from a Transaction Cost Perspective," 1991.

10. An alternative argument against the conventional view that dominance is bad is that a dominant exchange may, as a result of its large scale, have a marginal cost sufficiently lower than that of a small competitive exchange so that even after a higher "monopoly" markup it charges a lower price. I thank Avinash Dixit for pointing this out. See Williamson, "Scale Economies as an Antitrust Defense," 1968.

11. Krasner, "Global Communications and National Power: Life on the Pareto Frontier," 1991; Knight, *Institutions and Social Conflict*, 1992; Fligstein, *The Transformation of Corporate Control*, 1993; Barnett and Finnemore, "The Politics, Power, and Pathologies of International Organizations," 1999; Gruber, *Ruling the World: Power Politics and the Rise of Supranational Institutions*, 2000; Moe, "Power and Political Institutions," 2005; Posner, "Sources of Institutional Change: The Supranational Origins of Europe's New Stock Markets," 2005; Büthe and Mattli, *The New Global Rulers: The Privatization of Regulation in the Global Economy*, 2011; Stone, *Controlling Institutions: International Organizations and the Global Economy*, 2011; Jupille, Mattli, and Snidal, *Institutional Choice and Global Commerce*, 2013; and Farrell and Newman, "Domestic Institutions beyond the Nation-State: Charting the New Interdependence Approach," 2014.

12. Knight, *Institutions and Social Conflict*, 1992, 20

13. March, "The Business Firm as a Political Coalition," 1962, 666.

14. March, 675.

15. Abolafia, *Making Markets*, 1996, 191.

16. March, "The Business Firm as a Political Coalition," 1962, 678.

17. Jupille, Mattli, and Snidal, *Institutional Choice and Global Commerce*, 2013, 44–45.

18. Williamson, *The Economic Institutions of Capitalism*, 1985, 47.

19. Williamson, 47.

20. Williamson, "Markets and Hierarchies: Some Elementary Considerations," 1973, 317.

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21. Knight, *Risk, Uncertainty and Profit*, 1965, 254. Knight insisted on the need to study "human nature as we know it" (270).

22. See Williamson, "Markets and Hierarchies: Some Elementary Considerations," 1973; and Williamson, *The Economic Institutions of Capitalism*.

23. Williamson's governance alignment hypothesis suggests that a constrained optimum is always attained.

24. Akerlof and Shiller, *Phishing for Phools: The Economics of Manipulation and Deception*, 2015, 165.

25. Akerlof and Shiller, 8.

26. See, for example, Boyle, *Speculation and the Chicago Board of Trade*, 1920, Chapter 5; Brooks, *Once in Golconda*, 1969; Brutus, *Confessions of a Stockbroker*, 1971; Elias, *Fleecing the Lambs*, 1971; Galbraith, *A Short History of Financial Euphoria*, 1930; Gould, *The Manipulators*, 1966; Pecora, *Wall Street under Oath*, 1939; Schwed, *Where Are the Customers' Yachts?*, 1940; and De la Vega, *Confusion de Confusiones*, 1688 [2013], especially "Fourth Dialogue," 30–42.

27. An alternative justification of the opportunism assumption in this analysis, suggested to me by Avinash Dixit, is to say that there are opportunistic persons (not necessarily a majority) who naturally gravitate to positions where they can exercise opportunism.

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