CHAPTER FOUR

What is a 'real' transaction in high-frequency trading

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Past the turnstiles and security guards, walking into a stock exchange today is much like walking into the administrative offices of most other modern organizations: greeted by sleek concrete, polished steel, and heavy architectural glass, visitors encounter areas peppered with conference tables, personal workstations, and communal sites for refreshments. One space is conspicuous for its absence: the trading floors where markets were once made in quick glances, jostling bodies, calculated voices, and the cacophony of crowds. Bar a few exceptions, these spaces have mostly disappeared. To observe the sites of feverish market activity (Simmel 2004) where millions of financial instruments are traded every day you need to look further afield, to the data processing centers where stock exchanges host their digital marketplaces. Resembling minimalist warehouses occupied by neatly organized rows of computer servers, these are the places where markets come to life, not through conversations and the density of social interactions but through the varying electronic signals received and processed by the automated stock exchange.

The computer servers and sophisticated communications networks of stock exchanges are subjects of various arguments about the "realism" of financial

capitalism. This is clear, for example, in recent debates about high frequency trading, a series of practices that hinge on the use of computers, network configurations, and speed to exploit minute arbitrage opportunities in the electronic trading platforms that structure stock and foreign exchange markets (Chordia et al. 2013). High frequency trading, wrote the leading broker Charles Schwab in a statement in 2014, is "an explosion of *head-fake* ephemeral orders—not to lock in *real* trades, but to skim pennies off the public markets by the billions" (Russolillo 2014). The firms participating in these activities, noted Peter Henning (2014) of the *New York Times*, have "no *real interest* in the underlying value of the companies whose shares they trade." These critiques are underpinned by a fundamentalist conception of stocks as contracts that represent a materially valuable stake in a public corporation. A stock's price is supposed to reflect the value of its associated firm or a future-oriented judgement of its strategic actions. Yet when stocks are traded thousands of times every minute, the connection between price and value becomes less tenable. What does it mean, ask fund managers and other institutional investors, that high frequency traders own financial instruments for only fractions of a second?

This chapter focuses on one aspect of the realism of electronic, automated stock markets: it probes controversies about whether specific forms of market transactions are "real" or "fictitious." Specifically, it looks into debates surrounding a set of contested trades known as "spoofing" that involve creating intentions to buy or sell stocks with the objective of manipulating prices and other market participants. An exploration of how spoofing is constructed as a false transaction implies uncovering some of the "performances of reality" (Mol 1999) that constitute legitimacy and a collective sense of taken-for-grantedness in the worlds of automated finance. As data packages traveling through computer networks, spoofs and "true" trades are physically and computationally indistinguishable. What matters, then, are the mechanisms through which actors come to see transactions not only as legal or illegal, legitimate or illegitimate, moral or immoral, personal or impersonal, but more fundamentally as being real against the possibility of being fictitious.

To make sense of these performances, I turn to one of the key infrastructures of modern stock exchanges: the electronic limit order book, a computational list that captures and matches the orders to trade received by anonymous investors from across the world. In this chapter I argue that the "performances of reality" of automated trading involve a combination of knowledge about the market

(such as market microstructure theory) and infrastructures of trading (such as the electronic limit order book) constituting the distributions of knowledge that make the actions of traders intelligible (Barnes 1988). What matters in the marketplace, surely, is not whether a transaction is real "in actuality" but rather the conditions under which participants come to evaluate it as such. The "regimes of truth" (Foucault 2012) governing electronic transactions are performed as much by the power of regulators, lawyers, and economists, as by the affordances, constraints, and possibilities of the material mechanisms that enable trades in the marketplace.

This chapter is organized as follows. In the next section, I introduce the empirical context that makes spoofing possible by overviewing the operation of electronic limit order books and their connection to automated trading. This is followed by a brief theoretical discussion that highlights how infrastructures, market relations, and knowledge configure performances of reality in finance. I then explore an example of how spoofing in an automated market setting was contested in the courts to then compare this to similar instances of price manipulation in face-to-face exchanges. This is followed by some concluding thoughts.

INSIDE THE MACHINE

Electronic limit order books are a fundamental technology of contemporary financial markets. Introduced at the margins of stock trading in the early 1970s, they became dominant exemplars of exchanges and other regulated trading platforms by the late 1990s (Castelle et al. 2016; Pardo-Guerra 2019; Gorham and Singh 2009). Order books are simple devices: they act as centralized lists that record the intentions to trade of investors and allow either a human or a machine to "match" compatible trades (or what economist William Stanley Jevons once referred to as the "double coincidence of wants"; Jevons 1879). Consider, for example, the order book for Apple Inc. on the electronic exchange BATS Global Markets (see fig. 1; BATS is now operated by the Chicago Board of Options Exchange). At any given moment in time, multiple investors might have slightly different valuations of Apple's stock. Some might think that shares of Apple command a higher price than what others deem them to, and vice versa. In the book, these valuations are expressed as "limit orders" sent in the form of electronic messages to the exchange's systems (the structure of individual

messages often follows the Financial Information eXchange protocol, or FIX, that identifies the instructions contained in each message; see fig. 2). Within the computer warehouses of stock exchanges, incoming orders are time-stamped and logged in the order book according the moment of their arrival, their volume (the number of shares an investor is prepared to trade), and the price at which an investor is willing to buy or sell (an "ask" is the price set by sellers for the shares; a "bid" is the price determined by buyers). In the left columns of figure 1, for example, at 14:14:23 EST on September 28, 2017, the lowest amount at which an investor could buy 210 shares of Apple Inc. was $153.44. Conversely, the best price an investor could get for 601 shares in Apple Inc. was $153.43. In this instance, the difference (also called the spread) between the best bid and the best offer (or, the "top of the book") is $0.01. This is common in the most actively traded instruments—and is partly so by regulatory design: in the United States, in particular, shares cannot be traded in fractions of a penny. When an investor submits an order to buy at the best ask (or sell at the best bid), the system automatically matches these intentions and executes the trade. The right side of figure 1 shows the result of this automated matching: second after second, small lots of orders in Apple are traded at $153.44.

AAPL

	Orders Accepted	Total Volume
APPLE INC COM	300,888	1,982,057

	TOP OF BOOK		LAST 10 TRADES		
	Shares	Price	Time	Price	Shares
ASKS	700	153.48	14:14:08	153.44	100
	400	153.47	14:14:08	153.44	1
	350	153.46	14:14:08	153.44	50
	560	153.45	14:14:08	153.44	284
	210	153.44	14:14:01	153.44	36
BIDS	601	153.43	14:14:01	153.44	100
	400	153.42	14:13:55	153.44	100
	501	153.41	14:13:55	153.44	100
	350	153.40	14:13:55	153.44	100
	700	153.39	14:13:55	153.44	100

Last updated 14:14:23

Figure 1. Apple Inc.'s top of book on BATS's EDGX at 14:14:32 EST on September 28, 2017. http://www.bats.com/us/equities/market_statistics/book/AAPL/?mkt=edgx.

From this very simple design of what is essentially an ordered list of intentions to buy and sell shares, order books can produce complicated dynamics. For instance, because order books are transparent in the sense that they are visible to all the investors that are connected to them, they quickly reveal strategies that can be gamed by other market participants. Imagine I wanted to buy one million shares of Apple Inc. Submitting an order at whatever prices are available (also known as a "market" order) would be an economically inefficient strategy. The order book only has 210 shares at $153.44, so filling the

order would require going deeper into book, paying increasingly more for each batch of shares of Apple. Conversely, submitting a single limit order for a million shares at the best price would leave 999,790 shares outstanding and would likely trigger other market participants to increase their asks, thus increasing my overall costs. Much automated trading emerged around this problem of reducing "market impact." To trade large volumes of shares, algorithms slice orders into smaller lots that limit the effects and they have on the market: they try to "hide" the transaction, like minute whispers spreading through the interstices of a crowd. This slicing is paired with geographic diversification (Pitluck 2011); the strategy is pursued not in one but many markets, transmitting orders to several exchanges and trading platforms to obfuscate even more the original order—at the time of writing, Apple Inc.'s shares were traded in twenty-three different venues across the world.

8=FIX.4.2 | 9=178 | 35=8 | 49=PHLX | 56=PERS | 52=20071123-05:30:00.000 | 11=ATOMNOCCC9990900 | 20=3 | 150=E | 39=E | 55=MSFT | 167=CS | 54=1 | 38=15 | 40=2 | 44=15 | 58=PHLX EQUITY TESTING | 59=0 | 47=C | 32=0 | 31=0 | 151=15 | 14=0 | 6=0 | 10=128 |

Figure 2. A "typical" FIX message. Each element in the string of characters represents a meaningful instructions (PHLX, for example, corresponds to the Philadelphia Stock Exchange, or field 49 in this example).

High frequency trading emerged in this context. Betting on the long-term movements of stocks is still a common practice, but the fragmented, multisited, and electronic character of order books offers the possibility of profiting from miniscule price differentials across multiple trading sites. If the price of Apple Inc. is lower in Hamburg than anywhere else, there is quick profit to be made by arbitraging across this and other exchanges—buying shares in the cheaper to sell in the dearer. Traders equipped with the fastest systems are at an advantage because they are the first to observe and react to such differentials, creating a relentless incentive for an arms race in speed and connectivity (MacKenzie 2018). This leads to some well-known features of high frequency trading, such as the practices of colocation (where firms rent space next to the order books of stock exchanges at premium prices), or vast investments in telecommunications systems that reduce the transmission speeds between participants by small fractions of a second (generally, a few milliseconds; see MacKenzie et al. 2012). And while these practices were peripheral and somewhat controversial to the world

of equities a decade ago, they are now more or less standard. In a short article in *Traders Magazine* titled "We're all HFTs now," Tim Quast notes that "today's stock market structure in large part reflects the pursuit of speed and price. . . . The entire structure has become high speed" (Quast 2017), diminishing the returns for even being called a high frequency trader.

THEORIZING SOCIETY IN THE ORDER BOOK

A frequent assumption about electronic order books is that they are altogether removed from "sociality," that they are emblematic of some form of "post-social" world where algorithms and humans are ontologically equal (see Arnoldi 2016). This is a common trope of financial automation: that through electronic devices and the apparent removal of humans, the social relations that once reigned on the trading floor are now entirely gone. This is incorrect: behind every electronic order, there is a trader, an institution, an organization; and the order book itself is not just a practical albeit anonymous informational device: above all, it is designed as a depository of intentions and "truthful" valuations. Limit orders are meant to represent what investors consider the value of a stock to be, in the same way that bids in an auction reflect, at a first degree of approximation, the preferences and senses of worth of collectors (Smith 1990). As Donald MacKenzie argues, precisely because they are spaces of perceived intentions, electronic markets are dense interactional orders (Goffman 1978) in their own right, populated by codes, expectancies, dissimulations, and multiple performances acted through, not without, the order book (MacKenzie 2019).

Studying the order book as an infrastructure for the social has two immediate theoretical implications. First, it underscores transactions as forms of relation-making rather than as ephemeral arm's-length exchanges. When two agents transact, they are tied for the duration of their exchange; they are related, even if through their membership of a community of exchange (Weber 1978). The order book frames this community—through its affordances, it bounds the membership and its codes of conduct, it defines who can trade with whom and how. Here, I am evoking the work of Marilyn Strathern (1995) and her provocative querying of "the relation" as a central analytical object in contemporary anthropological thought. Social anthropologists, writes Strathern, "route connections through persons," attending to "the relations of logic, of cause and effect, of class and category, that people make between things [but also] to the

relations of social life, to the roles and behavior, through which people connect themselves to one another" (1995: 11). Such routing is the "substance of anthropological empiricism," she continues, creating a "double emphasis" on relations "known to the observer as principles of social organization and relations observed as interactions between persons." Social structure is located in relations that are "relevant to people's acts and intentions" (1995: 12), encoded in shared knowledge about society (Barnes 1988). The consequence of this "double emphasis," she adds, is that persons are discerned "by their relations to one another"—by shared, authoritative forms of knowledge that, like legal, informational, and scientific infrastructures, *establish* meaningful connections. Take the Paiela, for whom relations are "subjected to the test of time fall by the wayside depending on the warmth of that relationship" (Biersack 1982). Biological relatives that fail to provide support are "false" kin, whereas those that offer are thought of as "true" kin. More proximally, think of discussions about relatedness at the intersections of law and biomedical knowledge: transformations in reproductive technologies and legislations around their use imply that biological familiarity no longer guarantees relatedness in Western societies but does so only under finite combinations of law and its technique. A surrogate mother can only lay claim on her child in specific legal circumstances, in the same way that the donator of a gamete is not guaranteed relatedness to his or her genetic offspring. Relations are always underdetermined, be it by law, shared social knowledge, or by technologies of property and reproduction (Shalev 1998). The varieties of relevant relations are plentiful. As Strathern notes referring to Gregory Bateson's work with the Iatmul, kinship takes unexpected forms: for the Iatmul, "human beings are simply one manifestation of clan persons also manifested as every conceivable entity in the environment. . . . Yams have personal names, give birth, respond to speech, walk about at night" (1995: 16). The boundaries and dynamics of relations are never entirely trivial: the task at hand is finding how relations and personhoods are co-constituted, rather than taking for granted the existence of a dense relational system that serves as the basis of order and signification.

Like Strathern's anthropological relations, infrastructures deal with the apparent opposition between categorical and transactional accounts of social life. The question is not whether all transactions in the order book are meaningful relations, or if there is an abstract set of knowledge that defines—as if a view from nowhere—what constitutes a true trade. What matters is the interplay of infrastructures and knowledge, transactions and categories. For Strathern, the anthropological relation is divided:

> On the one hand are those relations seen to make connections through a logic of power of articulation that acquires its own conceptual momentum; on the other hand are those relations that are conducted in interpersonal terms, connections between persons inflected with a precise and particular history. (Strathern 2005: 7)

These two elements, the abstract and the particular, are necessarily conjoined in a tandem. Interpersonal relations create what is conceivable, whereas the conceptual apparatus provides social life to—or infuses with meaning—the interpersonal:

> It is through the interacting with persons that diverse interactions and further connections become intellectually conceivable [the interpersonal creates possibilities for the conceptual], while it is through creating concepts and categories that connections come to have a social life of their own [the conceptual as a terrain for the potential interpersonal]. (Strathern 2005: 8)

Kinship provides an example, where the eminently abstractive conceptual apparatus of law meets the apparently thicker everyday experience of interpersonal, familial connections. It is, as Barry Barnes might argue, a particular distribution of knowledge that constitutes what can be known about actions, behaviors, and intentions (Barnes 1988). The law is not independent of these, as it is through court cases and battles over relativeness that novel categories get made. Conversely, law shapes our everyday experience: who can marry whom, who is deemed a sibling, and who has parental responsibilities, are subjects of legal technique that affect our capacity to create kindred groups in our intimate lives. Through the tandem, Strathern evinces a connection between the relational and the infrastructural: between densely inhabited proxies of concepts—worlds of classifications, gateways, standards, protocols, measurements, templates—that make relations possible—by connecting machines, encrypting signals, or locating cases in the same classification situations (Fourcade and Healy 2013). Infrastructures (the order book) are to relations (intentional trades) what the abstract (market microstructure theory) is to the particular (the identification of "real" trades).

A focus on the order book as an infrastructure for relations is relevant for a second reason. The concept of infrastructure matters not only because it speaks of relation-making in a Strathernian sense, but also because it is doubly and essentially relational. It is relational analytically, as Susan Leigh Star and Karen Ruhleder (1996) observed: something is infrastructural not in and of itself but

only with respect to a particular community and set of practices—there is no substantive quality of being infrastructural *without* reference to practices and knowledges. But infrastructures are also relational in an operational sense: they enact relations by re-creating categories of membership, equivalence, and interoperability. Think of paradigmatic forms of infrastructure such as platforms, standards, and classification systems (Edwards 2010; Bowker and Star 2000) that, like relations, "summon to the field," discriminating between "all those possibly connected and those whom one choses to recognize." Standards and classifications order entities by locating them within specific categorical systems, but in doing so they also enact associations and dissociations, relations of similarity and relations of difference. This is visible in the recent work by Marion Fourcade and Kieran Healy (2013), whose Weberian-inspired analysis of classification situations points at how infrastructures—from credit scoring systems to crowd-sourced mechanisms for wine rating—operate as distributed sieves that sort people, things, and evaluations along specific orders of worth. Infrastructures facilitate this type of classification situations by making them durable and naturalized. The construction of a stable "reality" for market actors is necessarily predicated on the infrastructural work carried out by others (on the creation of a taken-for-granted arena of action): what is second nature to those involved in a transaction, what is obviously and blatantly a "meaningful relation" for parties to an exchange, is some other actor's rebuttable convention (Boltanski and Thévenot 1999) of counting, ordering, and technical interoperability. Order books and the forms of knowledge that make them intelligible constitute something similar to an "intersubjective spacetime" defined by a "likeness of intention" (Munn 1992: 264–65). Like Strathern's tandem, the double condition of infrastructures makes possible alternative accounts of how stable worlds emerge: they do so not only in reference to the creation of collective, intersubjective, front-stage categories shared by actors in a particular field, but also in connection to how relations are reflected upon the infrastructures that support the field's operation; contested relations are "tested" by how well they fit with extant infrastructures.

Note the potential shift in explaining sources of stability and change in the "real economy." Existing institutional, relational, and processual accounts place great emphasis on how, during moments of conflict and uncertainty, actors create shared repertoires (Swidler 1986), dominant cultural conceptions (Fligstein 2002), and accepted frames of interaction, narrative, and interpretation (Bandelj 2003; Goffman 1978) that allow closing controversies and coordinating action.

In Ann Swidler's classical account, for instance, unsettled times are wrangled by recourse to ideologies that bring together actors from distinct cleavages fixing them on common expectations (Swidler 1986). For Neil Fligstein, the key problem of market actors is curtailing competition by creating shared, field-level conceptions of governance, exchange, and control that produce stable and predictable worlds within the market (Fligstein 2002). And for Viviana Zelizer and Charles Tilly's (2006) account, actors participate in the ongoing construction of boundaries through which they collectively stabilize exchanges and tie these to extant social categories. In these as in other approaches, the "real" field of the economy is conceptualized as a space of front-stage action: what matters to markets and institutions are the knowledge and practices of the actors engaged in exchange—producers observe producers, firms observe firms, "real" actors with "real" relations. The dual condition of infrastructures, however, allows considering how front-stage actors refer to other operational planes to settle disputed moments and coordinate action. Actors do not invent the world anew every time there is a controversy or critical moment, nor do they constantly engage in a reflexive production of boundaries and classifications (cf. Bourdieu 1977, 2005; Zelizer and Tilly 2006; Barnes 1988). Rather, actors refer to "unquestioned conceptualization[s]" (Frank 1979) of what works *in practice* in taken-for-granted action. Infrastructures bootstrap the sense of reality shared by actors, anchoring accounts of what is possible, desirable, and permissible in moments of uncertainty. To determine what is "real" is to perform an infrastructural inversion (Bowker et al. 2009) that exposes the devices, techniques, practices, and objects assumed to ground action in the field, to then cool their meanings into a stable form.

An example of this form of infrastructural inversion is offered by how financial market participants deal with the "reality" of so-called spoofing in high frequency trading. Spoofing involves manipulating market prices by submitting "false" orders to buy and sell securities. In the context of electronic financial markets, spoofing has become a particularly notable object of contention for regulators and market participants alike (Lewis 2015): at the core, the issue is determining the reality of trades and the legitimacy of what seems, from the outside, an esoteric marketplace. Is a trade "real," the product of clear intentions to exchange, or is it simply algorithmic smoke meant to hide an underlying reality?

SPOOF!

What is at stake in the reality of spoofs? In addition to its pecuniary implications, spoofing elicits ontological and moral uncertainty in market transactions. Questions of spoofing remit to more substantive discussions about the makeup of society: if exchange is, indeed, productive of social cohesion (Bearman 1997; Mauss 1997), if relations matter for creating the forms that give life to the social, then "false" or "fake" exchanges corrode the character of markets. Fake transactions, like the danger of fake relations, challenge idealized principles of market and community, respectively.

Spoofs are challenging because they are difficult to identify: the process for generating a legitimate order to buy and sell securities and a spoof is much the same; both start their lives as standardized messages produced by the trading systems of brokers and other investment intermediaries that travel as electronic signals to the computer servers of exchanges where they are processed. A false order will not sink in water, nor will it look differently on the trading screen. Rather, what differentiates the real from the fictitious is the intent of whoever originated the trade or its underlying automated trading system. A real trade, market participants say, only exists when it was made bona fide. This is precisely how law singularizes spoofing: as an activity that distorts *true* prices through calculated (intentional) deception and manipulation. For example, since the securities markets reforms of 2001, it became unlawful, under Section 10(b) of the Securities Exchange Act 1934, "for any person, directly or indirectly [to] use or employ, in connection with the purchase or sale of any security . . . any manipulative or deceptive device or contrivance." Similarly, under section 17(a) of the Securities Act 1933, it is unlawful to "employ any device, scheme, or artifice to defraud, or to obtain money or property by means of any untrue statement of a material fact . . . or to engage in any transaction, practice, or course of business which operates or would operate as a fraud or deceit upon the purchaser." Legal prohibitions against spoofing in particular (rather than market manipulation in general) are even more recent: in the United States, they were only coded into law with the Dodd-Frank reform of 2010, when spoofing was defined as "bidding or offering with the intent to cancel the bid or offer before execution." This definition was reaffirmed in the courts, where spoofing was interpreted as "nonbona fide orders, or orders that the trader does not intend to have executed,

to induce others to buy or sell the security at a price not representative of actual supply and demand."[1]

The notion of intent as a placeholder for reality is at the core of definitions of spoofing and market manipulation. Establishing intent, however, is notoriously difficult (for example, in parenting, see Coleman 1995; Wald 2006), particularly in the context of a system (the market) where actors mediate and delegate their behaviors onto algorithms, remain mostly anonymous, and act in ways that are supposed to reflect personal, subjective valuations and the ever changing state of public information (Malkiel and Fama 1970). It is not unlawful to be a bad investor, mistakenly digit a wrong number, or change one's mind. It is also not illegal to consider investment strategies that are contingent on other events ("Buy XYZ while ABC goes up"). It is also perfectly legal to submit orders that are completely nonsensical (and thus that have no real likelihood of being executed). But determining the existence of spoofing requires discerning the actual motivations of an individual trader or the designer of an automated trading system. "Identification of an abuse," writes legal scholar Jerry Markham "is itself problematic, since not every advantage or stratagem is abusive even if it provides advantage to its user at the expense of others" (2015). The phrasing of law is also far from trivial: if a strategy is based on a probabilistic expectation of execution (say, that 1 of every 100 orders submitted to an exchange will be executed, expecting to cancel the rest), can one speak of intent, as defined in Dodd-Frank? How to distinguish lousy, erratic, jittery, or informed trades from active forms of deceit? In other words, when is a transaction real? When do market participants say that a market relation exists?

A partial answer is provided by the Commodities Futures Trading Commission's (CFTC) Interpretive Order on spoofing, a document that serves as guidance in cases where there is suspicion of market manipulation.[2] For the CFTC, distinguishing between legitimate trading and spoofing requires evaluating "the market context, the person's pattern of trading activity (including fill characteristics), and other relevant facts and circumstances." To aid comparisons, the CFTC provides "four nonexclusive examples of possible situations for when market participants are engaged in 'spoofing' behavior, including: (i) Submitting or cancelling bids or offers to overload the quotation system of a registered entity, (ii) submitting or cancelling bids or offers to delay another person's execution of

1. https://www.osc.gov.on.ca/en/Proceedings_set_20151211_panzz-oasis.htm.
2. https://www.govinfo.gov/content/pkg/FR-2013-05-28/html/2013-12556.htm.

trades, (iii) submitting or cancelling multiple bids or offers to create an appearance of false market depth, and (iv) submitting or canceling bids or offers with intent to create artificial price movements upwards or downwards."[3] Note that within the CFTC's Interpretive Order, intentionality is framed with respect to specific technical conditions: "overload of the quotation system," "delayed execution," "false market depth," and artificial price movements. Indeed, although the CFTC does not interpret spoofing as an activity restricted to "trading platforms and venues only having order book functionality," it nevertheless ties its recognition to a specific technical device, the electronic limit order book. (Note, also, that the CFTC ties intent to individuals, not distributed *agencements* of humans and nonhumans. Regulation behaves "as if" all market actions are tied to a discernible human actant, the "market participant.")

Order books are infrastructural to finance in at least two ways. First, across countries and asset types, the majority of trading today is either routed through or executed in an electronic limit order book. In the United States, for example, at least 59.2 percent of the trades in equities are automated through order books (with a remaining 22 percent tied to manual, yet electronic, trading), whereas 97.1 percent of the most common (G10) foreign exchange operations go through the book. Indeed, soon after their introduction, electronic limit order books became the undisputed standard for building a market.

Second, and perhaps more important, trading strategies are often designed in reference to the order book's dynamics. Order books matter not only because they are operationally necessary; their technical details determine, to an important extent, the space of strategies available to market participants. A cursory exploration of "practical" publications in algorithmic and high frequency trading exposes this well: unlike a previous generation of textbooks in financial economics—concerned mostly with determining risk adjusted equilibrium prices—contemporary manuals focus on so-called market microstructure that involves understanding order book dynamics and the effects of variations in market design on aggregate patterns of trade and the profitability of specific trading strategies. Algorithms are designed to fit the functionalities of specific order books, exploiting different ways of signaling information, modifying orders, and executing trades (Balarkas and Ewen 2007; interview with platform developer, 2013). In addition to the very simple limit order (an order to buy or

3. https://www.cftc.gov/LawRegulation/FederalRegister/FinalRules/2013-12365.html.

sell a certain volume of securities at a certain price), an order book may process Calendar Spread Orders (that instruct to buy one delivery month of a contract and sell another delivery month of the same contract, at the same time, and on the same exchange), Deferred Orders (that sit on the order book until triggered), hidden orders (that are not visible to other users), or any other of the 1,200 order types available in American financial markets across the sixteen national securities exchange recognized by the SEC (Mackintosh 2014).

What matters is that action is tied to infrastructure in concrete ways. Such a tie (or tandem) is apparent in how the question of spoofing is resolved in courts of law. While market manipulation is as old as organized finance, the first legal criminal for suspected spoofing under the Dodd-Frank Act occurred only recently, in 2011, when the Commodity Futures Trading Commission of the United States and the Financial Conduct Authority of Britain brought charges against Michael Coscia and his Panther Energy Trading for illegally manipulating markets on the Chicago Mercantile Exchange and the Intercontinental Exchange. Agreeing with the Department of Justice, a grand jury indicted Coscia in late 2014 on six counts of commodities fraud and six counts of spoofing. During the ensuing trial, the government argued that Coscia knowingly "entered large-volume orders that he intended to immediately cancel before they could be filled by other traders" (*US v. Coscia*, Indictment, 2015). This case presents a useful illustration of the performances of reality surrounding high frequency trading.

Coscia's defense relied on two arguments. First, that the trial was procedurally incorrect because existing statutes against spoofing were simply too vague, encompassing "much routine, innocuous conduct by commodities traders" (*US v. Coscia*, Motion for Acquittal, 2015). Second, Coscia argued that both intent and manipulation were not evident. Since he never made an explicitly false statement or material representation about when or how he would cancel the orders submitted to the market, he rejected the representation of his actions as frauds (*US v. Coscia*, Memorandum opinion order, 2015).

For the prosecution, however, Coscia's intentions were clear: his strategy manifested the intent to cancel orders systematically, differentiating his conduct from other, widely accepted legitimate practices such as fill-or-kill and partial-fill orders. (A fill-or-kill is an order to buy or sell that has to be executed immediately upon receipt. If it cannot be executed, it is cancelled. Partial-fill orders, on the other hand, allow for the execution of only some of the order if the market does have enough depth to fill.) According to the government's legal

team, Coscia manipulated the market by conveying "a misleading impression to customers" through his activity (*US v. Coscia*, Memorandum opinion order, 2015). That he had not misrepresented his intentions beforehand was simply immaterial. Indeed, much of the proof offered by the prosecution consisted in highlighting the logic of Coscia's strategy, consisting of so-called layering orders—that is, placing large orders to buy and sell instruments slightly above and under the best bids and offers in the book, creating a "false sense of supply and demand." Through this, argued the government, Coscia affected the offers of other (principally algorithmic) market participants and profited from market movements artificially created by his fictitious orders.[4]

Layering is important because it references order books as depositaries of "truthful" intentions—it indexes a shared, moralized expectation of what order books ought to be. Recall the explanation of the order book given earlier in this chapter. One strategy for manipulating the market is submitting trades that do not have the aim of being executed but that are meant to elicit actions from other participants. In the case of Apple Inc., the top of the order book has a slight imbalance: I can sell up to 601 shares, whereas I can only buy 210 shares at the top of the book. This means that it is more likely that the next transaction will move prices down rather than up (more people are willing to buy shares at a lower price than sell at a higher). If I wanted to fool market participants, I could submit limit orders just below the top of the book. These would give the impression that markets are likely to move in a specific direction (this is, for example, how trading algorithms are often programmed; see Lange, Lenglet, and Seyfert 2016; Goldstein, Kumar, and Graves 2014; Seyfert 2016). If I am fast enough, though, I can cancel these limit orders before they are executed and after betting against the likely movement of the market. This is what layering consists of: it involves creating deceitful orders in the book, playing with the system as a mechanism that ought to reflect true intentions. This form of trading is widely repudiated, and not surprisingly so: as fictitious trades, these deceits "fracture connectivities" (Munn 1992) in the order book and stand as threats against the market community and its alleged clarity of intentionality.

Note, with this, the nature of the evidence presented by the prosecution: it involved opening up the CME and ICE's order books—performing an infrastructural inversion, of sorts—to discern the aggregate nature of Coscia's actions by tracing the fine-grained logics of transactions. The indictment, for

4. http://www.ft.com/intl/cms/s/0/7b9ccde8-638c-11e5-9846-de406ccb37f2.html.

example, accused Coscia of knowingly transmitting "to a CME Group server Euro FX currency futures contract orders that he intended to cancel before execution, so he could purchase 14 contracts at a below-market price and then sell them immediately thereafter for a higher price, in order to obtain a profit of approximately $175 in less than a second" (*US v. Coscia*, Indictment, 2014). (Though Coscia's indictment included only six counts of spoofing, none of which resulted in more than $500 in profits, Coscia is thought to have engaged in multiple events, earning $1.4 million over little less than three months.) The intent of these orders was not established from confessions or other first-person accounts, but rather was inferred from the strategy followed by the defendant in the context of what was possible and expected within the order book. In addition to testimony by Coscia's programmer, the government relied on the expert testimony of Hendrick Bessembinder, a professor of finance at the University of Utah and specialist in market microstructure theory, who set much of the tone for the trial. As *Bloomberg* reported, Bessembinder "went through data for the jury that showed that even after orders were filled there were attempts to cancel them by Coscia's algorithms" (Louis, Massa, and Hanna 2015). The construction of intent relied heavily on Bessembinder's representation of how the book works. "The only way trading is generated in electronic markets," noted Bessembinder,

> is through order submission. So if one is seeking to generate trading, seeking to generate a reaction, the only way one could do that is by inducing people to change their order submissions. [The] high fill rates on the small orders [suggest manipulation]. They were not only very high relative to the fill rates on the large orders, they are actually remarkably high for fill rates for other high frequency traders, so the high fill rates on the small orders are certainly very much consistent with the idea that the reaction that was generated was to induce other traders to submit orders to trade against, interact with the small orders. (*US v. Coscia*, Trial Tr. 1390, 2015)

Bessembinder did not speak directly of Coscia's intentions; he did not "implicate intent as to any element of the crime charged" (*US v. Coscia*, Memorandum opinion order, 2015). Rather, Bessembinder's testimony suggested to the jury what is expected of *normal* order book dynamics, signaling that the only possible way of making sense of Coscia's orders was as fictitious dealings. The order book linked native conceptions of intent with the specific technical repertoires

of market microstructure economics. And the coupling was effective: in early November 2015 and after but an hour of deliberation, the Chicago jury found Coscia guilty on all twelve counts.

The trial of Michael Coscia was historically momentous in at least one important dimension. In addition to testing the waters of Dodd-Frank, it introduced a new way of establishing intent—of testing reality—within the increasingly electronic marketplaces of the American financial system. As economist John Montgomery commented,

> the recent enforcement and criminal cases [against spoofing and market manipulation] generally involve allegations that orders submitted by the defendant induced changes in orders submitted by other traders. . . . *It would then fall to economic experts to analyze whether such a pattern exists, and whether the trading suggests an intention on the part of the defendant to induce the other limit orders to be submitted*. The pattern described could be consistent with benign activity as well. For example, the trader could have orders on both sides of the market to benefit from the spread. A more aggressive trader could enter and submit more aggressive orders that then interact with the other side of the defendant's orders. Seeing those more aggressive orders, the defendant concludes the market is moving, cancels his/her open orders, and submits orders on both sides of the new market price. If a trader is alleged to have pursued spoofing as a strategy, *an analysis of the risk and expected return of the strategy can provide evidence on whether this is a plausible claim*.[5] (my emphasis)

There is, then, a test of "real" relations: if economic experts find risk-adjusted returns abnormal within the context of a particular order book design, something must be amiss. The result of such logic, argues Steven McNamara, is that *US v. Coscia* "takes the natural step of inferring a second-order intent in the programming of algorithms to accomplish certain tasks" (McNamara 2016). In this, the material cultures of electronic financial markets may not only be cultures of second-order-transparency, as Fabian Muniesa (2014) pointedly observes. It is also possible that, following *Coscia*, intentionality within the market is now observable only from a distance, through the judgment of experts that discern the boundaries of actions by discriminating between true and false transactions,

5. https://ankura.com/wp-content/uploads/2018/10/Spoofing-Market-Manipulation.pdf.

real and fictitious market relations, according to how they are positioned within the order book.

MANIPULATION, IN ANALOG

That infrastructures matter in configuring relations, that they create and shape the communities that exist above them, can be seen perhaps by looking at the past as much as at the present. Consider, in particular, the trading floor, an infrastructure that contrasts sharply with the logic of the order book. Whereas order books operate under strictly symmetrical rules of price-time priority, trading floors are spaces of slightly more asymmetric interactions. Order books are organized as queues of electronic messages; trading floors take the shape of crowds of traders. Order books are mostly anonymous; the dynamics of trading floors are characterized by interpersonal knowledge and communication (Zaloom 2006; Hertz 1998). Yet spoofing is native to both, receiving quite different treatments across each setting. In the digital domains of electronic limit order books, spoofing is, quite clearly, an illegitimate transaction, a false relation that threatens the moral standing of the anonymous market. In trading floors, however, spoofing was at times tolerated, sort of a joking relation (Mauss 2013) through which traders on the floor teased and tested their market-kin.

One example jumps to mind: a case of spoofing on the floor of the London Stock Exchange in the early 1980s. Then, prices were mostly verbal, sometimes represented through whiteboards propped on the pitches of market makers on the trading floor. Over interview, a once young trainee at one of the most reputable market makers in London recalled how representations were used to drive prices in particular ways. The individual in question was assigned to work on the Australian mining book, which consisted of a list of mining shares selected and managed by a senior partner. As part of his research, the senior partner traveled to Australia to inspect facilities, talk with managers and engineers, visit brokers in Sydney and Melbourne, and buy shares for the firm's inventory. On an occasion during which the trainee was on the pitch, the partner had returned from Australia, bringing shares of a newly found mining company. The market, as the trainee recalled, was "a bit frothy," yet the price of gold was "really going through the roof." Before the market opened at 9:30, the senior partner introduced his new finding to the firm's members and trainees in the pitch: "Alright. I've got this company called GEM Exploration, which I've bought 250,000 shares of . . .

and I've bought them for the equivalent price of 3p. [We'll] see what we can do with them." So he wrote "GEM" on the whiteboard and next to it he wrote "5" as the opening price for the share. Because it was written rather than printed on the board, it was clear for everyone in the market that this was a new share. And so, the first brokers were drawn to it. The first to enquire about this strange new entry said "I see. . . . What's this GEM you've got up there? They look interesting. Tell me about that." As the one responsible for managing Australian mining shares, the senior partner replied: "Well, I went to Australia. I saw this company," and after explaining their business he mentioned he thought they were "a real prospect in the current market conditions." Intrigued, the broker asked for a quote. "They're 4 6" replied the senior partner. "What size would you like that?" asked the broker. "25,000" answered the market maker. "OK, well, thanks very much. I'll go away and have a think about that one," said the broker as he walked away from the pitch. Regardless of the fact that there had not been a transaction, the senior partner changed the price on the whiteboard, writing in blue the number 6. The next broker approached the pitch, seeing GEM Exploration on the board.

> "What are they this morning?" "Ah, well they're 5 7." "What's the size?" "Ah, well they're at bid for 25, offered in 10." Which showed that I'm a buyer, obviously. And he said "Oh, OK, well, I'll buy ten." The next guy comes along and literally, within half an hour, the things are trading at 25p. By the end of the day, they're trading at 40p, and we've turned over 2.5 million and we are long 350,000 shares instead of 250,000 shares.[6]

The case was blatantly one of market manipulation: the representation of prices on whiteboards was meant to elicit, like Coscia's orders, reactions within the market community. But any similarities obscure an important difference: these types of manipulations on the floor, although certainly contested, had an altogether different moral valence. To manipulate one's relative is one thing; to manipulate a stranger in an anonymous environment is quite another. Those were the days of the floor. As Gregory Meyer of the *Financial Times* wrote, technology "changes the nature of violations" (2015). But if it does so, it is necessarily because different technologies imply and enact different "mutualities of being" (Carsten 2013). The risk of spoofing is a risk of false, rather than joking,

6. Interview with former market maker, London, July 2012.

relations—a challenge to the legitimacy, morality, and sense of reality of modern markets (Arnuk and Saluzzi 2012).

SOME FINAL THOUGHTS

So what do we gain by looking at infrastructures? First, they suggest focusing on relations and the mechanisms that bound, format, and enact them and their social worlds. The market is, indeed, an arm's-length setting: agents in financial markets today, for instance, have an ease of exit that is quite unparalleled historically. Yet markets are also bound by connections, mutual dependencies, and reciprocal obligations—materialized through settlement systems, contractual linkages, and connectivity standards, but also through associations, professions, employment matching patterns, and others. (As Turco and Zuckerman [2014] show, exit is indeed quite limited, even in the putatively rational and calculative spheres of private equity.)

Second, if relations emerge in connection to infrastructures, then the politics of relations cannot be contained within the categorizations of social actors and their mobilization. Relational economic sociology, like broader relational approaches, stresses the unequal distribution of power and resources as shaping categorical (and thus relational) work. This is certainly part of the story—but what an infrastructural inversion would advise is looking further afield than front-stage struggles. Definitional battles over spoofing were surely shaped by overt institutional politics (see Arnoldi 2016); but practical instances of spoofing depended on an altogether different articulation of intent on the basis of overlapping (yet disparate) forms of knowledge and expertise. Spoofing was not the object of ideological intervention—rather, it was at best a boundary object (Star and Griesemer 1989), linking the different ecologies of trading platform designers, lawyers, market microstructure economists, regulators, and a mixed gamut of market participants.

Third, infrastructures compel us to think of the "invisible"—not as an inherent quality of infrastructures but as a positional achievement, as something that happens when a device or system becomes infrastructural to a community (but certainly, the site of action and activity for others; see Larkin 2013). The question of spoofing is unescapably linked to issues about the nature of order books, the implicit assumptions they make about how things can (and should) be meaningfully connected, and the politics of their dissemination in finance.

To understand how reality was "realized" in finance, how specific modes of action emerged as second nature to market participants and their performances of reality as seamless parts of everyday action, requires tracing the histories of these invisible platforms and their multiple makers. For contemporary financial markets, so it seems, reality is partly manufactured by the invisible hands of others.

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