stated bluntly, "Just when you think you're starting to figure these markets out, they come back and squash your ego like a peanut." The market seems to insist on the complete remaking of the trader in accordance with its requirements. It does not give out subtle hints. As Adam Berger said, "Any crack or psychological weakness, the market will find it . . . and will put a chisel in there and bang, bang, rip it apart."

When discipline breaks down and the trader's mastery of the game is called into question, he begins to use the language of death. Common descriptions of losing money include "getting killed" and "getting burned." These physical metaphors draw attention to the danger of close contact with the market. The break from discipline lends these losses moral meaning. One trader, David, described to me the unraveling of his proper trading technique:

> There have been [trades] that I just got killed . . . just everything goes against you. You sell it when you shouldn't, you buy it when you shouldn't, all day long and its a busy market, you're trading numbers you shouldn't, value down, trying to get it back, so you're trading bigger. When you have a profit, normally you'd get out, but because you're down money, you're trying to squeeze it, get more out of it. [You] turn it into a loser. Hate yourself. Hate yourself. Consumed with self-hatred. I'd still be down money but instead I tried to squeeze it for another five hundred and now I lost seven hundred. Hate myself, threw my pen. Oftentimes I'll throw my pen. Just hate yourself.

When he cannot manage his profit-making strategies and emotions with discipline, David's downward spiral of loss gathers force. The more losses he incurs, the greater his self-loathing, and the more losses he takes on. He is consumed by emotion and unable to divest himself with techniques of discipline.

Discipline is an ideal that traders work to enact. Yet even those who can successfully lose themselves in the market encounter significant obstacles to maintaining discipline over time. The greatest challenges to practicing disciplined trading are the pressures that impose themselves on traders from beyond the market frame. The strains of money and family tempt traders to allow their thoughts to wander beyond the market present and, therefore, to break the ethical imperative to separate economic and social spheres. Shaping the self into an instrument that can read and trade in the market is a vocational practice that is difficult and painful to maintain. Adherence to discipline waxes and wanes. Traders operate under the constant threat of losing their discipline and with it their focus and trading skills.

* CHAPTER SEVEN

Ambiguous Numbers

LIFFE's open-outcry markets opened in 1982. The wild behavior and spending practices of the mostly working-class traders became legendary as these "barrow boys" stormed the City of London.[1] In the pits the traders would scream out orders, cut deals with their buddies, scribble out completed trades on note pads, and verbally abuse the clerks who checked their trades. The clerks, knowing that many successful traders had begun on the lowest echelons of the hierarchy, hoped that someday they too would have the connections or the capital to climb into the pits. The trading pit was more than the social world of these rough-and-tumble traders. It shaped how traders perceived the market and, in turn, conditioned how they took action within it. The pit, in this sense, was a "means of perception" that structured how traders did their daily work to create circulation in financial commodities.[2]

Information technologies, like the pit, underpin traders' daily practice of economic judgment by shaping the available informational resources. Yet these foundations of financial knowledge and action are rapidly changing. New electronic trading technologies and all-digital exchanges are supplanting the traditional open outcry pits where traders meet to exchange contracts in financial futures. For traders, this shift from face-to-face to screen technologies has transformed the relationship between trading skill and exchange technology.[3] The screen changes how traders apprehend and interact with the market. Specifically, it reconfigures the embodied work, techniques for understanding the market, and material context of trading. In doing so, trading screens create new kinds of market actors. In the pits, the traders lived the markets in their bodies and voices. On the screen, traders *observe* the market and work *on* it.

This technological shift in financial futures markets displays the tensions between the technological creation of rational market players and the existing norms and practices of contemporary financial capitalism.[4] Futures traders using both technologies enact a specific form of modern economic

rationality that combines technological acumen with financial interpretation. Their actions are based on a form of reasoning that is far from strict calculation. Futures traders act under highly uncertain and rapidly changing conditions. Their techniques focus on creating fragile scenarios that account for constant shifts in the market. These scenarios identify the specific social information—the identities and patterns of their competitors—within the bid and offer numbers for financial contracts.[5]

Traders base their interpretations of financial conditions on the numbers that represent the market. Numbers are a cornerstone of economic calculation, the essential tools of rationalized action. Yet the practice of economic judgment in futures markets challenges this representation of economic action and requires a shift in the way we think about numbers. Numbers have often been considered elements of knowledge production that increase objectivity and certainty. The fluid numbers of futures markets invite us to examine the use of numbers more closely. Traders look for clues to the direction of the market by observing the numbers. At the same time, the short time frame of futures trading introduces a fundamental instability and uncertainty into economic judgments based on these numbers. The provisional nature of market numbers and the approximate character of traders' conclusions suggest that their practices are best characterized as interpretation rather than calculation. But scholarly theories of numbers and quantitative representation are insufficient to provide a full reading of the power of numbers in financial futures markets.

Numbers acquire the status of definitive statements through a process of "firming up," becoming, in their ideal form, stable in time and meaning and adding to a transparent presentation of knowledge.[6] These "firm" numbers that scholars point to as a foundation for accounting and scientific knowledge contrast with the fluid numbers of the pit and screen. Firm numbers work in the service of accountability and objectivity as tools of standardization and commensuration, establishing expertise and authority, making knowledge impersonal, portraying certainty and universality, and contributing to resolving situations of doubt, conflict, and mistrust.[7] In Mary Poovey's words, numbers perform ideally as representations of "non-interpretive facts." As stable objects, numerical units resist conjecture or theory and serve in the production of systematic knowledge.

The pace of trading in futures markets undermines this stability. Traders at the CBOT and Perkins Silver practice scalping and spreading that focus on the profits to be made within the daily fluctuation of futures markets. In these trading styles, numbers that represent bids and offers for financial contracts are the material traders use to interpret market conditions and orient their profit-making strategies. A bid is a price at which a trader is willing to buy a financial commodity, and an offer, or "ask," is the price at which he is willing to sell. In the CBOT's own account, these numbers represent the "needs and expectations of hedgers and speculators."[8] They are not established price facts. Rather, they are temporary assessments of market conditions, momentary markers of approximate valuation.

Bid and offer numbers surge into the market and fade away in instants. The tempo of the market speeds and slows as the number of contracts on bid or offer increases or diminishes and one set of possible trades slides into the next. The trader will not always "get 'em," or be able to turn his evaluation into a completed purchase or sale. He may add to or withdraw his bids and offers as time alters market conditions. Traders develop styles of interpretation that incorporate the fluidity of numbers at the same time that they construct explanations for market fluctuations.

The technological transition from open-outcry pit to trading screen reconfigures the foundations of market knowledge by changing the representation of the bid and offer numbers and how traders read them. Each technology represents the market in numbers, but the numbers are not all alike. The structure and design of the pits and the screen influence how traders apprehend and act within the market, shaping their techniques for managing quantitative information, for fashioning their calculations, and for understanding the dynamics of competition and emotion that are central to financial action.

Informational Transparency

Open outcry pits and electronic trading screens are information technologies shaped and constructed in accordance with particular ideals of economic information. The representation of market action—whether in the pit or on the screen—relies heavily on the capacity of numbers to convey abstract and objective information. Both trading technologies are based on highly rationalized techniques of exchange and information delivery. Modern financial markets build toward an ideal of informational transparency that presents market information as facts free from the distortions of social information. The numerical foundations of financial markets reveal a desire for "correct representations" of economic information.[9] By supplying these economic truths, market technologies lay the foundations for traders' calculations. In 1869 the CBOT introduced the pit to create a unified market space where all participants could see each other and hear all the bids and offers available.[10] About a century and a half later, designers of online trading systems have used technology as a tool to reshape traders' knowledge context. These architects of financial exchange deliberately distilled the

economic content of the market by removing the social information so readily available in the pits.[11]

The designers and the market managers who hire them rely on a narrative of rationalization that rests on a particular idea of the way that market data is constructed, transmitted, and received. In an ideal competitive arena, market information must have self-evident meaning. To achieve such "informational transparency," all information must be visible for interpretation. In the pit, this information is transmitted through the bodies of traders and received by their colleagues, who challenge and help them in face-to-face competition. The numbers shouted in the pit have this claim to "clean" representation. The designers of electronic dealing systems seek simply to "purify" the transparent representation that already exists in open outcry.[12] Alan Lind, an ex-official at the German-Swiss Eurex exchange and the designer of the Perkins Silver graphic user interface, championed the connection between technological rationalization and democratizing access to information. "The truth comes out in the electronic world. There are no physical crutches required." On the screen, a trader needs only eyes to read the market and a finger to click.

The presentation of the market as a set of numbers is critical to the production of informational transparency. But the visual and auditory contexts of open outcry pits create opportunities and ambiguities that are not present in the graphic user interface of a digital exchange offer. In the transition from the pit to the screen, the contrasting representations of "the market" demand that traders develop new strategies for using numbers to understand it.

In both technological contexts traders undermine the rationalizing effects of technology. The tensions between the rationalized technology and situated action emerge on the trading floor and in the dealing room as the social is displaced and reconfigured.[13] Traders search out social information contained in the bid and ask prices that anchor their knowledge of the market. They interpret the market numbers through the particular framing of each technology and thereby unearth the specific social dimensions of market conditions. Traders bring questions about the social content of the market to their calculations. Who are the competitors? What are their individual styles? Are they scared, stolid, eager, or anxious? Traders avidly pursue this information, and when it is not apparent, they often fabricate it. Social contextualization and interpretation are critical parts of a trader's calculations.

What constitutes "social" differs in the pit and on the screen. The technological context influences the scope and content of the social in economic life. In the pits, social information is founded in deep knowledge of the local environment. Traders organize trading strategies with the situations and motivations of their particular competitors and compatriots in mind. On the screen, social information arises from the landscape of competitors that traders imagine and identify within the changing digital numbers. These competitors are cloaked in the abstracted numbers of the market, but traders assign personalities and motivations to the characters behind them. In the London dealing room where I worked, traders did not construct these visions alone; they reached out to their co-workers to help them interpret the social dimensions of the electronic marketplace. Software designers may attempt to excise such information from their technologies, but traders create new social contexts to replace the ones they have lost.

The profit-making strategies of traders are based on the many-sided nature of market information. Through their particular technological framings, quantitative objects that seem straightforward gain a complexity that conveys information far beyond what they apparently describe.[14] Located in the interaction between the presentation of market data and the technology of exchange, the layered information of market numbers inspires each trader to interpret its meaning.

What Traders Know about Numbers

Traders in both open outcry and online markets exploit the informational ambiguities of numerical information.[15] The changing bids and offers of futures markets demand interpretive agility. Traders learn that numbers have contradictory roles in the market. Between the representation of the market and the decision to buy and sell futures contracts lies what traders "know" about numbers.

The first thing they learn is that numbers tell very little. Although the full number of a bond futures price is five digits long, traders use only the last one or sometimes two digits, playing the differences between fractions of a point in the price of a bond. Numbers, in this sense, are simply placeholders in a sequence leading from 1 to 9. Once the last digit of a price passes 0, traders refer to their bids and offers as 1s or 9s again without specifying the larger change. The number is only a symbol in a sequence that stands apart from its mathematical significance.

For short-term traders, larger numbers do not indicate potential for profits. Rather than always "going long," or buying contracts anticipating that the price will rise, futures traders play both the rise and fall of daily volatility. They can also profit by "shorting" the market, selling contracts in advance of a drop in price. If their predictions prove correct, they can then buy them back at a lower cost and pocket the difference. Traders have the opportunity for profit as prices ascend and descend the scale.

Traders know that numbers stand on their own without reference to

events outside the immediate bids and offers. Events external to the immediate market, such as rate cuts, election news, economic reports, or the intervention of a large buyer, can storm the market unexpectedly. The immediacy of the market dictates that attention remain on the bid/ask figures that represent the position of the market at that second. Outside news is supplemental to the information available in the bid/ask numbers. Traders can act with little information or understanding of the instruments they trade or the economic conditions of the countries that issue them. Government announcements are some of the most powerful forces that alter market conditions. A surprise intervention that occurred at Perkins Silver shows the attenuated connection between trading in second-by-second markets and the fundamentals of their underlying assets.

On November 3, 2000, the Perkins Silver dealing room was relatively calm. The market was steadily ticking up and down. Suddenly, shouts erupted from behind computer terminals as routine patterns snapped and the market for all European products spiked upwards. Traders who had bought contracts rode the move upward. Traders holding short positions cursed as the market pummeled their bearish expectations and forced them to take losses. The market move took only about thirty seconds but reversed the downward trend in bond prices denominated in the ailing Euro, which had dropped toward .80 to the U.S. dollar. Once the action ebbed and the traders had regained their composure, they leaned toward their neighbors and asked each other what had caused the move. The first trader to lift himself from his seat and find a terminal with a Reuters wire scrolled down the screen until a headline appeared on the electronic tickertape. It read, "C-bank intervenes in Euro." The traders buzzed about Citibank until an older trader pointed out, nonchalantly, that "c" bank meant Central bank. Although such a basic mistake would make any economist squirm, to these traders, it is immaterial if it is Citibank or the European Central Bank that takes action. The market prints the result before the news comes through the wires. Knowing the cause is more important for satiating an after-the-fact curiosity than for organizing market action. The news wire can supply the reason, but it does not necessarily cause the reaction or even precede it. All the necessary information for these second-by-second traders is in the bid/ask numbers.

Traders also learn that numbers have particular personalities and effects on the human mind. This is especially so for traders who practice "technical analysis." This interpretive strategy bases predictions of future market movements on historical trading patterns. Technical analysts are also known as "chartists" for their use of graphs and other visual tools that describe the past movements of the market. In technical analysis individual numbers gain strength or weakness, positive or negative potential, as points of support and resistance to the overall trend of the market. Numbers that halt a decline in the market are called "support levels" and numbers that "turn back a price advance" are attributed to powers of resistance. The numbers themselves in these statements are agents.

According to the book considered to be the bible of chartists, John J. Murphy's *Technical Analysis of the Financial Markets*, numbers gain further significance for technical analysts because "traders tend to think in terms of important round numbers, such as 10, 20, 25, 50, 75, 100 (and multiples of 1,000), as price objectives and act accordingly."[16] Traders invest these numbers with their own psychological significance and the expectation that these numbers are significant to other traders.[17] Numbers develop greater solidity as signs of support or resistance as more traders invest in a particular price area. According to Murphy, "The more trading that takes place in that support area, the more significant it becomes because more participants have a vested interest in the area."[18] The limited variation around a price defines a "trading range." Trades build up around the fair value, or modal price. When the market sharply departs from oscillation around the mode, or between points of support and resistance, technical traders call it a "range break" and seize the opportunity to buy into or sell that swing.

It is not only by watching investments at certain prices that traders assess the quality of a number. Traders identify the significance of an individual number as the depth of bids or offers builds up around a price. The larger the number of offers, the greater the expectation that the market will begin to decline in price. And the greater the number of bids, the more likely it seems that the price will go upward. Weighty numbers create an informational gravity attracting other traders to the price. For short-term traders, the perceived judgments of other market participants contained in the bid/ask hold an opportunity for making money. As critics of technical analysis point out, this continuous evaluation of others' perceptions of the weight of the bid/ask creates a self-fulfilling effect that validates the circular judgment of traders in relation to the numbers they trade.

Numerical information and technological presentation are intimately connected. Because the meaning of these numbers is flexible, traders use the context of the technology to tell them more about the numbers than they represent on their own.

In the Pit and on the Screen

Standing on the trading floor of the CBOT, a roar from inside the raised octagonal pits follows the opening bell. Traders stand in the tiered pits, each dedicated to a single contract—some based on the American Treasury bond

complex, others on the Dow Jones Industrial Average or other indexes. Individual voices pierce the din shouting "Fifty at three," or "Five for a hundred," indicating the quantity and price they are selling "at" or paying "for" futures contracts. Each call indicates how many contracts a trader is willing to buy or sell at their price.

These shouts—which represent a key technology of the open-outcry system—are the main mechanism for conveying bids and offers in the pit. The tiered steps of the pits organize the physical space of open outcry trading. Most important, the stepped structures create a unified space of financial competition where each trader can see and hear all the bids and offers in the market.[19] Every bid or offer is legally required to be shouted to the competitive market. In this regime of exchange, shouts are most often accompanied by hand signals. Hands turned toward the body, palms possessively pulling inward, show a desire to buy, and hands thrust forward, palms out, indicate an offer to sell. Numbers from 1 to 5 are shown predictably with the fingers on each hand extended upward and turned sideways to show the numbers 6–9. Zero is indicated with a closed fist.

In a simple transaction, a trader makes an agreement with another trader by meeting his eye in response to a bid or offer. The selling partner in the operation yells, "Sold." The two jot down the price, quantity, and three-letter code of their trading partner on a card, and each trader hands the card to his clerk, who will hunt down his counterpart and confirm that each party agrees that the trade took place.

By design and by regulation, all trades must enter into the space of competitive bidding and offering. Rules 332.01A and 332.00 of the CBOT handbook state that

> Bidding and offering practices on the Floor of the Exchange must at all times be conducive to competitive execution of orders. . . . All orders received by any member of this Association, firm or corporation, doing business on Change, to buy or sell for future delivery any of the commodities dealt in upon the floor of the Exchange must be executed competitively by open outcry in the open market in the Exchange Hall during the hours of regular trading.[20]

The accountability and competitiveness of the market reside in these shouted quotations. Any trades that happen beyond this arena, either outside of trading time or through whispers of trading neighbors, are illegal. Each bid and offer in the market must be outwardly presented for all participants to see and hear.

Physical strategies for delivering and receiving bids and offers in the pits are part of the traders' financial strategies. Delivering and receiving the bids

and offers of the pits are full bodily experiences that require stamina and strength. While there is only one ex–Chicago Bears player on the floor, many traders compete with him in size. Those who lack the natural stature of a professional athlete can visit the cobbler in the basement of the CBOT, who will add lifts to their shoes. Traders from the CBOT and the nearby Chicago Mercantile Exchange can be identified in the streets of the western Loop not only by the loud oranges, blues, reds, and yellows of their trading coats, but also by the extra inches of black foam affixed to the soles of their shoes.

A trader's physical location in the pit can limit or expand his access to other traders' bids and offers. Being seen or heard when they deliver their bids and offers to the market may be difficult or easy. Their sightlines may be obstructed by other traders or limited by their position in the pit, or they may have wide angles of vision, enabling transactions with a large area of the trading arena.

Because of the physical and emotional information conveyed along with the numbers, not all bids and offers are equal. Every bid or offer in the pits is transmitted through the voice and bulk of another trader. The numerical information cannot be divorced from the bodies through which it is conveyed and received. The tone of voice, the body language of the trader, who may be steadily and confidently holding his hands forward in engagement with the market, or who may be yelling his bids, spittle flying and eyes wide in desperation to get out of a trade, are crucial inflections that traders draw on to form market judgments.

In a pit bursting with six hundred screaming traders, a trader's skills and calculative repertoire require physical and emotional techniques for transmitting and receiving market information in the pit. Leo described training himself for the vocal and emotional demands of open outcry trading: "When I first got in the business, I had to go in front of a full-length mirror every night and practice screaming, looking at myself."

The intricacy of physical strategy in the pit becomes particularly clear when smaller traders must compensate for their stature by manipulating other resources to get the attention of potential trading partners. It is not enough to be on the right side of the market; each trader needs to attract the others' attention—to have another trader *receive* the numbers they shout into the market. Victor, an ambitious young broker who is physically short and narrow, described how he creates a presence in the pit that will attract attention to his bids and offers:

> Voice is number one. . . . You have to be a controlled loud. You can't be like a panic loud because once the panic comes out of your mouth, you're pretty

> much admitting to whoever wants to assume the other side of the trade with you that that's not a good trade. . . . Tones of your voice are very important. A lot of guys have higher voices, . . . and they can really be heard throughout the pit. . . . A lot of it is hand gestures, being able to kind of like offer your hands out at just the right pace to catch people's attention. . . . Sometimes it's jumping up. People watch me sometimes when I start to catch air, and they go, hey, there's Victor, you know, bidding them.

In addition to orchestrating the presentation of bids and offers, timing the delivery is key. Victor described how he attracted the attention of one of the "big dog" traders:

> Just at the right time, I mean literally it was within a second, a split second. I literally caught a little pause in his offer where he was just kind of looking in all directions. I just happened to jump and bid and scream at him at literally—I mean I'm not even going to say tenths of a second—I'm going to say hundredths. . . . If I didn't jump and jump a foot and a half off the ground and bid fours at that guy just as I did and the way I did it, he wouldn't have seen me.

The presentation of market numbers in voice forces traders to cope with the immateriality of the bid or offer. A number is rarely shouted once. Because each bid or offer hangs in the air for only a second, the trader barks the number into the pit repeatedly to make sure he is identified with it. At the same time he holds out his hands, fingers extended into numerical signals, to bring a concrete visual presence to his bid or offer. The sounds of repeated numbers form the cadence of the market and can convey urgency or boredom. In receiving the numbers that others bring to the market, traders appeal to "feeling." This word, encompassing all sensory information, is one traders use to characterize their knowledge of the market.

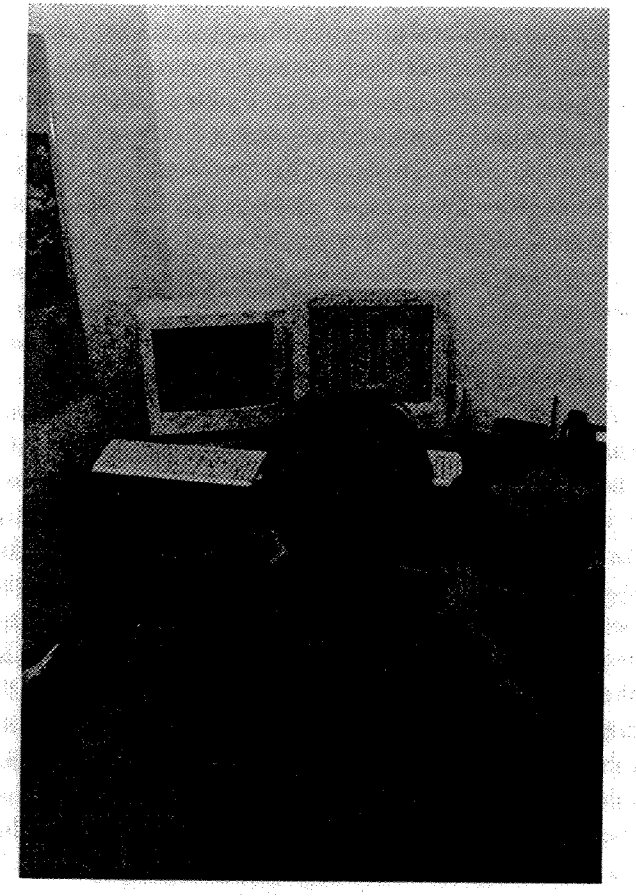
The body is a key interpretive instrument for the pit trader. Listening to rhythms of the numbers as they run in the pits leads traders to judge the market as "heavy" or "light," likely to rise or fall according to their sensory estimations. Beyond creating the basis for individual traders' economic judgments, the ambient noise of the pit affects the market as a whole. Economists studying the CBOT pits found that increased sound levels lead to higher trading volumes and foreshadow periods of high volatility in the pits.[21] But just as numbers cannot be divorced from the bodies that deliver them, noise cannot be divorced from the numerical content that it conveys. Traders monitor the changing bids and offers of the pits through their eyes and ears. Numbers, in the context of the dense arena of exchange, produce emotional states in the traders that shape their predictions. Rather than functioning as obstacles to rational decision making, these signals work on an intuitive level as a central trading tool. Traders see formal calculation as a hindrance to their job and to their ability to react. In training their bodies to be both receiving and delivery instruments for the underlying information of market numbers, the first step is learning not to calculate.

Sean Curley Jr. assessed the effects of his legal education on his habits of mind and trading practice: "I am prone to get set in my ways. I'll reason to a particular conclusion based on assumptions that I've got built into the market. . . . Just like I'd craft an argument. I'm crafting a plan, and then all of the sudden my plan is this, and, boy, the market had better listen." It rarely did. Sean's deliberative skills led him to conclusions that may have been theoretically correct according to the system he had established, but in formulating arguments, he lost the ability to play on the indeterminacy of market movements. Explicit construction of logical systems inhibited his ability to adapt his positions to rapidly changing market conditions. Leo says, "If you start thinking too much during the course of the day when the battle is on, it is really a disadvantage." Jack added, "It's just like you're in there and, you know—like, sometimes you just don't want to be buying or you don't want to be selling. I presume, like, you could figure [some things] out after trading off the floor for a long time and really watching things and charting—but nothing like knowing—nothing like standing there and having that feeling." The immediacy of the market requires traders to interpret every present moment. Perceiving and interpreting sensory cues in both delivering and receiving numerical information in the pit requires all a trader's wits and physical skill.

In contrast to the overpowering sensory information in the pits, screen-based technologies actually narrow the scope of information available to traders. The representation of the market as a set of changing numbers on the screen is the primary source of information for traders in electronic markets. At the same time, traders try to gain contextual clues from other traders by calling across the dividers that separate them, offering interpretations of market movements. In addition to drawing contextualizing interpretations from their co-workers, traders search within the numbers to find social reasons for the movement of the market. They craft identities for their competitors and construct motivations for these illusory actors in the online arena. Fashioning a social narrative for abstract information helps traders create understandings of market fluctuations that direct their decisions to enter and exit the market. Traders create stories around the shifting direction of numbers that many economists consider a "random walk."[22]

The E-trader graphic user interface is the point of contact between Perkins Silver screen traders and the market. The interface refines the rep-

resentation of the market in numbers. In his design, Alan Lind, the creator of E-trader, framed a numerical and visual representation of the market.[23] Fulfilling his role as a "pragmatic technician" of economic rationality, Lind's design cleaves to the dictates of informational transparency.[24] The interface design presents all market action and information as if available in plain sight, introducing the closest thing to a noninterpretive format possible. It pares market data down to a minimum—boldface numbers in rectangular boxes. Lind's central concern was to use the design to reduce the distance between the trader and the market. For him this meant assembling the simplest visual cues to represent market action. The outward simplicity of the user interface illustrates its numerically rationalized representation of the market.



7.1 In a private office in the CBOT building, a floor trader examines the market on screen. Photo by Bob Davis.

The interface organizes the market for each financial product into a vertical or horizontal strip. The trader can drag each block to drop it where he likes it on the screen next to a record of his filled orders, a record of all the orders he has placed in the market, and the box that displays profit and loss (P&L). A casual glance at a trader's screen can show if he has made or lost money that day. If the numbers in the P&L box are a profitable green, then he is up for the day. If the numbers are red, the trader often slides the box off to the right of the screen so the numbers are invisible to him and any curious bystanders. The most important information, the bids and offers and the "depth" of the market, that is, the number and the price levels of bids and offers, are shown in black lettering against blue and red backgrounds.

This spare visual depiction embodies a commitment to reducing the intermediation between trader and market and to providing a simple and unadorned numerical representation of the market. The use of numbers as a means of transparency draws the trader toward a distilled idea of the market where disembodied actors display supply and demand for futures contracts.

This attempt to reduce the interface to bare, numerical representation shapes the traders' informational environment by elevating numbers to the status of the market itself. Numbers gain a synecdochical power in their relationship—the price stands for the market as a whole. On the interface, numbers that represent the bids and offers are supposed to raise all hidden information to the surface and deliver the total market information. In a sharp break from the complex information system in the pit, where fathers and sons, friends and allies passed information through tightly controlled networks, the interface displays the market in terms available to the eyes of any trader with access to the screen. In addition to overcoming social and physical distance between actors in a global network of exchange, numbers are, in Lind's design, a technology of proximity drawing traders toward the market.[25] Lind's strategy endeavors to cast aside the intermediation of the social information of the pits to present "pure" information, based on a representation of the market in numbers.[26]

Lind created direct contact between traders and market information through the numbers of his interface. As he explains, his plan was to "strip down the chassis" of the exchange technology.

> [Traders] don't care about German economic status or European economic status. What they're looking at typically are numbers. They're trading numbers, using numbers to make decisions all day long. I would say that it's like a motor racing driver that doesn't look at the scenery as he's doing two hundred miles an hour going down the track. He's looking at the hazy outline of the road. He's looking at the numbers on his dial. That's it. He's focused.

The organization of the trading industry places many intermediaries between participating traders. The mechanisms of exchange are located in the clearing firm, the material technology itself, the CBOT and Eurex, and their programs for completing trades. However, in the technological framing of E-trader, these intermediaries become virtually invisible, producing an experience of direct connection between the trader and the market.[27]

The technology of E-trader holds the informational frame steady while it delivers the constantly changing bids and offers to the trader's eyes, fixed inches from his screen. Using this data to form interpretations, the electronic trader can leap into the market with a click of his mouse. Understood in terms of informational transparency, the design works to eliminate not only institutional intermediaries but also intervening tools of evaluation. As Lind explains,

> [I want to communicate] ultrafast prices. In other words, I want to show you the real market quicker than anyone else so that you can make the decision to trade. I'm not going to give you analytics, fancy recommendations, because my recommendations may need some explanation, or they may need to be mathematically complex. . . . The Spartan approach with technology today is still the best one. Keep it down to the absolute minimum; get rid of the stuff you don't ever look at. . . . Only observe the market that you want to.

Lind created a system of information delivery that provides austere data about bids and offers. While reducing the market to a few printed numbers, he also opened the possibility of interpretation based on the very simplicity of the interface.

In the dealing room, Alan Lind's design becomes part of the training methods of the Perkins Silver managers and the daily practices of Perkins Silver traders. To enter the dealing room floor, traders pass through three doors leading from the elevator bank. At each door they swipe their key cards through a security lock. Swaths of gray dividers partition the trading space. Each bank of trading desks is split again into four workstations, personalized by bits of decoration that are pinned to the fabric walls. Light filters through the cloudy London sky, supplementing the blue-tinted glow of the computer screens. A beige, plastic-encased terminal sits at the center of each trader's desk. A thin layer of glass screwed to the monitor shields the trader from the screen's radiation.

A walk down the left-hand corridor of the dealing room reveals images of soccer-club posters, hot cars, babies, and girly pix. Traders program their computers to make a noise when Eurex, the German-Swiss futures exchange, has filled their trades. During busy markets, tinny computer speakers fill the room with the simulated sounds of breaking glass and ricocheting bullets.

Here, the Perkins Silver traders and managers brought Alan Lind's spare, silent numbers into social context of competition both inside the dealing room and beyond it. The managers tried to supplement the weak sensory information available through the interface with a program called Market Sound that augments the visual data of the screen. This software replicates the aural dimensions of the pit by recreating ambient noise levels linked to the size of bids and offers in the market. A trader can hook into the program by plugging an earpiece into the speakers on his computer. Hardly any of the traders used it. The algorithm that replicates the noise of open outcry trading recreates only a sliver of the total body experience of the pits. Although there are demonstrated effects of noise on trading activity in the pits, without the context of face-to-face interaction, the noise of Market Sound was more distracting than illuminating to the screen traders. The sort of sensory information helpful to pit traders' interpretations was inappropriate to the context of the screen.

Despite the raucous atmosphere, the Perkins Silver managers insisted on discipline from their new recruits. In our logs, we kept an abbreviated record of our trades. Some excerpts from my own trading journal, which documents part of a morning's trading activity, show the focus on the patterns and rhythms and the problem of learning to make sense of the numbers.[28]

> Trying to go long the spread at 7 or 8.
> Long at 8.
> Very slow moving—trying to sell 9 now 0 after shift in Bobl.
> Back to 9s, out at 9.
> Looks like the spread is moving down. Bobl moving up again. A steady Schatz.
> Bought 62s
> Going 1/2/3 seems like upward pressure.
> Scratched.
> Buying the Spread at 61, Spread 0/1/2
> Bought 9s trying to scratch
> Bought 0s

These spare representations show the trader's focus on numbers.

Some other cues were available that oriented us to the direction of the market. For example, at the same time that the other new traders and I were developing our basic trading skills, we were learning to develop a narrative

around the patterns of the market by listening to the calls and responses of the more experienced traders. Market chatter is an important device for interpreting market fluctuations, despite the ephemeral nature of the conclusions that arise from it.[29] The importance of market chatter lies in the collective construction of unstable interpretations. These weak narratives supply interpretive logics for the market's movements.

Jason and Paul were the most prolific chatterers in my cohort. In a process that was at once competitive and cooperative, they exchanged commentary and tips back and forth across the aisle that separated them. They assessed and reassessed the market's movements in relation to their positions. "I'd get out of there, the bid's about to disappear." "The offer is weak." "The Bund is moving, watch out in the Schatz." They commented on the pace and depth of the numbers, trying to evaluate the forces shaping the rise and fall of the digits. Market chatter could not produce a definitive explanation of the action on the screen; the uncertainty and instability of the commentary paralleled the constant fluctuation of the market.

Traders compare positions with each other, or simply tell other traders their positions to confirm their decisions or seek help in recalibrating their interpretations. This information is not usually shouted across the room, but shared between traders at the same desk. At the desk across the aisle from me, Freddy was flailing through the transition to screen-based trading. The three traders who shared his desk were helping him sharpen his skills at interpreting the market. They identified actors and significant changes in the market. They showed Freddy how to spot big traders by watching how the bid/ask increased or decreased. If a big trader changed his opinion of the market's direction and moved his orders, the bid number would drop by a large, round amount, such as 500 contracts. The more experienced traders encouraged Freddy to accumulate knowledge of the strategies of other players in the market by watching the changing quantities. Jason and Paul picked up on their remarks and discussed them between themselves. The chatter at the desk helped Freddy, Jason, and Paul to form their own interpretative strategies.

Market chatter does not always help the traders who listen to it. It can be used as a tactic to undermine others' confidence. The confinement of an individual to his own screen and the faceless nature of screen-based trading create opportunities for savvy traders to supply misinformation to the room. A trader can misrepresent his interpretations in chatter to gain information about the others' positions and opinions. Martin, the object of envy for most Perkins Silver traders, fed his co-workers his own exaggerated reactions. He would gasp as if his gains had been decimated by a market move only to reveal minutes later, as he headed triumphantly out the door for the day, that

he'd pocketed enormous profits. He faked panicked reactions to market events, hoping to fluster the other traders into chattering about their own positions. His status in the room meant that his opinions could confirm or cast doubt on the other's abilities to read market action.

Despite hints available in the environment of the dealing room, the information on the screen was the focus of traders' interpretive energies. This absorption is pronounced in Perkins Silver's Chicago dealing room. Joshua Geller called me in, worried that the London room had given me a distorted picture of the market chatter and the social nature of online dealing. When I arrived at the Chicago office, he led me to the trading floor, where about thirty traders sat in silence staring at their screens. "I try to get them to make some noise," he told me, but their attention was concentrated on their screens. During my visit, Alan Greenspan was scheduled to talk to Congress, and Geller turned on the trading room television set. The traders shrieked at him to turn it off and then compromised on a lower volume.

For both the London and Chicago screen traders, the majority of players with whom they exchanged were outside the Perkins Silver room. Online traders' individual actions are represented in the aggregate numbers of the bids and offers, which narrow the opportunity to understand the intentions of particular traders. There is no access to individuals' strategies that traders can leverage for their own profits. Yet the social context of competition is crucial to traders as they form narratives of market action that offer an explanation for the market's behavior. When denied the social information of competition and strategy so easily available in the pits, the Perkins Silver traders constructed social scenarios to explain the movements of the market.

The Perkins Silver traders learned to look for signs of key players hidden in the rhythms and sizes of the changing bids and offers. The traders at Freddie's desk were trying to help him notice and collect this kind of information about the social content of the market. These characters are usually types constructed on the basis of trading styles and risk-taking strategies. Traders locate these characters in the swiftly moving bid and offer numbers, creating a conceptual sketch of the market as a field of specific competitors. Drawing this field establishes a narrative space of competition into which they can insert their own strategies.

The most persistent character was called the Spoofer. The Spoofer used large quantities of bids or offers to create the illusion that there was more demand to buy or pressure to sell than the "true" bids and offers represented. The Spoofer manipulated the weight of the numbers to force the market to go in his favor. Traders learned to identify a spoofer by watching changes in the aggregate number of bids or offers on the screen, creating a novel strategy for profit. By riding the tail of a spoofer, a small trader can make money

on market direction. Traders who dealt in large contract sizes aspired to "take out" the Spoofer by calling his bluff, selling into his bid and waiting for him to balk. There was great symbolic capital attached to "taking out" a Spoofer by matching wits with this high-risk player. It showed the prowess of a trader in one-on-one combat.

Eliminating the Spoofer has the effect of enforcing the informational transparency of the bid/ask numbers. Although there was nothing illegal about a Spoofer's maneuver of supplementing the numbers with the weight of his bid or offer, he undermines the verisimilitude of the bid/ask representation. The Spoofer attempts to post bids and offers to manipulate the market, an intention that disrupts the abilities of other traders to interpret market numbers with their usual tools. The trader who takes out the Spoofer returns the market to the "true" bid and offer by eliminating the distortion. With the Spoofer eliminated, traders can once again use their interpretive techniques with confidence.

The social information that traders construct is not limited to identifying individual actors and their strategies. Traders considered the market as a whole to have convictions and sentiments. They searched within the numbers to understand these states of market affect. For Perkins Silver traders, the first task of the morning was trying to understand the mood of the market. Traders approached this understanding by "testing" the market. They sold into the bid to see how easily the market would absorb their trades. A market with strong conviction could absorb the pressure from the sale without a shift in the bid/ask, supporting their conviction that their interpretation of the market was correct. They were willing to ignore a signal that another trader believed the market would fall. If the test did not change the composition of the bid/ask, the trader sensed confidence that the market would rise. He would likely buy contracts in anticipation of this climb. If the other traders immediately withdrew from the bid, the Perkins Silver trader would have less confidence in his interpretation that the market would rise.

Traders took short-term losses to make these tests. But the managers of Perkins Silver valued gaining information about market sentiment with this method. They trusted it would help traders make correct interpretations of the market's direction and, therefore, secure profits. Andrew Blair said that he was always nervous if he saw that the company was making money in the early hours of any market. Traders must "pay the price of admission" to understand what lies beyond the surface representation of the bid/ask.

Losing money to gain information was not unique to the morning test. A trader who bought a large number of contracts in expectation of a market rise was said to "get run over" when the market reversed its direction. But such losses were not entirely negative. A loss produced by a strong trend

could signal the market's sentiment that the contract was overpriced. The trader might then find an opportunity to take advantage of this information. Joshua Geller believed that losing money to the market provided a "free look" at dimensions of the market that were not visible in the numbers. The market might be skittish or stolid, immediately giving in to pressure to sell or standing firm. Such metaphors expose the contradictions within the ideal of informational transparency. In the methods Joshua taught, traders used the numbers presented on their screens to unearth information about the strategies and characters that populate the market. Although their interface reduces the market to a set of visual cues, traders can use the patterns of the market and strategies for gathering social information to understand more about the bids and offers than the numbers alone can show.

The ideals of information systems designers and financial exchange managers fit neatly with familiar narratives of progressive rationalization. Yet there is reason to be suspicious of this neat fit. Traders' uses of information technologies can break down the analytical complicity with economic discourses of standardization, depersonalization, and technological rationality. As users of numerical representations, traders combine abstract information with social narratives. In other words, they search out other individuals to compete with, both in the numbers and in their trading room. At the same time, discourses and strategies of rationalization are fundamental elements for the design and implementation of information systems and financial markets. Numbers operate as critical materials for rationalization, but they are not always used as the system designers intended. Traders who use financial technologies do not perceive numbers as objective descriptions of supply and demand. In both pit and screen formats, traders find a patterned logic in the movements of market numbers by identifying competitors around whom they generate specific strategies.

The meaning of numbers must be understood within the specific context of their simultaneous production and consumption in financial markets, and within the technologies that present them. In the context of both open outcry and screen-based technologies, traders seek out nonquantitative information in the market numbers. In the new digital context, the social dimension is a market element to exploit for profit, and traders search it out where there seem to be only non-interpretive facts. Traders prosper from understanding the layers of meaning that lie between market numbers and their material presentation. The transition from pit to electronic trading creates a new informational matrix, and each technology demands competence in different skills of interpretation.

Flexible interpretation rather than formal calculation characterizes the styles of reasoning common in financial futures markets, both in the pits

and on the screen. In contemporary trading rooms, sentiments, actors, and market numbers are always in flux. The technological presentation of the market provides a context and establishes the parameters of financial knowledge. Searching for the hidden values and phantom figures that lurk behind the numbers is the anchoring activity in a global marketplace where the only certainty is instability.

* CONCLUSION

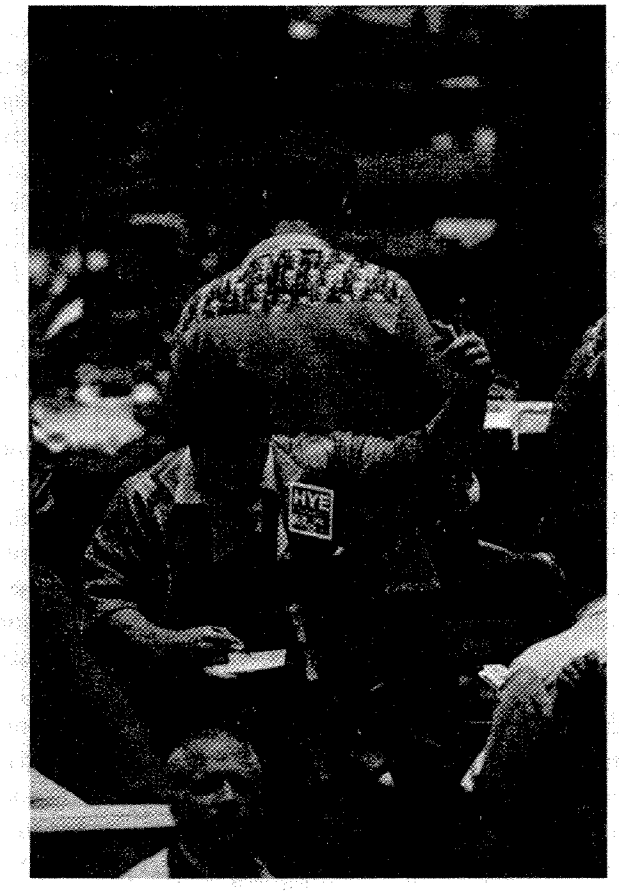
Practical Experiments

During my last visit to the trading floor, the bond futures pits stood half empty. The thirty-year T-bond is sleepy compared to the days when I began my fieldwork in 1998. Many traders had moved to the busy ten-year pit, and many others had left the floor altogether. The traders who continue to work in the pits, whether ten-year or thirty-year, suspend computer notepads from their waists to work both the online and pit markets simultaneously. Traders no longer have to compete for spots, and they leave their thick-soled shoes at home in their closets. David, who first introduced me to the CBOT, told me flatly, "The physicality of the pits is gone. You can't trade in here without a computer." David still works in the pit, but he rarely lifts his head from his monitor. With ears open, he can glean a certain amount of "feel" and the important information that the pit has to offer: who, exactly, is buying and selling. But for David, simultaneous trading in the pit and on the screen has caused problems. He pulls two trading cards out of his pocket and points to a number, 159, that he has labeled "pit." The number is matched by what he has traded on the screen. He is flat, with no outstanding trades for the day, but he is uncomfortable with the arrangement. "One-fifty-nine is kind of a weird number," he tells me. It is not a round number, and he sees it as evidence of the disorientation produced by trying to work across technologies and different visions of the market: "I sold three in the pit and bought one on the screen. Then I sold eleven in the pit, so I was short fourteen in the pit and long one on the screen. It's hard to keep track."

Today, the market exists somewhere between the pit and electronic space. The traders' hand-held devices provide a window into the online world, even as they stand in the pit, but the shift to the screen is almost complete—only about 5 percent of ten-year contracts change hands on the trading floor. Many locals have left the pits to trade in offices or in boutique firms established to house the ex–pit traders. Echoing the logic of technological

rationalization, David says that there is no longer any advantage to being in the building at all.

The shift to the screen was not the first time that CBOT had been through the process of rationalization. As we have seen, the organization has a long history of aligning technology and market practice in an effort to remove social connections and cultural life from markets. During the construction of the 1930 building, as well as in the transition to electronic trading, managers and transnational trading firms worked to extricate the market from the web of personal relationships. Although social ties create the basis among traders for understanding and analyzing the market, the effort to create spaces, technologies, individuals, and representations that express pure market reason is a key part of the rationalization process. Whenever market designers



C.1 A pit trader watches the online market on a monitor hung around his neck. Photo by Bob Davis.

C.2 The pits, once teeming, now stand half empty. Photo by Bob Davis.

move to rationalize the marketplace, traders work to resituate rationalized information within their distinctive ways of understanding, interpreting, and calculating.

The interplay between these two sets of economic rationalities and professional sensibilities drives a process of creative destruction in market forms. The shift to the trading screen, however, was the first technological change to threaten the existence of the Chicago nexus. Online technologies created the possibility of a decentralized marketplace that stretched the institutional fabric between cities and forced managers and designers to reinvent local trading styles for the increasingly global exchange. The CBOT, like so many institutions of capitalism before it, is now endangered by the dynamic system that it has worked so hard to produce.

To managers, designers, and traders in the financial arena, the contemporary markets pose the question of how to create fields in which competitive individuals can operate with what Max Weber might have called a "thorough market freedom," a space where autonomy in judgment and action facilitates competitive struggle. For Weber, as for contemporary market champions, autonomy means that the participants orient themselves only to the thing being traded—the commodity—without "obligations of brotherliness or reverence, and none of those personal human relationships that are sustained by personal unions."[1] Creating autonomous market spaces depends on a commitment to separating the trader from the ties of family, friendship,

place, and work; it is, therefore, a political as well as an economic process. An individual is to be measured solely in terms of personal achievement, not by the conditions of collective work life. However, there is no clear way to establish the conditions in which economic competition and individual action are possible. The "rational, purposeful pursuit of interests" that marks the autonomous economic sphere is not a natural tendency, but a project that requires strategic construction, constant vigilance, maintenance, and repair.

The everyday work of rationalization in financial markets takes the form of "practical experiments," projects in which the goals of economic rationality are brought into line with the existing and evolving social forms of market action. The experimenters—architects, CBOT managers, software designers, online dealing-room managers—work to align ideals and material realities. In particular, the experimenters align the technological and social infrastructure of the market to create conditions in which traders can become more detached observers, providing distance from the heat of exchange that facilitates calculation based on pure economic information. The experimenters conjure images of an observable market, the conditions of observation, and the individuals who will conduct rational evaluation.

These experiments are never binding and rarely durable; they remain provisional, often ad hoc, and constantly under revision. Yet market designers remain devoted to the challenge of creating institutional conditions and fostering professional habits that promote virtuous economic action. They manipulate the materials of market rationalization—space, technology, social composition, the self, and the representational order—because the success of the exchange or firm hinges on how well all these components are organized. The challenge, though, is that it is never clear exactly how the designers can bring market spaces, whether physical or digital, in line with economic norms. Consider some of the projects we have seen: the new trading floor of the 1930 building; the practice of seeding the London trading pits with Chicago traders; the Perkins Silver dealing room, built around the principles of multiculturalism. These are all practical experiments in market rationalization.

In these projects, managers and designers work with unstated notions about how individuals make decisions and take action in market environments. This everyday labor of rationalization is one of the key elements of contemporary economic life that departs from the economic and political engineering of financial systems.[2] Weber had a label for experiments like these: they are attempts to produce the "substantive conditions of formal rationality," intended to create a material and social form in which individual calculation and competition can operate as fully as possible and autonomous

economic action can flourish. Yet if, on the one hand, this form of market rationalization seeks to eliminate the social from the market, on the other hand, it manipulates the social to fashion what managers hope will be an autonomous market. In this sense, the materials of rationalization are both human and technological, shaped by social labor and the culturally organized preferences and practices of the same actors they are designed to constrain. Moreover, such work is never quite finished: there is no end to the process of producing the conditions of formal rationality.

Nonetheless, the long-standing and ever-changing project of creating purely economic spaces is not merely a fantasy. The drive to improve the conditions of economic action leads to the making and remaking of new technologies, reformed rules, creative calculative practices, and emergent classes of professionals who bring the market into being. Design is central to establishing a formal order that can influence economic action. The transformation of futures trading from the pit to the screen and the extension of Chicago-style trading practices to London markets demonstrate that there is nothing self-evident about how professionals create the conditions in which calculative actors can emerge, even in domains that we think of as the most formally rational. The labor of creating a market takes unexpected forms, from constructing bridges in Chicago and planning the architecture of a trading floor to the rationalizing of personal conduct through discipline.

Ultimately, financial markets are social and technical fields—groupings of actors, both collective and individual—held together by material technologies, the problems of risk and circulation that they address, and by competition for profit.[3] In financial markets, the overarching problem is circulation—how to produce consistent circulation in markets that professionals call "liquid," while arranging a field of action designed with regard to economic norms—particularly, how to make profits from individual competition. Within these markets, organizational arrangements and collective expectations about individuals' behavior, or norms, work in tandem with exchange.

Financial markets pose a series of problems to designers and practitioners. Focusing on these problems highlights how markets work in practice, how traders and managers think they *should* work, and what kinds of new arrangements exchange managers, traders, and the technology professionals they hire generate in the interplay between practice and normative ideas about markets.[4] These problems are not simply economic; they are, in important ways, frames for political engagement as well. Once a problem is defined, it creates needs, attracts resources, and draws attention, as we have seen with the struggles of the CBOT over electronic trading. The world's financial exchanges are organized around a constant and evolving series of problems that market managers must solve. Formal economic theories

often inform solutions to these issues, shaping the financial field in their image.[5] However, the executives in charge of managing these markets are not often academic economists; rather, they are technicians who translate general ideas into practice, tweaking economic ideas as intentions come into conflict with existing techniques, technologies, and forms of exchange.[6] Theirs is a stripped-down approach to making things work, concerned with theory or system only when those are essential to its operation. This approach is itself meaningful, driven by constant calculation, judgment, and assessment of profits and people—it constitutes the cultural life of contemporary economies.

At both the CBOT and Perkins Silver, managers and traders attempt to solve problems in market action by shaping five elementary forms of financial life: space, technology, social composition, selves, and representation.[7] To conclude, then, I return to these elements and consider what an anthropology of finance and exchange helps us learn about them and, in turn, about the culture of markets.

Space

The problems of arranging and profiting from financial circulation immediately raise the question of geography. The rhetoric of globalization has taught us to think about financial markets as generators of flows that cross national boundaries. The spatial arrangements of global capital exchange involve both the possibility of and conflict over practical experimentation. Historically, the city has been the site of capital markets, and the work of rationalization has focused on drawing commercial space together through the development of a central place, or urban nexus.[8] In the nineteenth century, Chicago grew to be America's primary capitalist city as it drew together western agriculture and the eastern market with railroad tracks and shipments of grain and meat.[9] The CBOT was instrumental in developing the hub city by orchestrating the physical development of the harbor and roads that channeled Chicago's commerce. Ultimately, however, the CBOT's major innovation was to replace the movement of goods with the movement of money, drawing participants and information together in the trading pit that its managers designed and redesigned to create better conditions for competition. By creating open sightlines and good sound conditions in the space of the trading floor, designers engineered a physical field that minimized the benefits of cliques and heightened the importance of an individual's speed and acumen. The plan was to atomize traders and generate autonomous, rational, calculative actors. Immersed in the crowd, each speculator was to operate alone.

Within the pit, however, the whirl of speculation remains entangled in the social network of traders. The stepped rings of the pit defined a space where relationships of obligation and reciprocity between traders were put to work and where information about financial commodities was evaluated and solidified into a price. The social organization of the marketplace became a central feature in traders' strategies, and deciphering the cultural life of the pit was a necessary first step for anyone who wanted to work in the exchange. The pit structured traders' daily economic actions by reliably producing liquidity. As a trading technology, it was successful enough to command the allegiance of the CBOT's membership when electronic trading appeared. Over time, as we see now, CBOT traders defined themselves through their relationship to open outcry and the physical space of the pit. It became their symbol, the official icon of their organization, and many of its participants fought to maintain the pit when electronic systems transformed other exchanges.

Now that futures markets are electronic, they continue to be based in cities, yet traders who work together in digital dealing rooms and encounter global markets through a screen have developed new techniques of calculation and new understandings of the market. For market designers, the rise of digital dealing has renewed the challenge of organizing the space of the trading room, which is focused now on the screen rather than on face-to-face interaction. For market managers and city officials, the transformation of the market poses a new question: How can they retain their protected marketplaces and sustain the presence of financial organizations in their cities when new centers are competing for a slice of the action?

In electronic markets, a new sense of space emerges that unites locations that share digital circuits rather than adjacent land.[10] Up-to-the-minute technologies, the newest financial products, and the sharpest economic talent intersect in productive and sometimes reckless ways.[11] Circulation happens as capital moves from place to place, but some cities have greater roles than others. Especially in New York, London, and Tokyo, highly educated workers produce, analyze, and trade on information that drives the global economy.[12] These are capitals of finance and producer services, like law and accounting. But other cities, like Chicago, have more specialized roles.[13] Clusters of urban centers emerge as significant sites for some interests.[14] Futures markets bind Chicago, London, and Frankfurt together through ties of technology and trade. These cities house both major exchanges and traders who deal in the others' markets. The exchanges wrangle over if and how they should engineer these connections. For instance, members of the CBOT and LIFFE have direct access to all of each others' markets, a deal that they struck after a similar alliance between the CBOT and the German-Swiss

exchange, Eurex, fell apart. Each alliance is forged through a complex process of political negotiation between exchange officials and the regulatory bodies that coordinate economic activity across national borders. In the case of the connection with Eurex, the exchanges fought over the technologies for connecting the two exchanges. Although technology provides the infrastructure that makes these alliances possible, it is the struggle over potential alliances and the arguments over the use of new equipment and techniques that ultimately shapes the network.

But even as markets move online, traders continue to do business from their desks in the world's financial centers. The global network does not end the importance of the city; rather, it raises new questions about how cities influence online action. Most important for our story, the trading techniques developed in Chicago now form a common reference for understandings of risk and norms of conduct in the global futures market. The members of Chicago derivatives markets have worked with their counterparts in other financial centers to spread Chicago-style trading. But the Chicago forms are not simply reproduced elsewhere. They are taken up and transformed as they are refracted through local styles. These transformations have serious consequences for cities. Chicago has long been the leader in derivatives markets, but since electronic trading has threatened to circumvent the Chicago nexus, its exchanges are fighting to retain their city's place among the global players.

Socio-Technical Arrangements

Markets are arrangements of technical devices, such as the trading pit and telephone; techniques, such as the bodily postures that traders master; and institutional arrangements, such as the design of the Perkins Silver trading room or agreements for trading and payment with the German-Swiss exchange Eurex. Technical devices such as computer screens, which may seem freestanding, always operate in relation to human skills and institutional contexts, giving managers and designers the opportunity to organize their use.[15] Through a messy set of cultural and political processes, the managers and designers plan and orchestrate the elements of socio-technical arrangements that encourage individual calculation and competition.

Fierce debates over the prospects of Chicago's futures markets involve two socio-technical arrangements: open outcry and digital dealing. The particular arrangement of the open outcry system features many diverse elements: the architecture of the trading pits, the bodies and voices of traders, traders' social hierarchies and the skill of exploiting them for profit, the structure of the CBOT building, and the structure of the Chicago Board of Trade itself

as a membership organization. The elements of digital dealing, however, are more difficult to delineate. Although the material connections provided by fiber-optic cables that channel the electronic impulses of individual trades are important, I have concentrated on the trading room, where speculators act. The view from the dealing floor amplifies several elements: the social composition of the trading room, the skill of reading a social field from a computer representation, and techniques for constructing information among traders in the dealing room.

The shift from face-to-face to online markets requires that managers, designers, and traders answer questions about who should be included in the collective constitution of the market and what kinds of faculties those individuals should have—both at the level of their trading rooms and on the scale of the global marketplace. With the transition from pit to screen, traders could no longer embody the market. In digital dealing, the market develops a material reality on a computer screen that traders can observe. Each trader's relationship to the market requires social, personal, and calculative capacities, some of which are incommensurable across technological contexts. As the new cultures of trading evolve, some speculators will be able to make the leap and some will not.

Today managers of trading firms are redefining their criteria for who will make a good trader with the trading screen in mind—a decision that leads to redefining who will be included and excluded in the field. New technologies thus provide opportunities for social experimentation at the levels of organization, trading room, and individual. Debates about who should enter the marketplace and how—as in the Perkins Silver strategy for replacing the working-class futures traders who began in the 1980s with university graduates—make those technologies political.[16]

The practical experiments designed to shape electronic trading in new institutional contexts leave little question that market-makers recognize the importance of the physical and social architecture of finance. The history of the Chicago Board of Trade shows that earlier market makers had these same concerns when they designed the trading pit. The famous CBOT building in the downtown Loop is a "walk-through machine," a structure that both shapes the markets that operate inside its walls and is shaped by them.[17] But the edifice is also a symbol of the organization's place in the city. The trading pits that the building houses are themselves architectural technologies; the ringed steps shape competition as they arrange bodies and channel communication among traders. Electronic markets take on a different form. Telecommunications networks, electronic trading systems, and highly developed information networks create global interconnections among actors in real time. Financial markets would not have their contemporary

form without them. This is the form of technology that Castells describes as the "material support for the space of flows [which is] actually constituted by a circuit of electronic impulses."[18] Yet these material devices of interconnection are important because they channel traders' deals, which themselves depend on traders' techniques for gathering and deploying information, their strategies of profit-making, and the legal arrangements between exchanges. The materiality of technological devices seems to crystallize the possibilities of interconnection and speed, two prospects that make them hard to ignore for institutions that value rationalization. However, material equipment simply marks the beginning of the inquiry.

The first level at which technology matters is that of the material infrastructure of markets, but it is equally critical at a second level. Information devices shape the way traders work—how they understand and interpret the market and how they take action in it. Technologies shape economic rationality by establishing common frameworks for the evaluation of knowledge and a common trust in the contracts that constitute the objects of transaction.[19] In electronic markets, actors with no physical contact and no personal knowledge of each other are integrated through their trading screens into the global social system of financial exchange.[20]

Socio-technical arrangements establish common ways of understanding and interpreting the market and, in doing so, set the basis for understanding how other actors will receive the information. Technological objects on the trading floor and in the dealing room carry information to traders and provide frames for interpreting it. For the rapid work of traders, the goal is not firm knowledge but the creation of fragile interpretations that allow traders to draw profit from uncertain economic conditions.[21] Unlike scientists, whose goal is to establish truth, traders regard their technologies and their understandings of the market simply as tools for producing profit. They do not strive for stable knowledge; instead, their technologies enable profitable improvisation. As Niklas Luhmann has explained, such forms of understanding are built on "a 'provisional' foresight," in which "value lies not in the certainty that it provides but in the quick and specific adjustment to a reality that comes to be other than what was expected."[22]

These common styles of reasoning form a kind of community based on shared approaches to knowing and acting in the market.[23] Technical devices are powerful agents for bringing these communities into being. The architecture of the trading pit and the visual technology of the trading screen are inseparable from how financial traders ply their business. The tools condition how traders think and work every day.

Because technology in the second sense is such a powerful force in the operation of markets, exchange executives meticulously design and manage

both the technical and social composition of the market. They examine how traders use technologies and constantly reform them to bring them more closely in line with market ideals such as impersonal competition, complete information, and direct contact between individuals and markets. But traders do not blindly accept the tools they are given. In their daily use of them, they manipulate these technological devices to their advantage, and this often means discerning in technologies the social content that designers have worked so hard to extract.

Although technology is crucial in creating the material conditions for formal economic rationality, the conduct that financial exchanges and managers promote and that traders teach, learn, and transform in their everyday work is equally important. In other words, we need not only to understand how machines and humans are tied together into a financial system, but to focus on the relationship between technologies and practices—ways of thinking about and acting in the market—that are linked through practical experiments in rationalization.

Social Composition

Rationalizers work not only to purge the market of social influences but also to use the social characteristics of traders to engineer efficiency. This was most apparent in the efforts of the Perkins Silver managers to create a team that would bring their firm greater profit. The managers used American notions of multicultural individualism to engineer their trading room, recruiting and developing a cohort of traders that included Asians, blacks, and women. Their goal was to increase profits by expanding the ways their traders would perceive the market and strategize in it. They assumed that including individuals who were under-represented in the overwhelmingly white occupation of futures trading would extend their profit by multiplying perspectives, an idea that dovetails with notions of standpoint epistemology. These managers believed that each trader's ethnic or racial background and gender would shape his or her approach to the market. Profitability would come from aggregating these diverse reasoning processes. Ideally, such a mixed group would create a new kind of instrument for perceiving and acting on the market. The multiple points of view stemming from varied social categories would add different facets to the lens, creating a new mechanism for profit-making.

This use of perspective to build a dealing room ties ethnicity to a post-national discourse of market inclusion. These traders worked from particular points of view, born in the history of British migration and gendered labor. The managers wanted the Perkins Silver trading room to be a collection

of their social vantage points, from which would emerge a new way of seeing the market that would help the firm draw greater profit from it. The Runnymede Trust's report on multi-ethnic Britain uses a parallel form of multiculturalism, which marks an economic as well as a cultural transition. The report replaces a common notion that links Britain's class-based society and industrialism with a multicultural vision that fits neatly with the vision of the global marketplace expressed in places like the Perkins Silver trading room. In this emergent vision of global markets, individuals, regardless of location, social position, or personal characteristics, can seek profits through competition. This is not a race-blind strategy. Rather than denying the importance of ascriptive characteristics, it elevates them to useful tools in the search for profits. Instead of understanding the operation of race in markets as "possessive investment in whiteness" or as discrimination,[24] this strategy prompts us to see how firms work with race in the pursuit of profits and also how they use race and gender to buttress collectivities (like trading rooms) that are spaces of neither racial solidarity nor conflict. The Perkins Silver managers treated race, gender, and ethnicity as resources, finding in the politics of the trading room an approach to the social and economic uncertainties of the new online markets.

Although not explicitly, the markets of the CBOT were also produced through social orchestration. Access to the market was informally granted and restricted along social lines. Through the networks of family and friendship that granted access to membership at the CBOT, the city's African American population was excluded. So when Pat Arbor declared that "Chicago breeds futures traders," the breeding grounds were limited primarily to the white neighborhoods of the city and its suburbs. The Chicago trader in whose blood trading runs is almost certainly white and male. The legendary liquidity of the futures markets and the city's claim of prowess at creating traders are products of white ethnic networks of trade.

The recruitment of traders through networks of family and friends restricted the composition of the trading floor. Ethnic networks and racial exclusion shaped the basic function of the market.[25] Recruiters appealed to the skills of the local population and to the ties of obligation in local relationships in order to create liquidity. Supporting and extending those ties determined the social composition of the market. The networks of white, Irish, German, and Jewish men made the market work.

As the technologies and spaces of the market change, new forms undermine the networks that gave whites the advantages of exchange membership. In England, however, in the moment of technological change, the exclusion of others from the market field began to appear as a hindrance to liquidity. The Perkins Silver managers took advantage of this social dislocation to realign the relation of race and profit. They harnessed the perspectives of their newly hired traders to their profit-making strategies. The shift away from the CBOT trading floor and the anonymity of the new trading screen assisted them in their project. It hid race and gender from the eyes of competitors, creating rationalized conditions in which an individual's skills could emerge.

Paradoxically, at the same time that the Perkins Silver managers sought the new perspectives of diverse young people, they also worked to teach each trader a particular relation to the market. In the Perkins Silver trading room, managers blended multiculturalism and the notion of the self-regulating individual. Although each trader brought a perspective, the managers trained them all to develop an ethical relation to the market by developing an interior space dedicated to market action and to regulating affect.

Self

Becoming a finely tuned market instrument required each trader to develop a particular relationship between self and market that severs certain capacities and connections and builds up others. Speculation requires temporarily giving up part of the self to enter into the space of economic action. Specifically, daily self-discipline requires separating the world of social responsibilities from the world of speculation. Despite the outwardly raucous atmosphere of a trading floor, there is an ascetic component to the way traders manage themselves to become risk-takers. These practices enable a trader to focus on the movement of the market alone and to act as a purely economic individual. To achieve this state of reason on the trading floor, traders use discipline to temporarily reject the responsibilities of social connections, especially the connections to their families. Traders discipline themselves to be responsible only to the market, which determines their success or failure and reveals whether they have acted with virtue—that is, with economic acumen alone, not from their responsibilities outside the market or from an arrogance derived from success. Separating his market self from his social self, a trader refashions himself as a machine for trading, immune to the physical discomforts of standing for hours in the trading pit or hovering over a computer screen—an actor who ignores the future consequences of success or failure and whose sole aim is to draw profit from the market.

Speculation positions traders at the edge of the present moment, a location of high uncertainty where the authority of knowledge fades as traders try to anticipate slight market movements.[26] With this murky view of the future, traders orient themselves with charts and social knowledge, but the material that they shape the most assiduously is the self. The discipline of specula-

tors unites techniques of profit-making with continuous formation and reformation of self. Shedding outside responsibilities and working to disconnect from desires for continuity, the trader makes himself into an economic man. Speculation places money and self-definition on the line simultaneously.

For the managers at Perkins Silver, nothing was as critical to convey to the London traders as self-discipline. In the Chicago pits, their friends, financial backers, and trading neighbors had instructed them in these techniques as markets rose and fell around them. The conditions of the electronic dealing room and the distance from the Chicago pits forced them to examine these techniques explicitly and plan how to train the London traders. First, online dealing separates traders, assigning them to their own neat spaces. No other trader can see or hear the positions a new trader takes on or the panic or elation in his voice on a winning or losing streak. Online traders act alone. In the absence of the informal training of the pits, the Perkins Silver managers improvised new techniques to develop self-discipline. First, they required traders to maintain trading diaries to record their deals and give reasons for their them; second, they watched traders' deals through the online surveillance system. As the managers formalized these techniques, they trained their traders to be rationalized observers of the self.

Representation

As we have seen, economic rationality is also aesthetically patterned. Whether through the architecture of buildings, the garish ties of traders, or even though technologies that have symbolic aspects in addition to their rationalizing functions, the representational order defines the spaces of purified economic activity and shapes the affect and self-image of those engaged in trading.

These representations are part of the practical experiments that separate economic activities from the social. The architecture and screen design at the CBOT and Perkins Silver create distance between the technological order, social interaction, and even nature. In contrast, a trader's self-presentation and style of interaction mark the trading space as asocial, where human nature is stripped of the manners that smooth social interaction and reduced to brutal competition. Markets are places where technological rationalization combined with the natural competitiveness of economic men establishes an autonomous space of economy.

Holabird and Root's design for the 1930 CBOT building was an image of machine-honed nature. The new building committee and the CBOT membership preferred the symbolism of nature transformed over the neo-Gothic spires and the neoclassical columns of the competing designs. Neat

limestone ribs run like railroad tracks from the building's base to the tower's peak. Interior details show ships and grain chutes but not the human hands that operate them. These modern images represent the order that technology can impose on nature and create a feeling of control over the matrix of price and weather that futures contracts themselves accomplish.

As the CBOT worked with architects to hone its modern image, it also designed the trading floor to establish the conditions of calculation and economic competition. The arrangement of the trading floor and the invention of the trading pit structured traders' sightlines. The pit's steps elevated traders so that they could see all of the bids and offers, bringing each trader into contact with the full market. Engineering the acoustics of the trading floor was equally important to creating a centralized market. Designers and managers considered what materials would allow sound to travel without producing disorienting noise and created an arena in which each trader could clearly perceive information—a level informational playing field where traders could compete primarily on the basis of their understanding of the market and their speed at executing trades.

This marking of space at the CBOT is not the first example of Chicago's elite using the architecture of order to counterpoint the chaos of capitalism. At the famous Chicago World's Fair, the White City—a literally purified image—created an idealized Chicago that banished the muck of capitalism, replacing it with the rhythmic and regular display of neoclassical architecture. Architecture's reflection of capitalism's operation continued in the construction of the glass tower extension of the CBOT, where the constructed abstraction of capital matched the structured abstraction of the building.

The screens of E-trader extended the project of establishing aesthetic distance between the image of the market and the human elements that compose it. In representing the market in a set of bid and ask numbers simply presented in the columns of a trading screen, designers composed visual elements to achieve a shift in calculative practice.[27] The numerical representation of the market resonated with the principles of *disintermediation*, a term that came into vogue in the 1980s as companies began to use securities like junk bonds to raise money from investors rather than banks, eliminating intermediaries between the borrowers and their market.[28] The design of the trading screen was intended to achieve a similar direct contact between market actors, creating disintermediation in the manipulation of visual information. Of course, from an analytic perspective, there are always agents, whether human, linguistic, mechanical, or electronic, between traders. However, technological rationalization supports the idea that eliminating human intermediaries provides greater contact with "true" market forces. The num-

bers consolidate the image of the market on a trading screen; in those numbers, traders confront only the aggregate market they receive through their computers, not an image of their human competitors.

The architectural environment and the picture of the market presented on trading screens give a particular look and feel to the market. The architecture of the 1930 CBOT building marks the transformation of nature through technology that is the foundation of the circulation in futures contracts. It also marks the CBOT as a space of modern action, where men not only work to integrate the city with the market but also create circulation well beyond its boundaries.

The aesthetic rationalizations of the trading screen heighten this effect. They create the image of a complete market apart from the human actors who comprise it and require that traders on the system become observers of this distanced entity. By changing what it looks and feels like, disintermediation shapes a trader's interactions. Secluded in front of the screen, he measures his skills directly against the market as a whole. The tranquil and measured quality of the screen leaves behind many of the habits of the trading pit, but it retains others. In particular, it replicates the dispassionate aesthetic of discipline. However, like the techniques for teaching discipline that the Perkins Silver managers employed, the new screen imposes a quiet intensity that the ex-floor traders who import their raucous work habits resist.

Whether they remain in the pits or work in the new confines of the dealing room, traders display their commitment to competition as the primary mode of human interaction in their dress, language, and aggressive demeanor—conduct that undoes, at the representational level, the social ties between people and aims to dissolve any collectivity that might emerge. This image of competitive human nature, which links competition and profit to the vitality of both men and the market, obscures the continuous use of social information to make decisions. Traders say that being in the market brings them closer to the maverick, uncompromising spirit they associate with human nature, as if the market strips away the pretenses of society. The one-upmanship, crass jokes, and the insults that traders hurl mark the trading room as a place for war between men over money and status. These games of dominance and defeat help to create an asocial space. When the Perkins Silver managers tried to control the obscene language of the London traders, requesting that they stop using the word *cunt* to mitigate the brutality of the trading room for their new female recruits, the traders revolted. The new, seemingly feminized trading room threatened the connection between masculinity and market rationality that gave these men special access to the market. The cosmopolitan order of the American directors abstracted reason from masculine play. Yet the traders clung to the crass characters that

reflected the asocial economic actor, persisting in their intense competitiveness. In the digital dealing room, however, the new recruits submitted to the newer affective order of the market observer—more distant from direct competition, more reflective, and quieter. The new conditions of electronic trading create a new economic aesthetic form, and with it is emerging a new variant of economic man.

The processes that produce abstract information in financial markets are not themselves abstract. Managers and designers integrate people, technologies, places, and aesthetics into a zone of autonomous economic action. The move from the pits to the electronic screen realigns human abilities and technologies, just as the transition from the crowded old Chicago Board of Trade building to the new, more spacious trading floors did in 1930. In their quest to make perfect markets, designers attempt to evade the social world. Shifting the market from its location in the bodies and voices of traders to the quiet blinking of a trading screen creates a new order of formal rationality based on digital representations. Yet traders inevitably develop profit-making strategies that bring social and cultural materials back into the rationalized market, producing a cultured structure that organizes everyday life and labor in the futures markets. Today, at the dawn of the digital age, market makers are inspired by the enticing possibilities of electronic exchange. Soon these technologies will appear insufficient, and a new generation of designers will begin their own practical experiments, convinced that they can improve on modern markets.