

Comment Letter to the SEC

Regulation of Dark Pools and Other Trading Interests
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Elizabeth M. Murphy, Secretary
Securities and Exchange Commission
100 F. Street, NE., Washington, DC
20549-1090

Dear Ms. Murphy:

I appreciate the opportunity to comment on dark pools and other related issues that the Commission is currently grappling with.

By way of personal background, I am a Professor of Finance at the Zicklin School of Business, Baruch College, CUNY. My area of research and teaching is securities market microstructure, and I have been an observer of market structure developments since the days following the 1975 Securities Acts Amendments.

Since 1975, we have experienced tremendous change in the structure and operations of the equity markets. Quite dramatically, the transition has been made from manual, human intermediated trading to predominantly electronic trading. Remarkably, however, the fundamental issues that are currently being addressed in the regulatory debates have hardly changed at all. Matters such as transparency, competition (the consolidation/fragmentation issue), and fairness have been high on the list of items that the Commission has been and continues to be concerned with. Transparency, in particular, is prominent in the current Dark Pool Concept Release.

It is not debatable that, all else constant, transparency, competition, and fairness are all desirable, and that regulatory attempts to make markets more transparent, more competitive, and fairer are well intentioned. The problem, in my opinion, is that “all else” is not constant. Consequently, it is very difficult to force these attributes on the market without causing other problems (which are commonly and rather euphemistically referred to as “unintended consequences”). Despite all of the regulatory and market structure innovations of the last thirty or so years, our markets remain in good part opaque, competition is not in all respects panning out the way one might like it to, and

the playing field does not appear to be much fairer. In this comment letter, I address each of these attributes separately. I also suggest that not one of them should be taken as an ultimate regulatory goal. I urge that more fundamental objectives concerning liquidity creation, price discovery, and the containment of accentuated intra-day volatility be moved to center stage.

Transparency

The term “dark pools” refers to liquidity pools that do not display the price, size, or even the existence of submitted orders. Rather, they are opaque. My remarks in this section concerning dark pools apply to those opaque venues that have been established to handle large, institutional size orders.

For very understandable reasons, opacity is required for handling large orders. No portfolio manager (or buyside trader) would want the market to know of his or her desire to buy or to sell, for instance, 300,000 shares of a stock that, on average, trades 500,000 shares a day. Dissemination of this information would only serve to drive market prices up for a buyer or down for a seller. Buyside traders seek to mitigate their market impact costs by slicing and dicing and thereby obscuring the orders they submit to a lit market, and/or by sending their orders in larger blocks to a dark pool trading venue. Of course, neither strategy offers users perfect results, however. Try as they might to keep them hidden, the order flow from the large traders may leave footprints that can be sniffed out by others in today’s technologically interlinked, high frequency, electronic marketplace.

While the terms “dark pool” and “dark liquidity” are new, the reality is not. The NYSE trading floor has historically been a pretty dark pool; nobody could see the orders that were held in floor traders’ pockets (although the existence of these orders could be inferred). The Nasdaq dealer market has historically had dark pool features, as larger blocks are handled and turned into trades with relative opacity (although the possibility of information leakage is always a reality).

Both the NYSE trading floor and the Nasdaq dealer market can be understood as institutional arrangements that facilitate quantity discovery in the dark. Larger orders find each other and are turned into trades when, pre-trade, neither side of the market is willing to reveal publicly its buying or selling intentions. It is interesting to note that electronic dark pool venues have emerged in far greater numbers concurrent with both the NYSE trading floor and the Nasdaq dealer market having been diminished to fractions of their former selves.

In my opinion, any regulatory attempt to retard or to reverse this shift, or to force the dark pools to further information disclosure, would run the risk of substantial unintended consequences. As I have noted above, all else constant, greater transparency is desirable. Unfortunately, all else is not constant.

Competition

With few exceptions (a natural monopoly, for example), economists and regulators have long favored markets that are competitive. For the equity markets, intensified competition has long been sought in the form of stronger inter-market competition. Vibrant competition between alternative trading venues has been counted on to keep exchange fees low, bid-ask spreads tight, and innovation vibrant. Again, all else equal, the objective is supportable.

Unfortunately, there is a tradeoff: strengthening inter-market competition fragments the order flow. This weakens competition in a different market: the market where the buy and sell orders themselves compete. With regard to this one, I have long been a supporter of consolidated order flow. I believe that intensifying competition within the order flow strengthens the liquidity pool and leads to enhanced price discovery.

Order flow can fragment in two ways: spatially and temporally. The spatial dimension has received the lion's share of attention. Currently, we have a plethora of alternative trading venues, many of which are dark pool facilities. As is clear from my comments above, the lack of transparency, in my opinion, is not the major concern. Rather, the problem lies in the multiplicity of facilities. Of course, inter-venue connectivity helps. But is it sufficient to effectively put Humpty Dumpty back together again? Opinion is divided on this one. Some people think that connectivity is the antidote for fragmentation; others feel that price discovery and quantity discovery are adversely affected in the spatially fragmented environment. I side with the skeptical observers on this one. I suggest that the Commission explore this issue further.

Fragmentation's temporal dimension is of major consequence. Temporal fragmentation refers to the problem of how orders meet each other in time in a continuous trading environment. Liquidity is unduly thinned out in continuous trading, especially when bi-lateral matches are made in a high frequency environment where time is measured in microseconds. In the NYSE's older, non-electronic market, a specialist could effectively halt trading whenever a slew of new orders arrived in a brief interval of time (a few seconds or so). When faced with rapid order arrival, the specialist, not knowing who exactly came first, who exactly should be matched up with whom, or what a reasonable price might be, would effectively batch the orders together so as to set a single price that was fairer for all. This temporal batching of orders is not occurring with continuous, electronic trading with time measured with micro-second precision. The Commission might ponder the effect that trading with micro-second precision has on the dynamic behavior of price discovery (and, by extension, the level of intra-day price volatility).

Fairness

Fairness is a noble goal. It is also a particularly difficult goal to achieve. To a large extent, the fairest of all trading environments is a periodic, single price, multilateral trading environment that is referred to as a “call auction.” Electronic calls are currently being used to good advantage to open and close markets in major market centers in the U.S. and Europe. With call auction trading, all participants, both large and small, and both better informed and relatively uninformed, can enter their orders for simultaneous execution at the same price, and at the same time (when the market is called). Because they amass liquidity (that is, obviate some of the temporal fragmentation discussed in the previous section), call auctions are also more difficult to manipulate. All of this adds up to a trading environment that puts a broader spectrum of participants on a more equal footing. In this sense, call auction trading is fairer.

But call auctions do not offer participants executional immediacy. For this reason, call auction trading is typically combined with continuous trading in a hybrid market structure (commonly, trading starts with an opening call, is followed by continuous trading, and ends with a closing call). Fairness, however, is considerably more difficult to achieve in the continuous market.

Continuous trading emphasizes the importance of speed. Alternatively stated, speed has economic value in continuous trading. When a trade is made whenever a buy and a sell order cross in price, traders who are able to get their orders to market fastest can achieve executions to the disadvantage of others. For instance, the better informed can more easily hit the orders of the relatively uninformed. In today’s high speed environment, the very location of a participant’s computer affects his or her success as a trader and co-location bestows a sizable economic advantage.

Recognizing this, what steps might the Commission take to ensure that a market is fair to all? Two absolutely essential regulatory functions, guarding against abuses of power and position, and controlling for systemic risk, can be viewed in the context of fairness. It is unrealistic to think, however, that the continuous market could ever be turned in other respects into a totally fair and level playing field. Unfortunately, excessive attempts to do so can (once again) have unintended consequences.

Liquidity Creation: A Fundamental Objective

A major economic function of the securities markets where already issued shares are traded is to facilitate capital-raising in the market where new shares are issued. This function underscores the importance of liquidity. If investors are not able to rebalance their portfolios at reasonable cost, in reasonable size, and in a reasonable amount of time, they will not buy newly issued shares in the first place. This would have devastating implications for the economic growth of the country.

Much attention has been given in both industry and academia to two parameters of a stocks’ returns distribution: mean (a stock’s expected return) and variance (a commonly accepted measure of risk). But investors do not operate in a two dimensional

world. There is a third dimension – liquidity. Risk constant, the expected return for a stock should be less (and the company’s share price should be commensurately higher), the more liquid the marketplace where the shares are traded. Accordingly, risk constant, greater liquidity lowers the cost of capital for companies, and thereby spurs growth for the broader economy. But liquidity does not just happen. It is created.

That is, a stock’s liquidity is not simply an exogenously determined characteristic of the stock itself (as one might consider risk to be). Rather, it very much depends on the governance rules of the marketplace which have been established by the markets and by government regulators. The primary suppliers of immediately available liquidity are limit order traders in an order driven market, and market makers in a quote driven market. Are limit order traders (in aggregate) and dealers (in aggregate) providing socially optimal amounts of appropriately consolidated immediate liquidity? I think it safe to say that the answer is “no,” that the problem is one of undersupply.

The development of strong and deep liquidity pools should be one of the most important, overarching objectives of exchanges and regulators. As such, it is critically important that rules concerning order exposure, order flow consolidation/fragmentation, and fairness which the Commission is now contemplating be assessed in terms of how they will affect the depth of our liquidity pools.

Price Discovery and Quantity Discovery

Liquidity, however, being difficult to define and to quantify, may not itself be an operationally viable regulatory objective. Recognizing this, let us consider two economic objectives that are more fully realized in a more liquid marketplace: accurate price discovery and complete quantity discovery.

Let us first focus on price and quantity discovery in a well attended call auction. At the time the market is called, buy orders are sorted and cumulated, from the highest priced buy to the lowest priced buy. Similarly, sell orders are sorted and cumulated, from the lowest priced sell to the highest priced sell. When graphed, the cumulated buy orders describe a downward sloping curve (much like the demand curve of microeconomics) and the cumulated sell orders describe an upward sloping curve (much like the supply curve of microeconomics). The intersection of these two curves establishes the market clearing price (which may be thought of as an equilibrium value) and the (equilibrium) number of shares to execute. Price discovery refers to finding that market clearing (equilibrium) price, and quantity discovery refers to trading that (equilibrium) number of shares.

In both economic theory and call auction trading, price and quantity (here, the number of shares traded) are determined simultaneously. The simultaneous solution has desirable properties. One of these is that the clearing price is set at the value which maximizes the number of shares that trade (and that, after all, is what a market is all about).

In the remainder of this letter, I will pay primary attention to price discovery. True equilibrium values, of course, are achieved only when all participants fully reveal their orders to the market. Order revelation is never complete, however, and there is little reason to presume that clearing prices in real world call auctions are perfect reflections of true equilibrium values. In continuous trading, on the other hand, price discovery is a more protracted process, and transaction prices are noisier reflections of equilibrium values.

Accurate price discovery has wide importance for the broad market. I have pointed out that a market, in discovering price, is producing a public good. I put it this way [Schwartz (2010)]:

“A classic example of a public good is the beam from a lighthouse that any ship passing in the night can see. Similarly, an exchange produced price shines light on a stock’s valuation that is used for a multiplicity of purposes that lie outside the trades themselves. These include marking-to-market, derivatives pricing, estate valuations, and converting mutual fund cash inflows (redemptions) into shares (cash). And there is one further use: the dark pools themselves are beneficiaries of exchange produced prices. With regard to this one, one might note that trading in these secondary markets free rides off of the prices produced in the primary markets.”

Price Volatility

For one simple reason, the quality of price discovery is itself difficult to assess: deviations from equilibrium values cannot be easily quantified because equilibrium values are not directly observable. However, the deviations do leave their imprint on the transaction record. They do so in the form of accentuated short period (e.g., intra-day) price volatility.

The elevation of intra-day price volatility has been well documented in the academic literature. While bid-ask spreads and market impact costs are contributing factors, my own empirical findings suggest that, to a significant extent, the accentuation of intra-day volatility is attributable to noisy price discovery. In this section, I summarize a few of my recent findings.

Ozenbas, Pagano, and Schwartz’s (2010) study, based on data for three exchanges (the New York Stock Exchange, Nasdaq, and the London Stock Exchange) and two years (2000 and 2004), examines the intra-day pattern of half-hour volatility for large cap, medium cap, and small cap stocks. I will underscore two findings and our interpretations of them:

- Across the board, volatility is elevated at market openings and closings relative to mid-day volatility. At the openings in particular, this pattern is

best explained by the difficulty of discovering opening prices after the advent of overnight news.

- At market openings, volatility is more elevated for large cap stocks than for medium and small cap stocks, while no significant relationship between volatility and cap size was observed at market closings. This pattern is best explained by the big caps playing a lead role at the openings with respect to price discovery.

Pagano, Peng, and Schwartz (2010), focusing on Nasdaq stocks for the months of February 2004 and February 2005, used one-minute measurement intervals to probe deeper into the volatility pattern. I will underscore two findings and our interpretations of them:

- With clear significance and substantial magnitude, intra-day volatility is most accentuated in the two minutes that immediately follow the open, and in the final minute that precedes the close. This result reinforces Ozenbas, Pagano and Schwartz's (2010) findings. In good part, the thirty-minute opening volatility accentuation documented in the earlier study is now found to be attributable to a sharp volatility spike in the first two minutes. This very much reinforces the conclusion that, at the open, noisy price discovery causes the volatility accentuation.
- Between the study's two sample dates, Nasdaq introduced electronic call auctions to open and to close their markets. Comparing the February 2005 results to the February 2004 results, we observed a significant reduction (but not total elimination) of the volatility accentuations in the opening and closing minutes of the trading day after the two calls were introduced. We attributed this reduction to the introduction of the two auctions. Achieving volatility reductions by instituting superior market structure underscores two important realities: (i) the opening volatility accentuation is indeed attributable to price discovery noise, and (ii) price discovery noise is not simply exogenously determined, but is controllable by the institution of superior market design.

Public Policy

The Commission is wise to keep a weather eye out for structural deficiencies in our financial markets, and the current request for comments suggests that there are in fact problems that should be attended to. The age old question is, where should the solutions come from, a government regulatory authority or the market centers and other venders of trading services?

Let us back up a step. Various empirical studies have suggested (and any number of commentators believe) that trading costs (principally commissions, bid-ask spreads,

and market impact costs) are indeed lower in the current environment than they were in the past, and that the reductions are not inconsequential. In the previous section, however, I called attention to the accentuation of intra-day stock price volatility. How might these findings be reconciled?

Commissions and spreads are relatively easy to measure. Market impact costs, however, are considerably more difficult to assess, especially for large traders who attempt to hide their intentions by slicing and dicing their orders for execution over an extended period of time. The opportunity cost of missed trades, another execution cost, is even more elusive to quantify. These costs (commissions, spreads, market impact, and opportunity) all apply to the participants in a trade. Noisy price discovery and accentuated volatility, on the other hand, impose costs on the broader market, and these should also be taken into account. But unfortunately, relatively little is known about how they have changed in recent years.

The decades of debate that we have experienced, the structural change that has occurred over the years, and an ever increasing regulatory involvement are testament to the complexity of the equity markets. This complexity may be understood, in part at least, by viewing an equity market as an ecological system. A multiplicity of diverse motives brings participants together to trade and, as is characteristic of an ecological system, a multiplicity is in fact needed for a market to function. The rules of trading determine how the parts of the ecology interact as participants' orders are brought together and turned into trades. Changing the rules for some participants affects their interactions with other participants and so can have consequences for the rest of the ecological system. With this in mind, I turn to four suggestions that I make in Schwartz (2010) [the thoughts were originally presented in Schwartz (2009)]:

“Suggestion #1: Exchange operations and brokerage operations should be more clearly differentiated. It is imperative that an exchange market's unique role in discovering price be explicitly recognized. The SEC Release, *The Regulation of Exchanges and Alternative Trading Systems* (Reg ATS) adopted in 1998, has created an environment that promotes a multiplicity of markets and hence fragmented order flow. It is important that the consequences this has for the quality of price discovery be better understood. With more accurate price discovery, individual and institutional investors will have more confidence in the quality of the prices that their orders are being executed at.

Suggestion #2: Order flow should be consolidated multiple times during a trading day in periodic, call-auction trading. With continuous trading, the technological ability to measure time and fire in orders with sub-millisecond precision fractures the order flow, thereby thinning out liquidity and disrupting the efficiency of price discovery. In contrast, call auctions by their very design match multiple orders so as to find the prices that best clear the market.

Suggestion #3: The impact of broker-dealers matching their customers' orders in-house to complete transactions should be studied closely.

Internalization, which preempts the market from setting prices, potentially disrupts the discovery of equilibrium prices. If price discovery is impaired, can

internalization nevertheless be justified by the operational efficiencies it may provide by eliminating steps in the transaction process? Perhaps not.

Suggestion #4: Accurate price discovery should take center stage as a regulatory objective of primary importance. The costs to investors that are implicit in inaccurate price discovery and the attending accentuation of intra-day price volatility may significantly outweigh the transaction fees, market impact and spread costs which typically receive much regulatory attention. I stress the importance of this fourth suggestion.”

In the context of the current Concept Release, I would add one further suggestion – that the Commission step back from its detailed management of order exposure rules and trading rules. Regulations that have unintended consequences can lead to further and more detailed regulations, and these can have further unintended consequences, and so on ad infinitum. It is indeed a slippery slope.

I wish to add one further thought. Due to powerful network externalities in trading, markets have a strong tendency to consolidate. Rather than focusing excessively on inter-market competition, I suggest that the regulatory authorities be considerably more willing to allow consolidation to occur naturally because of the benefits that attend consolidated order flow. With strict price priority rules enforced and reasonable secondary priority rules such as time or size specified, the full interaction of orders will lead to better liquidity creation, enhanced price discovery, and a more effective containment of accentuated intra-day price volatility.

Conclusion

Over the years, much regulatory attention has been devoted to augmenting transparency, competition, and fairness. Each of these goals is desirable in itself, but not one of them is readily achieved, and attempts to mandate their attainment can prove counterproductive. Moreover, each of these attributes is only a means to an end, not an end in itself. The more fundamental goal is enhanced liquidity creation, along with the attending accuracy of price and quantity discovery and the containment of accentuated volatility.

One reality must be honored: the equity market is a highly complex ecological system. In recent years, the large scale replacement of relatively slow, human intermediated trading with high frequency electronic trading and high frequency liquidity providers has had major impacts on the ecological environment and the participants who interact within it. In thinking about this, it is important to keep in mind that technology is itself neutral – its impact for good or for bad depends on just how it is being used. That said, the following questions can be asked:

1. How do the new, high frequency suppliers of immediacy contrast with the market makers of old?

2. How does the ability to measure time in microseconds instead of a few seconds or so affect the dynamic behavior of transaction prices?
3. Has the computerized era introduced two-tiered markets or have the markets always been two-tiered?
4. Information can be classified as either “fundamental information” (the underlying determinants of share value) or “trading information” (transaction prices, quotes, volume, etc.). High frequency agents in markets that are fragmented both spatially and temporally are operating more on the basis of trading information, not on fundamental information. What effect does increasing the percentage of order flow that is driven by trading information have on the quality of price discovery and the accentuation of short-period price volatility?
5. How does accentuated intra-day volatility match up against commissions, spreads and market impact, the more traditional kinds of trading costs?

Answering questions such as these is one thing; determining the regulatory actions to take in relation to them is another matter. As public policy is being formed, I stress that three fundamental goals of regulation be kept clearly in focus: (i) vibrant liquidity creation, (ii) efficient price and quantity discovery, and (iii) appropriate levels of intra-day volatility. I believe that these three goals will work well in harmony with each other.

Related Papers

This letter draws on a number of thoughts that are developed in further detail in some of my recent papers. These include:

Ozenbas, Deniz, Michael S. Pagano, and Robert A. Schwartz, “Accentuated Intra-Day Stock Price Volatility: What is the Cause?” *Journal of Portfolio Management*, Spring 2010, forthcoming.

Pagano, Michael S., Lin Peng, and Robert A. Schwartz, “The Quality of Market Opening and Closing Prices: Evidence from the Nasdaq Stock Market,” 2010, working paper.

Paroush, Jacob, Robert A. Schwartz, and Avner Wolf, “The Dynamic Process of Price Discovery in an Equity Market,” *Managerial Finance*, 2010, forthcoming.

Sarkar, Asani and Robert A. Schwartz, “Market Sidedness: Insights into Motives for Trade Initiation,” *Journal of Finance*, February 2009, pp. 375-423.

Sarkar, Asani, Robert A. Schwartz, and Nick Klagge, “Liquidity Begets Liquidity: Implications for a Dark Pool Environment,” *Institutional Investor’s Guide to Global Liquidity*, Winter 2009, pp. 15-20.

Schwartz, Robert A., “Discovering Price Discovery,” *Securities Industry News*, November 30, 2009.

Schwartz, Robert A., "Dark Pools, Fragmented Markets, and The Quality of Price Discovery," *Journal of Trading*, 2010, forthcoming. An earlier version of this paper, under the title "Dark Pools and Fragmented Markets," was published in the World Federation of Exchanges's *Focus*, No. 199, September, 2009.

If the Commission so desires, I would be happy to send any of these papers to you. Again, I think you for this opportunity to present my thoughts to the Commission.

Sincerely yours,

Robert A. Schwartz