Security Market Manipulation

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Abstract

This article uses a variety of contemporary developments to address artificial market pricing and market manipulation. It examines a variety of modern trading tactics and manipulation strategies in the context of trading and order mechanics. For example, I raise the connection between so-called best execution, cancellation rates, and manipulation. I explore the connection between manipulation and short exposures as well as potential connections between Federal Reserve policies and artificial pricing. I also examine the nature of market manipulation in different facets of the trading day and the transitions among these.

1. INTRODUCTORY COMMENTS

By manipulation of security prices I refer to actions and/or trades by market participants that attempt to influence market pricing artificially. For example, Allen & Gale (1992) highlight the distinction between manipulation by actions and trades. Market participants sometimes prefer to undertake trades to distort prices artificially or manipulate market prices to create opportunities to exploit compared to the benchmark pricing. Consequently, manipulating prices not only leads to redistribution of economic value and wealth (raising concerns about fairness) among market participants to the advantage of the party undertaking the manipulation, but more significantly leads to inefficiency by providing inaccurate price signals that lead to first-order distortions in resource allocation and production choices as well as inefficiency in the allocation of risks.

A crucial requirement for an economic agent to manipulate prices is that he has an economic incentive to do so, i.e., that he can do so profitably as a result of differences in elasticity across different trading contexts. Manipulation can arise in a range of manners, such as across related markets (e.g., stock versus option markets or the announcement of a takeover bid; see, for example, Jarrow 1994 and Bagnoli & Lipman 1996, respectively), across time (exploiting natural differences in market depth or liquidity over time), or across institutional contexts, such as through the preopening in virtual markets, as well as open, close, and within-the-day trading. Of course, another way in which market participants can alter artificially competitive market prices is by exercising market power.[1]

As suggested above, the ability to manipulate pricing can reflect a range of contexts and institutional settings. For example, it can arise as a result of rumors that spread false information. Obviously, if a market participant provides the market with false information that is viewed in the marketplace as truthful and credible, then an artificial (manipulative) price will emerge as a consequence. Of course, not every market participant is in a position to influence the market price; for example, if a presumably uninformed and unsophisticated individual were to hold a press conference about a specific company with whom he had no ties, it would be difficult for him to manipulate prices given the lack of credibility in his assertions. However, in various instances a company itself or certain sophisticated investors (such as particular hedge funds) could potentially make announcements, which if false would reflect an attempt to manipulate prices. Such announcements could include potential interest in undertaking a takeover or accumulating a substantial position, for example. If false communications would subject the announcer to market costs, these costs could enhance the credibility of the announcement.

Indeed, an investor's objective in manipulating the price of an asset could be to lower rather than raise it.[2] For example, during the financial crisis, some Wall Street executives suggested that their firms were victims of manipulative behavior by hedge funds who were seeking to talk down the values of their respective firms.[3] Such complaints to the US Treasury led it to push the Securities and Exchange Commission (SEC) to agree to a temporary ban on short sales on approximately 900 financial stocks for three weeks as the TARP legislation was being debated in early fall 2008.[4] In

[1]Whether the exercise of market power should be considered manipulation is itself ambiguous in my view. Easterbrook (1986) illustrates the close connection between monopoly and manipulation.

[2]However, the bulk of the SEC's manipulation cases are situations in which the manipulator is attempting to raise prices (see Aggarwal & Wu 2006).

[3]Of course, a far simpler explanation for the low value of the major securities firms during the financial (and mortgage) crisis was the low value of the underlying positions in their portfolios, poor risk management practices, and extraordinarily leveraged positions.

[4]Later, when then SEC Chairman Christopher Cox was asked about his greatest mistake as chair he referred to listening to his colleagues in the President's Working Group (PWG) and agreeing to a ban on short-selling financial stocks [see his "exit" interview with the *Washington Post* (Paley & Hilzenrath 2008)].

the aftermath of disclosures of the poor financial health of Fannie Mae [or Federal National Mortgage Association (FNMA)] and Freddie Mac in July 2008 and the need for a $300 billion bailout fund (which the Treasury termed a big bazooka), the SEC issued guidance to remind investors that manipulation in the context of short sales was problematic.[5]

In this article, I emphasize the economics underlying security market manipulation rather than focus on the underlying legal framework.[6] Indeed, in the security market space there is relatively little attention paid to manipulation because the securities regulator has the authority to bring fraud cases under Rule 10b-5, which is a very powerful regulatory tool.[7] It can be relatively straightforward to bring such cases by establishing the falsehood of key underlying statements of the respondent. The legal standard for establishing a manipulation is considerably more difficult because of the importance of establishing intent and potentially getting inside the head of a potential manipulator to prove that the underlying behavior was manipulative. Indeed, intent (i.e., state of mind) can be very difficult to prove. The Commodities and Futures Trading Commission does, somewhat more frequently, focus on manipulation issues in its regulatory space. Indeed, its regulatory arsenal lacks a ban on insider trading, unlike that of the securities regulator.

The investor in a classic manipulation is attempting to influence artificially the price as a way to gain potential advantage. In some important market contexts, however, the situation is essentially reversed, as the investor has information suggesting that the natural market price is itself artificial. Although that would not represent a classic price manipulation given that the investor is not attempting to establish an artificial price,[8] the investor would be attempting to limit artificially the adjustment to the natural price and in that sense could potentially impact market pricing. If the investor has monopoly power with respect to his information, he would exploit his informational advantage to the optimal degree. For example, in the quadratic-normal formulation underlying the classic Kyle (1985) model, the informed investor optimally utilizes half of his information at each trading stage, as in a classic monopoly solution assuming a linear demand curve. In such a framework, the informed investor need not be an insider in the classic legal sense, such as an investor who knowingly has information derived from insiders who owe a duty to the firm, which would be governed by insider trading restrictions. Typically, one does not associate insider trading (and its prohibitions) with market manipulation, whose objective would be to create artificial pricing that can be exploited through the underlying manipulation. Indeed, Kyle's (1985) is not a framework that one directly associates with the ability to undertake profitable destabilizing trading and manipulation.

The ability to manipulate pricing can be greatly enhanced by knowledge of the investor's underlying situation. For example, Benabou & Laroque (1992) suggest that the perception that

[5]One interesting case involving manipulative short selling was against Paul S. Berliner (**http://www.sec.gov/news/press/2008/2008-64.htm**). Despite this and the pronouncements described in the text, there were very few cases brought by regulators against equity short sellers during the financial crisis for manipulation or fraud (Rule 10b-5). Specifically, I have not identified any cases involving manipulation that entailed short selling and the spreading of false rumors during the financial crisis. Many of the short-sale cases brought by the SEC involve the IPO process (Regulation M) or abusive naked short selling. Arguably, a better focus of regulatory attention during the financial crisis would have been for the regulators to try to understand what they could learn and infer about the market context from the interest of sophisticated investors in shorting numerous major financial institutions. Such an approach could have offered insight about the valuation of these firms and their risk management practices.

[6]An interesting discussion of the legal framework for manipulation is given by Fischel & Ross (1991). One recent set of criteria for defining manipulation is provided by Kyle & Viswanathan (2008). A nice practically oriented overview of manipulation, which ties to the above contexts, among others, is given by Talisse (2014).

[7]Talisse (2014) points out that that the recent trend of enforcement actions against market manipulation has increased.

[8]Not only would this not constitute the classic type of price manipulation, but the discussion does not suggest that such behavior would be illegal in most circumstances.

investors are thought to have potentially noisy special knowledge and private information (the authors point to, e.g., journalists, experts, traditional corporate insiders) allows them to distort prices through a combination of announcements and trades. However, because the information is noisy, traditional antifraud measures cannot enforce truthfulness. The credibility of the information conveyed to the market by announcements and trades could be enhanced by restrictions on trading or requiring prompt trading disclosures.[9] In fact, Fishman & Hagerty (1995) show that mandatory disclosure rules can increase the anticipated trading profits of insiders because mandatory disclosure can make it profitable to trade even without the insider possessing private information about the asset's value.

I use recent market developments as a lens to frame my discussion of market manipulation and artificial pricing. In Section 2, I consider a variety of modern trading tactics and manipulation strategies in the context of trading and order mechanics. The discussion raises such issues as whether a broker-dealer not manipulating the market would be consistent with his so-called best execution responsibilities and how a broker's fill and cancellation rates relate to whether the behavior is manipulative. Section 3 considers manipulation and its interaction with short exposures. Section 4 discusses briefly from a microeconomic vantage point the consequences of the Federal Reserve Bank's (Fed's) distorting long-term bond markets. Section 5 considers price manipulation and artificial pricing in the context of different facets of the trading day, as well as the discontinuous transition among them. Section 6 provides concluding remarks.

2. MANIPULATION AND TRADING TACTICS

The challenging nature of the financial environment in recent years highlights the importance of strategic responses to substantial shocks in which other investors need to reduce their exposures, as in the collapse of Long-Term Capital Management as well as various outgrowths of the financial crisis. Brunnermeier & Pedersen (2005) use such situations to motivate a model in which when a trader needs to sell, others also sell (in an attempt to get ahead of the price response) and then subsequently repurchase to offset their exposure. This strategic behavior reduces the value obtained by the distressed investors. Whether one views this as manipulation or just a reflection of the fire-sale nature of asset pricing in equilibrium, it illustrates an important set of behaviors in response to shocks to the financial system.

Several different strategies in the context of trading are relatively widely discussed as manipulative strategies. For example, a pump and dump involves a trader "pumping" up the price of a company by spreading false information to many unsophisticated (often retail) investors to push up the share prices and then "dumping" the trader's shares. A basic protection against the pump and dump is the potential for short-selling and the discipline that sophisticated short sellers can provide. In that sense, excessive restrictions on short-selling can needlessly sustain manipulation. In contrast, stock bashing occurs when traders spread false or misleading information to drive down the price of a stock and allow its shares to be obtained at a lower price. Somewhat analogously, a bear raid is an attempt to push down the price of a stock by short-selling or extensive selling of the stock.

[9]Subsequently, Sarbanes-Oxley required prompt disclosure (within two business days) of insider trades, option grants, and option exercises. Although it was not known at the time, these requirements remedied problems associated with the backdating of option grants and exercises (see Heron & Lie 2007, 2009; Cicero 2009). Backdating of option grants and exercises was not an attempt to create an artificial price per se, but instead reflected an effort to utilize an artificial price that already prevailed.

Some types of manipulation focus on trying to manipulate artificially trading activity to attract additional (buying) interest to a stock or to signify artificially that more liquidity than normal would be available by manipulating the perceived level of activity rather than manipulating the price. For example, in churning and wash sales, the trader is placing purchase and sale orders at similar prices in an attempt to create and signify activity in the stock. Analogously, ramping the market is an attempt to take actions to try to raise the price of the stock and give the impression of voluminous activity.

Investors and traders who are interested in affecting markets could be able to obtain traction by influencing perceptions through trade executions. In some respects, trade executions and orders offer a tangible way to influence the market process and beliefs of other traders, particularly in light of the costs experienced by these traders, including both their out-of-pocket costs as well as the tangible consequences of the trade executions. These can influence the equilibrium pricing and through that the beliefs of other investors about preferences in the marketplace and the underlying shocks being experienced.

At the same time, however, there is the possibility that the transmission of orders (including unexecuted orders), rather than actual transactions, could potentially reflect an attempt to manipulate the market. For example, this might occur through so-called quote stuffing in which a trader floods the market with large orders that he cancels quickly to disrupt his competition. (A recent empirical analysis of quote stuffing is provided by Egginton, Van Ness & Van Ness 2014.) Spoofing is a related tactic in which a trader with a position to sell actually places a large buy to push up the market price (by creating the impression of high demand) with an order that he quickly cancels, but which meanwhile allows the original trader to obtain a sell execution at a relatively high price. Such a strategy is viewed by regulators as manipulative. Obviously, it does not directly represent a true statement of ultimate trading intent and may be an attempt to manipulate the NBBO (National Best Bid and Offer) to obtain executions at artificial prices.[10]

This discussion also emphasizes that to obtain favorable execution, traders can undertake more complex strategies to limit the price impact that they experience. To some degree, sophisticated trading tactics involve measures to limit the ability of the opposite side of the market to exploit an investor seeking particular executions. However, it's not clear to what extent one should view this type of strategy as an impermissible manipulation. It is at least arguably an attempt to ensure a more cost-effective execution. At the core of the strategy is an attempt to avoid showing one's hand (and tactics) to the other side, which would occur when using a predictable (or fully revealing) strategy whose ultimate objectives can be easily discerned, leading to excessive price impact relative to alternative strategies.

The strategy also involves some risk that the investor will buy shares (and incur greater trading costs and price impact), when he actually is seeking to sell. For example, Chakraborty & Yilmaz (2004) show that informed traders have an incentive both to trade less aggressively and even to trade in the opposite direction to increase the noise in the trading process. From a game theoretic perspective, it may not be surprising that there is a role for mixed strategies in equilibrium or even for so-called bluffing. By undertaking bluffing, the insider adds noise to the market's inference and makes prices less sensitive to trades (Chakraborty & Yilmaz 2004).[11] For a sufficiently large number of trading periods before all private information is revealed, long-lived informed investors

[10]The SEC recently charged a brokerage firm with so-called layering or spoofing (see **http://www.sec.gov/News/PressRelease/Detail/PressRelease/1370541406190#.VA3TwVeTHXo**).

[11]One widely discussed recent example in the markets involved an equity market participant who desired acquiring a few million shares on a net basis; to do so the participant executed hundreds of millions of shares in buy and sell orders.

will manipulate in every equilibrium in the Chakraborty & Yilmaz (2004) formulation, which builds upon the Glosten & Milgrom (1985) framework. This suggests that in some formulations manipulation is an inherent aspect of profit-maximizing behavior. This raises a fundamental question about proper regulatory decisions, as a broker-dealer who did not manipulate in implementing his order execution strategy would arguably not fulfill his best execution responsibilities. Because of competitive pressure among followers, the insider may bluff and undertake unprofitable trades early in his trading sequence (Chakraborty & Yilmaz 2008). It also bears emphasis that the endemic nature of manipulation depends upon the underlying theoretical foundation. In contrast, in the linear equilibrium in the Kyle (1985) model the informed investor's profit-maximizing strategy always involves trading in the same direction rather than manipulation, as it would detract from profitability to engage in destabilizing trades and pricing.

One of the interesting practical issues that has received considerable attention with the recent focus on high-frequency trading is the placement of orders that is immediately followed by cancellations. With improvements in technology and changes in trading rules, there is greater ability to control orders (both place and cancel orders quickly) and consequently, there has been a dramatic increase in cancellation rates. This raises an interesting question as to whether orders should be considered manipulative because they are cancelled with very high likelihood. Though this is a legal question, my own perspective is that although such orders could be manipulative if there is no intent or interest in executing the orders being placed, we should regard cancellations as a way for traders to protect themselves when their contingent orders cannot be filled. However, this is a somewhat elusive issue as the actual intent could be to execute a particular order with low, but nonzero, likelihood. This leaves ambiguous the answer to how small of an expected fill rate signifies manipulative intent. At the same time, it is worth emphasizing that the observed cancellation and fill rates would signify anticipated cancellation and fill rates under rational expectations. Of course, as market circumstances change, investors will be reluctant to leave orders exposed to adverse selection and will potentially want to cancel them (without this reflecting obvious manipulative intent). Restricting cancellations, such as requiring a minimum resting or exposure time, would likely greatly reduce the degree of order placement and liquidity as a result of heightened exposure to adverse selection. Indeed, the cancellation of orders in the face of changing circumstances is far from a new practice. For example, a long-standing order type on the New York Stock Exchange (NYSE) had been a so-called fill-or-kill order, an order that was withdrawn automatically, if it did not fill immediately.

A related rationale for the high degree of order cancellations is that orders are used by investors to probe or test the order book, evaluating its parameters and sensitivity. Such testing is criticized indirectly as manipulative because it makes it more difficult for others to assess market demand.[12] Investors can use the responses to orders to understand the extent of hidden orders and thereby improve their order execution tactics. Leach & Madhavan (1993) provide an early study of price experimentation in which it was undertaken by the market maker rather than outside traders.

3. MANIPULATION, SHORT SALES, AND SQUEEZES

Manipulation would be especially problematic with respect to short positions. The view of securities regulators with respect to short-sale manipulation may be particularly delicate—on the one hand, the role of short sales is perhaps most significant for investor protection because it

[12]I would not classify a trade as manipulative solely because it has the indirect effect of making it more difficult for others to assess the market.

protects investors against purchasing overpriced assets, but on the other hand firms will complain about their short sellers much more than about their long investors. After all, management is not likely to complain if the firm's investors are manipulating the prices of the company's stock upward. Furthermore, the regulatory requirements are naturally more restrictive for short sellers (to ensure that the short seller can actually borrow the stock and to ensure that the short seller can meet his obligation) as compared to long investors (to prevent naked short sales in the aggregate and even at the individual level). Of course, the unlimited exposure of short sellers together with the possibility of a so-called short squeeze creates more potential concerns for regulation on the short side than for long positions.[13] Inherently, there is more natural demand to hold long rather than short positions, as a result of both the equilibrium consequences of market clearing (stocks are in positive net supply and so must be owned in equilibrium) and the differences in regulatory frictions.

The potential for manipulation can be relatively serious in the context of a short position, in contrast to a long position. This is because the investor faces (*a*) unlimited liability and perhaps even more fundamentally (*b*) risk of a severe short squeeze as the risks and costs of acquiring the stock to close his open short exposure could be considerable, if the float on the stock is very limited and the stock is held in a concentrated manner. Concentration of the long position provides the owner tremendous bargaining power when the short tries to acquire the shares to cover his exposure. In this sense, the investor who has a substantial short position is at risk of being squeezed due to his own contractual obligation to deliver the underlying security and forced to pay an artificial price to close his exposure due to the concentration of available stock (e.g., limited float) and the ability of the owner to hold out and drive up the selling price in the marketplace to extremely large levels. Consequently, the investor who is short is vulnerable to the possibility of being squeezed and facing a large manipulation of the price. A classic example is the fourfold increase in the price of Volkswagen on the Xetra DAX in just two days during October 2008. In light of the vulnerability of a short position to a manipulation, it is striking that empirical evidence from SEC manipulation cases (Aggarwal & Wu 2006) indicates that the vast majority involve attempts to raise the stock price (rather than decrease it), which the researchers interpret as suggesting that short-sale restrictions make it difficult to manipulate the stock price downward.[14]

The potential for market cornering and squeezes arises in an array of situations. At the heart of some of the more conventional opportunities is a short position. For example, Kyle (1984, 1992) highlights the potential for a squeeze through the delivery mechanism of a futures contract in which the party delivering has the option to choose the specific variety of product to deliver. Kyle (1984, 1992) suggests that at the heart of a squeeze is the threat to take delivery of much of the commodity and thereby force the shorts to pay higher prices because the alternative is using more expensive products to deliver. To effect the squeeze, the trader first purchases large quantities of the futures to create the conditions underlying the squeeze. (Kyle 1984 provides an early and fully articulated model of a futures price manipulation and squeeze.)

An interesting example of the bargaining power in a market corner (that is not directly based on short sales) occurs for sinking fund bonds for which an individual owner who is a unique supplier for bonds meeting a sinking fund call schedule can obtain the face value (due to the absence of

[13]Short investors are inherently disadvantaged compared to long investors in numerous respects—they face greater regulation, they need to post supplemental collateral to ensure future performance, and they do not receive full (or in some cases any) access to the time value of the short-sale proceeds created by the short sale of their assets. The latter suggests limited competition on the short-sale side.

[14]An alternative interpretation is that the effective economic costs of establishing and/or maintaining a short position are much greater than associated with a long position.

competition). In contrast, when there is effective competition for the marginal units, the bonds are only worth the market value absent the sinking fund requirement when the bonds are selling at a discount. Cornering the market to be the unique supplier can arise in a situation with a concentrated long position.[15]

4. ARTIFICIAL PRICING, MANIPULATION, AND CENTRAL BANKS

Some of the most visible examples of artificial pricing involve central banks. One recent example that has attracted extraordinary attention is the Fed's effort to raise bond values and reduce interest rates (even for intermediate- and long-term bonds, which had not been a possibility previously). The purchases of longer-term Treasuries and mortgage-backed securities by the Fed were motivated by an attempt to raise the values of these instruments, potentially creating wealth effects and reducing funding costs. Indeed, purchases by the Fed before they began to taper purchases had peaked at a rate of $85 billion per month, absorbing much or even more than the equivalent of the incremental Treasury debt. Although one would not necessarily use the specific term manipulation to describe these purchases, they are widely acknowledged to be an effort by the central bank to influence (manipulate?) artificially asset prices.[16] Given the scale of these purchases, it is an interesting context in which to think about the nature of manipulation. To what extent can we evaluate the effect of a manipulation; for example, what would asset prices be without manipulation? Although in some contexts one might try to draw conclusions based on estimates of the elasticity of demand, this seems to be a particularly difficult and potentially problematic challenge in the face of very large interventions.

For example, most observers of the Fed's intervention in 2012–2014 would find it difficult to determine the so-called as-if asset prices, even though we do have important foundational models of asset pricing under noisy rational expectations with supply shocks (e.g., Grossman & Stiglitz 1980 and the many models that build upon it). However, the extent to which asset pricing effects may be driven by the Fed's intervention could potentially be very large—if only as suggested by market observers' huge focus on it, the dramatic increase in market volatility in many markets (including equity), and the extraordinary increase in market interest rates after the initial discussion by (former) Federal Reserve Chairman Ben Bernanke in late May 2013 of the likely "taper" of the Fed's intervention. These extraordinary responses were especially dramatic in light of the minimal informational change. (For example, many had thought that the intervention would not continue indefinitely; moreover, the taper did not begin as predicted by many in early fall 2013.)

To the extent that the wealth effects that arose as a consequence of the policy were viewed as especially important to policymakers, this highlights that the asset pricing that emerged was artificial and may distort important price signals in the economy.[17] This may even represent the mechanism by which this monetary policy has effects. For example, "Throw market manipulation into the mix and things get really confusing," said hedge fund investor Stan Druckenmiller (Agnew

[15]This context is described in detail, and the Nash equilibrium is analyzed in Dunn & Spatt (1984). The resulting equilibrium entails a two-part pricing schedule; the bonds for which there is scarcity value given the distribution of ownership command a higher price, while the remaining bonds do not command any scarcity value.

[16]One point to emphasize is that few, if any, observers would view these purchases as illegal, although certainly some/many observers have questioned the effectiveness of the program, especially in its most aggressive and recent forms (e.g., Lacker & Weinberg 2014).

[17]This is not a comment focused solely on contemporaneous low short-term interest rates per se, which presumably (at least in substantial part) reflected the limited productivity of capital in the economy (e.g., compared to the past) and which would not create the wealth effects associated with low long-term interest rates.

2013). “If the most important price in the most important economy in the world is being rigged, and everything else is priced off it, what am I supposed to read into other price movements?” he continues (Agnew 2013). Using a traditional microeconomic theoretical model, Goldstein & Guembel (2008) suggest that a portion of the profit of the manipulator arises from the impact of distorting the investment choice of the firm through the distortion in price signals. (The feedback effect of the manipulation for investment and the weakening of the allocational role of the financial market can be important consequences of the manipulation.) In effect, the distortion to investment decisions may be at the root of the manipulation rather than simply a consequence (see also the introductory paragraph of this review). This points to an alternative potential parallel interpretation that suggests a possible impact from using monetary policy in an attempt to alter investment choices.

There are diverse views about the impact of central banks in financial markets. One important cliché is “don’t fight the Fed”; certainly the market reaction to the Fed’s liquidity intervention in 2012–2014 and even the dramatic reaction to the initial discussion of tapering are in that spirit. Somewhat analogously, in foreign exchange contexts under fixed-exchange rates central banks often express interest in maintaining or supporting the exchange rate. In sharp contrast to this context, however, the central bank can even be regarded as somewhat of a “patsy” in foreign exchange trading when it seeks to maintain an exchange rate that is at substantial variation from the pricing that would otherwise clear the underlying markets without intervention; perhaps the most famous example of this is the fortune made by George Soros and Stanley Druckenmiller in responding to and at the expense of the Bank of England two decades ago. Soros and Druckenmiller sold more than $10 billion in pounds on what is now referred to as Black Wednesday to profit from the reluctance of the Bank of England to float the pound or to raise interest rates to the levels of continental Europe after determining that it lacked the resources to follow through on its strategy, leading to the devaluation of the British pound. This example illustrates that manipulation is relevant for a broad range of financial instruments, not only for traded securities.

5. OPENING, CLOSING, AND INTRADAY TRADING

There are various situations in which investors have information that suggests that they can exploit opportunities that arise due to artificial market pricing in various portions of the trading day, including obtaining liquidity at the closing price through mutual fund transactions. For example, let’s consider the closing price on a trading floor as well as the way in which closing prices are used by mutual funds to compute daily valuations. In many trading platforms, such as the NYSE, different mechanisms from those used within the trading day are used in the closing and opening processes. This is natural because during the end-of-the-day as well as at the opening of trading there is considerable aggregation of information[18] and, consequently, the use of a single market-clearing price. In the context of the NYSE, the market maker enjoys some of his little remaining advantage[19] through a potential last-mover advantage in setting the opening or closing prices.

For example, in an earlier era when the specialist played an especially prominent role on the NYSE, we observed substantial negative correlation between close-to-open (overnight) and the subsequent open-to-close (trading day) returns (Stoll & Whaley 1990). This suggests that some of the innovation in the opening price relative to the prior closing price reflects an artificial increase

[18]In the case of the opening price, this is a consequence of limited trading immediately earlier, and in the case of the closing price, this reflects the onset of limited trading due to the upcoming mechanism.

[19]Over the past decade, changes in the trading rules across platforms have reduced the NYSE’s market share of its own listings from almost 80% to 20%.

(decrease) in the overnight price change prior to a partially offsetting decrease (increase) in the subsequent within-day price change. Stoll & Whaley (1990) suggest that this reflects the market maker's exercise of monopoly power in the opening process—the specialist uses his last-mover advantage to partially cushion the order imbalance of other investors (which reflects the optimal strategy of the market maker exploiting his market power, as illustrated in the related discussion of monopoly in more general contexts, such as Kyle 1985; this is somewhat related, although there the insider possesses market power, whereas the market maker is competitive). The negative correlation associated with the opening and subsequent return is similar to bid-ask bounce within the trading day, although the effect at the open and the extent of the market maker's monopoly power can be more pronounced then.

A central feature of the opening (and closing) mechanism is the price discovery process—how does value get determined? In their study of the rather different (more competitive) market structure on the Paris Bourse, Biais, Hillion & Spatt (1999) note that the preopening process incorporates virtual (indicative) trading. It is striking that prices there were just noise until approximately 10 minutes prior to the opening (one cannot reject the null hypothesis that prices are noise relative to the opening price until then) and that the indicative prices are relatively efficient predictors of the opening. Because of the nature of virtual (indicative) trading, one could expect a priori somewhat greater scope for manipulation in such an environment through virtual prices, as executions do not occur until the end of the preopening.[20]

One aspect of the closing process that is especially interesting with respect to price discovery is the use of market-on-close orders (see Mayhew, McCormick & Spatt 2009), which provides a way to commit to closing executions on relatively favorable nominal terms. The closing auction, as with the opening one, provides important last-mover advantages to the market maker, who has some monopoly power at the closing. Indeed, to assure execution, outside investors must commit to a market-on-close order well before the closing, which can confer a substantial market advantage to those who have access to the information in advance and can at least leave open the potential for countertrading in that market because an investor who uses such a market-on-close order could be vulnerable to front running. An order type that would appear to almost dominate the market-on-close order is a limit order placed near the closing, because it would not require precommitment by the initiator and therefore not be exposed to adverse selection (at least nowhere near the same degree). However, such a limit order does not assure execution (at the closing price or otherwise).

A related type of vulnerability of the closing auction is the possibility of orders an instant before the close, motivated in part by interest in manipulating the auction price by limiting the ability of other investors to respond to the order. Sueng & Wan (2011) point to evidence of this (which they term price sniping) on the Hong Kong Stock Exchange, and recently, the SEC sanctioned a high-frequency trading firm for placing rapid-fire transactions to manipulate the closing pricing of thousands of NASDAQ-listed stocks over a six-month interval (SEC 2014). Indeed, the use of such tactics can lead to relatively variable prices and highlights indirectly the limitation of market-on-close orders with early deadlines (i.e., their vulnerability to being exploited). Comerton-Forde & Putnins (2011) quantify the effects of closing price manipulation. Deadline effects can create strong incentives for orders to be provided immediately before the deadline to maximize the information available and especially to limit the strategic response. Deadline effects were first highlighted by Roth, Murnighan & Schoumaker (1988) in an experimental setting and later by Biais, Hillion &

[20]A somewhat related theoretical analysis is provided by Medrano & Vives (2001), who find that a large informed trader using the price discovery process employed in opening auctions manipulates the markets by neutralizing the trades of informed competitive agents.

Spatt (1999) in the context of a virtual preopening. Clearly, these are of crucial potential significance to a closing auction, and indeed, Sueng & Wan (2011) suggest random timing of the closing auction within a trading environment to mitigate the potential price sniping that can arise.[21] Although it often has been viewed that a closing or opening auction is less vulnerable to manipulation because of the thickness of the market, the discontinuous transition to the auction does point to vulnerabilities for possible manipulation as illustrated by the potential for manipulating virtual (indicative) prices during the preopening when it is not costly (or is of very limited cost) to artificially alter the price as well as the run-up to the closing auction. Structuring the random timing of the opening or closing auction in a suitable manner can help smooth the discontinuous transition.

An important market context in which closing prices can be accessed by investors is the purchase and sale of open-end mutual fund shares. Mutual funds offer liquidity through their closing prices, which both highlights one of the reasons for the importance of closing prices and raises questions concerning how mutual funds can provide liquidity in this manner, especially in light of the complications in determining closing prices and the degree to which mutual fund pricing is artificial and subject to manipulation. Mutual fund pricing is an interesting beast; it had been based largely on the closing transaction prices for the underlying instruments owned by the fund.[22] The potential for staleness in pricing led to the mutual fund market timing scandals a decade ago, as many investors were able to exploit lags in the pricing of international assets (or relatively illiquid assets) whose most recent transactions were substantially prior to the closing of the markets in New York, but whose valuations were somewhat predictable due to trading in correlated assets, such as futures contracts or instruments in other platforms. Indeed, pricing the mutual fund products in a relatively passive manner can lead to an inherent artificial dimension in its pricing.[23]

Even more fundamentally, the pricing of the mutual fund product is independent of both the direction and size of closing trades in the mutual fund itself—even independent of the size of the signed aggregate closing trade. The price is applied independent of the signed aggregate flow, so needs to be robust—which itself would be a challenging determination unless one could condition upon the signed order flow. An inherent difficulty that the mutual fund faces is its need to both buy and sell itself at a prespecified price. Indeed, in other contexts intermediaries require significant price concessions to offer to supply or demand a basket of securities at the closing price (and often require that such orders be declared hours in advance). This illustrates the potential costliness to the mutual fund of offering to transact in either direction at the mutual fund's daily closing as well as on a potentially large scale. To mitigate adverse selection, the securities could be offered through a blind auction rather than identified, as highlighted in Kavajecz & Keim (2005). The frequent lack of advance knowledge of the direction of the trade in the case of the mutual funds (a huge relative informational disadvantage compared to the broker-dealers who are counterparties to the prepackaged trades), together with the explicit fee charged by securities firms for prepackaged trade, points to the costs faced by a mutual fund in supplying liquidity without it being priced explicitly.

[21]In a more traditional continuous trading context, Harris (2013) advocates the use of random system delays to reduce the incentives of traders to invest in an arms race with respect to technological speed using colocation and other techniques to gain microscopic time (and first-mover) advantages in the aftermath of the arrival of common shocks to the marketplace. Patterson (2014) provides a recent discussion that illustrates the arms race.

[22]In some instances, mutual funds substitute the use of fair value pricing rather than last transaction prices, but absent extraordinary conditions often have used the prior transaction prices. To speed the computation of the mutual fund price (and assure that the valuation weights are readily available), most fund complexes actually use the prior day's holdings to weight fair value or today's final asset prices (see Tufano, Quinn & Taliaferro 2012).

[23]Greater attention to fair value pricing rather than the use of stale prices has helped eliminate much of the exploitable bias in mutual fund pricing and greatly reduced concerns about mutual fund market timing.

Liquidity (depth) provided by the mutual fund is not free for the fund; to the extent that liquidity would be costly to provide through the marketplace, these costs are indirectly being borne by the mutual fund, suggesting inherent vulnerability of this aspect of the mutual fund regulatory regime (this vulnerability was further reinforced by the mutual fund market timing issues that had been faced by many mutual funds one to two decades ago). A simple way to internalize these costs is the exchange-traded fund (ETF), whereby investors enter into separate transactions with one another, potentially fully internalizing these liquidity costs in market-clearing transactions. In the same spirit, a mutual fund's valuation could be conditional on the orders to buy or sell the fund at the close. Of course, this would imply that the pricing of a mutual fund product would not be uniquely determined by the underlying composition of its assets and would not be derived in a mechanical fashion from the closing prices of the underlying assets on a trading platform.

A related weakness of the mutual fund pricing model is the capital gains tax externality—when investors with appreciated positions sell their mutual fund shares, the fund incurs tax liability, which is shared among the fund's full set of owners (so that the realization of capital gains by other fund owners creates tax externalities among the owners). Again, the ETF structure avoids this complication. Similarly, the mutual fund market timing problems that were so prevalent a decade ago in which the pricing of mutual funds was artificial would also be finessed by the ETF model because pricing would be structured to clear the market for this asset. As such, pricing would be conditioned upon the net demand (order flow), rather than computed in a mechanical fashion that would allow investors to exploit potential staleness.

6. CONCLUDING COMMENTS

Financial market manipulation and artificial market pricing have been subjects of long-standing interest by regulators and market participants. In this review, I examine this theme through the lens of recent market developments highlighting such issues as trading tactics that have played important roles in the trading process in recent years, renewed interest in short selling, the role of the Fed in transforming market interest rate signals, as well as the role of different portions of the trading day.

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