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Practitioner's Abstract: *Traders' perceptions drive their market behavior, and can influence the dynamics of liquidity. This study surveyed 420 traders on their perceptions of the price path during an order imbalance to better understand the dynamics of liquidity. While most liquidity models assume a linear price path, only 12% of traders perceive such a path. This raises questions on the validity of such models. There is considerable heterogeneity in the perceptions of the price path. While trader characteristics are often used to classify traders, trader characteristics do not explain the heterogeneity in perceptions. On the other hand, traders of a specific contract are associated with particular perceptions of the price path. This indicates that market microstructure may be the primary driver of traders' perceptions of the price path.*

Keywords: *Liquidity, market depth, market microstructure, trader behavior/perceptions*

Introduction

Adequate liquidity can mean the difference between a successful futures contract or its failure. Speculators flock to liquid markets because of profitable opportunities and lower transaction costs, while hedgers are also concentrated in the more liquid markets, because liquidity provides hedgers lower transaction costs. Pennings and Meulenberg (1997) found a strong relationship between hedging effectiveness and market liquidity.

Kyle (1985) described liquidity as having three distinct characteristics: tightness, depth, and resiliency. *Tightness* is the cost of the quick purchase and sale of a contract. The bid-ask spread is often used to measure a market's tightness. *Depth* is the number of contracts needed to change prices. Finally, *resiliency* is the time needed to recover from shocks. While there is no direct way to measure liquidity, previous researchers have developed a plethora of different proxy measures. Many of the liquidity measures, such as volume and open interest, do not measure the economic cost of low levels of liquidity. The economic cost of liquidity is the opportunity cost of not being able to trade one's order at the equilibrium price. This is usually considered one of the intangible components of transaction costs. The bid-ask spread does begin to measure the transaction costs of small orders. However, most futures markets are very tight, meaning that trades of a few contracts are traded within one or two ticks of the equilibrium price.

It is the second characteristic, depth, which reflects the economic cost of liquidity for all orders. Lack of market depth reveals itself during temporary order imbalances. These occur when too many buy (sell) orders come to the market at once, causing prices to temporarily increase (decrease) above (below) the equilibrium price.

When trying to measure market depth there are two important dimensions: the speed of price changes and the magnitude of price changes. These aspects are reflected in the shape of the price path, which identifies how prices change as the number of contracts changes. Most liquidity measures have not explicitly considered the shape of the price path due to temporary order imbalances, assuming a linear price path. The shape of the price path due to order

imbalances is crucial, as it determines the liquidity costs that traders incur when trading in illiquid markets. In this paper, we examine traders' perceptions of the shape of the price path due to order imbalances. We focus on traders' *perceptions,* as they ultimately drive traders' behavior. This focus allows us to better understand traders' behavior when they believe there are temporary market order imbalances, and hence provides insight into the dynamics behind liquidity. Furthermore, a focus on perceptions allows us to test whether the current liquidity measures, which assume a linear price path due to order imbalances, are helpful when understanding market behavior. In addition, studying traders' perceptions regarding the shape of the price path due to order imbalances may provide information for exchanges to improve liquidity.

To explain and understand differences in traders' perceptions, we investigate whether traders' characteristics or characteristics of the market microstructure influence perceptions of the price path. This has important implications for exchanges when implementing changes designed to promote liquidity. If traders' characteristics are the driving force behind traders' perceptions, exchanges have limited tools to enhance liquidity, as they cannot change traders' characteristics. However, if micro-market structures are the primary factor(s) explaining traders' perceptions, then exchanges have various tools available, including making changes to their trading system or rules.

The remainder of this paper is organized as follows: First, we examine the current models of liquidity, followed by an explanation of our research design. Then, we discuss the results in terms of traders' perceptions in relation to trader characteristics, and perceptions in relation to market characteristics. Finally, we will conclude with the implications of the results and thoughts on further research.

Review of Literature

The numerous liquidity measures that have been proposed can be categorized into three broad categories: trade-based measures, order-based measures, and market-depth measures (Aitken and Comerton-Forde, 2003).

Trade-based measures

Trade-based proxies generally comprise some of the easiest and earliest measures of liquidity. They consist of measures, such as volume, frequency, trade value, and the open interest. However, none of them relate back to Kyle's definition or capture the economic cost of an illiquid market

While these measures are easily accessible and may lead one to believe they give some ability to infer the levels of liquidity, the conclusions drawn from the trade-based measures may be misleading. Aitken and Comerton-Forde (2003) tested a variety of liquidity measures using a known liquidity crisis. Their results showed a high correlation among the trade-based measures, which means one need not worry about which to use since all provide the same assessments (i.e., high reliability). However, this result becomes meaningless when combined with their second finding that the measures give the incorrect inference of liquidity (i.e., low validity).

Order-based measures

Order-based measures are some of the most widely used and accepted measures for liquidity. The majority of these measures revolve around the bid-ask spread, which is the difference

between the price above the equilibrium at which one may buy a contract and the price below the equilibrium at which one can sell a contract. Among the order-based measures are Roll's (1984) measure, the covariance of price changes, and Thompson and Waller's (1987) mean absolute price-change squared.

None of the bid-ask spread proxies measure any attributes of liquidity other than tightness, which reflects the economic cost of trade for small transactions. An alternative order-based measure is the aggregated daily order imbalance (Chordia et al, 2002). This is the number of buy orders minus the number of sell orders in the order book. Many exchanges do not have an open order book, especially in the open outcry platform, though there is a move to open books on the electronic systems. While this proxy does indicate the possibility of an order imbalance, it does not reflect the economic cost of liquidity.

Market- depth measures

Many of the market-depth measures are relatively new, because the amount of data and computations involved did not make their development practical until the computer age and the availability of tick-by-tick, or transaction-specific, data. Market depth is the number of contracts needed to move the contract price by one tick. An empirical difficulty with the market-depth concept is separating empirically price changes due to fundamental shifts from those due to temporary order imbalances.

The research on market depth was stimulated with the publication of Kyle's 1985 paper. The paper focused on how insider trader information is incorporated into prices and the effects it has on liquidity. Kyle separated traders into three categories: the informed trader, trying to maximize the profit derived from his inside information, market makers, and noise traders. It is important to note that the structure of the model hints that liquidity may be driven by the market microstructure in the way Grossman and Miller (1988) suggested. Assuming a linear price path, Kyle found that market depth is proportional to noise trading and inversely proportional to informed trading not yet incorporated into price.

Pennings et. al. (1998) presented an alternative model of market depth, in which the price path due to order imbalances is S-shaped and consists of four phases. They model the price path during order imbalances, utilizing the Gompertz's mathematical model of S-shaped curves that can easily be interpreted. The first parameter measures the rate of price changes, while the second parameter measures the magnitude of price changes. This allows a clear view on the execution costs of a particular order.

While the recently-developed market-depth measures address the execution costs of liquidity, and hence are valuable, these measures either assume a linear or S-shaped price path. The question then emerges whether this is the traders' perception of the price path. If it is not, traders may react differently to an order imbalance than these models predict. As a result, these models may give inaccurate predictions of the execution costs of trades and/or the level of liquidity.

Market Microstructure

The market-depth measures, particularly that of Kyle (1985), hint that market microstructure may be influencing market liquidity and hence traders' perceptions. Tse (1999) views market microstructure as the specific trading rules that create the unique dynamics of a market. In this paper, market microstructure is given three dimensions: composition of traders, trading systems, and trading regulations.

Grossmen and Miller's paper on liquidity and market structure (1988) discusses the composition of traders. They categorize traders into two types: market makers and outside customers. They also introduce four general categories to separate the types of market structure found in the stock market: continuous auction, designated specialist (or market maker), upstairs markets (for trading large blocks), and over-the-counter swap markets. Most of the trades at the futures exchanges are traded in open outcry pits (or their electronic equivalent), but many of the financial contracts at the CME also allow trading of large blocks of contracts outside of the normal trading pit (i.e. Eurodollar for trades over 1000 contracts). In addition, the CBOT has instituted a designated market maker in the Dow Jones Index contract, which makes it unique among the contracts studied.

The second dimension of market microstucture is the trading system. Different trading systems give the traders access to different types of information. There are three broad categories that divide trading systems: open outcry only, electronic trading only, and side-by-side trading. However, each exchange's electronic platform varies slightly in design and information revealed. Until recently, futures markets have always been open outcry auctions, where individual traders, known as scalpers, have provided liquidity using their own capital. Scalpers generally do not have quick access to fundamental information and do not have information about market depth. However, computerized trading systems have become very popular in the last decade. Many foreign exchanges have become completely electronic, but the Chicago exchanges are utilizing both electronic trading systems and open outcry auctions simultaneously (except agricultural contracts, which are open outcry only). Electronic trading systems usually provide knowledge of the depth of the market through an open-order book, but the knowledge of whom one trades with and other information from the pit, in particular sound, is lost (Pirrong, 1996). In the contracts studied here, three different trading systems are utilized. Corn futures, corn options, and the soybean complex are traded through open auction. Notes, bonds, and the Dow Jones Index use side-by-side trading through the CBOT electronic trade system. Finally, Eurodollars and the SP500 Index use side-by-side trading through the CME electronic trade system.

Finally, trading regulations also help create each market's unique microstructure. The federal government provides basic rules, consistent for all contracts studied here. However, exchanges also dictate rules and regulations that may vary for each contract, such as tick size, price limits, delivery mechanisms, and trading hours. These regulations help exchanges promote liquidity and maintain order.

There are relatively few papers concerning the market perceptions of futures traders (e.g. Mitchell, 2001 and Wang 2003), and none relate to how traders perceive liquidity. Understanding traders' perceptions may help explain how traders respond to temporary order imbalances, and explain the dynamics behind the liquidity of a market.

Research Design

To investigate traders' perceptions regarding the price path during order imbalances, we collected data from 420 traders at the Chicago Board of Trade (CBOT) and Chicago Mercantile Exchange (CME) traders through face-to-face surveys in 2003. We exposed traders to five different shapes of the price path, due to order imbalances. These five shapes, no price change, linear price path, exponential price path, step-wise price path, and S-shaped price path, were selected based on a pre-study conducted with 87 CBOT traders in 2002. In the 2003 survey, we

also collected data on traders' perceptions of the number of contracts that cause an order imbalance, how fast prices change during an order imbalance, and when the price hits resistance. In addition, we collected background information on the traders' primary commodities, their trading venues, and market capitalization.

The final survey used was short and concise, so that traders did not have to spend more than ten minutes filling it out. We set up tables adjacent to the trading floor for distribution and collection of surveys. This also allowed for individual interaction with the traders, who could ask questions or make suggestions. Many traders stopped to have conversations after completing the survey, which has enriched the analysis by helping us to better place our findings in context.

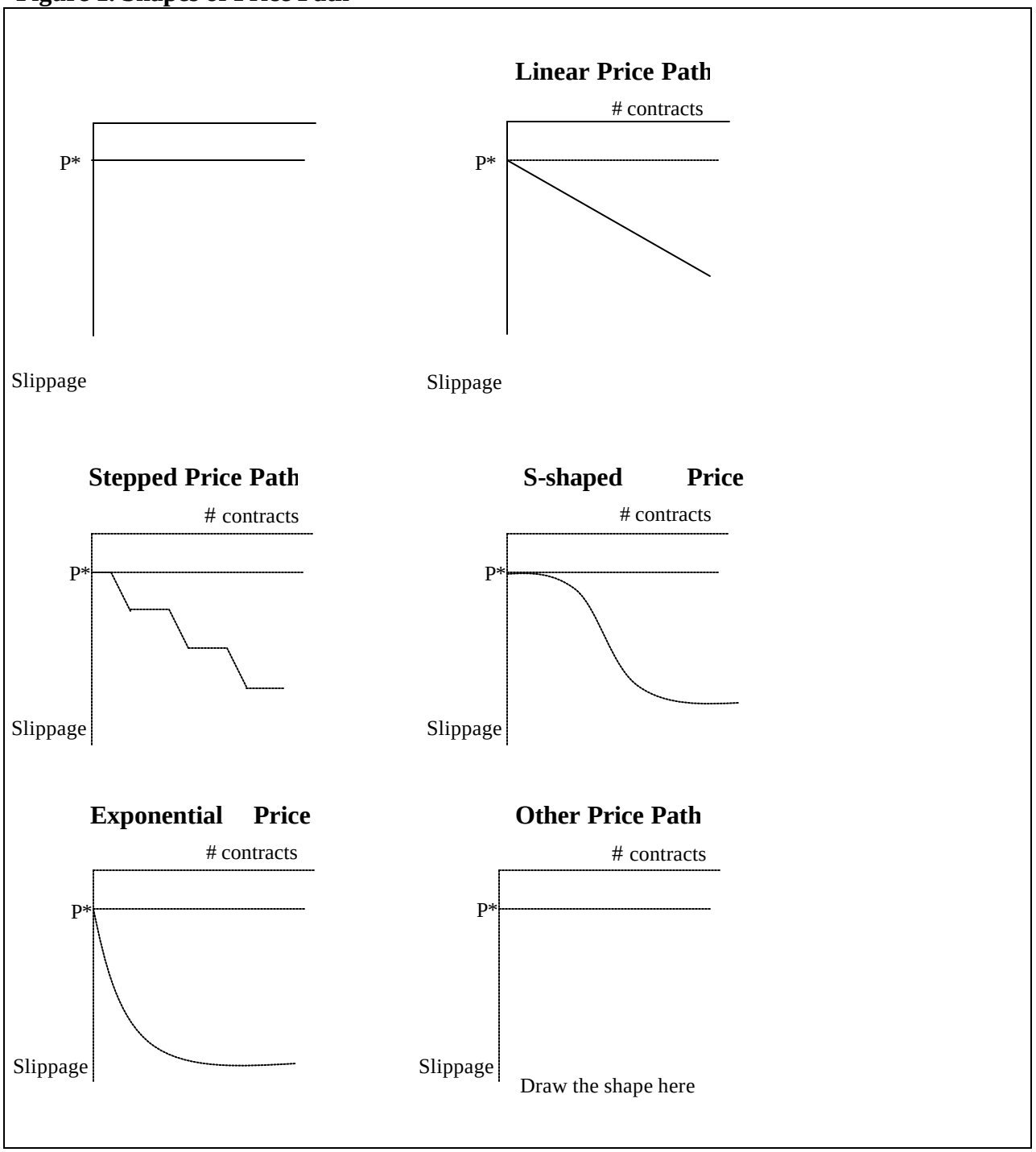
Survey design

The labeling of the horizontal and vertical axes is critical in properly framing trader response. Many models put time on the horizontal axis (for example, Grossman and Miller, 1988), because they are concerned about the immediacy of trading. However, the duration of an imbalance is not relevant to our research problem, as we are concerned with the execution costs associated with a lack of liquidity. To examine the cost of an illiquid market, one needs to know how much each contract traded deviates from the equilibrium price. Therefore, it is important to track the price path through the sequence of contracts traded. This interpretation is consistent with the models proposed by Pennings et al (1998) and Bessembinder and Seguin's (1993).

In addition, we also had a line showing the equilibrium price. This was done to emphasize how the price path due to order imbalance deviates from an equilibrium price. The final version of the five shapes that we exposed the traders to is shown in Figure 1.

Additional questions about the price path were used to gain a different perspective on the dynamics of an order imbalance. These questions were descriptive and included how many ticks a small or large imbalance would cause prices to change (in trader's primary market), how many contracts it takes to create an imbalance, and how fast prices change. These new questions also allowed us to check the accuracy of traders' different perceptions. For example, we hypothesized that a trader choosing the exponential shape to describe the price path due to order imbalances would also indicate rapid prices changes during the imbalance.

Figure 1. Shapes of Price Path



Results

Descriptive results

Participants in the survey were active traders at either the Chicago Board of Trade or the Chicago Mercantile Exchange. Over half of the traders worked in the financial markets, while

35% of the participants were in the agricultural markets. Only 5% indicated that they utilized contracts in both markets.

Type of traders

Traders tended to classify themselves as scalpers (22%) or choose multiple answers (22%) (See Table 1). A large number of traders indicated that they hold positions for less than an hour (46%). They choose very short time spans: seconds (15%) and minutes (18%). A chi-squared analysis shows that traders are consistent in their answers. Traders who responded that they held their positions for only seconds tended to classify themselves as scalpers, while those who answered that they held their position for longer than month classified themselves as a position traders ($?^2 = 245.889$, $p = 0.00$).

Table 1. Types of traders in Survey (N = 408)

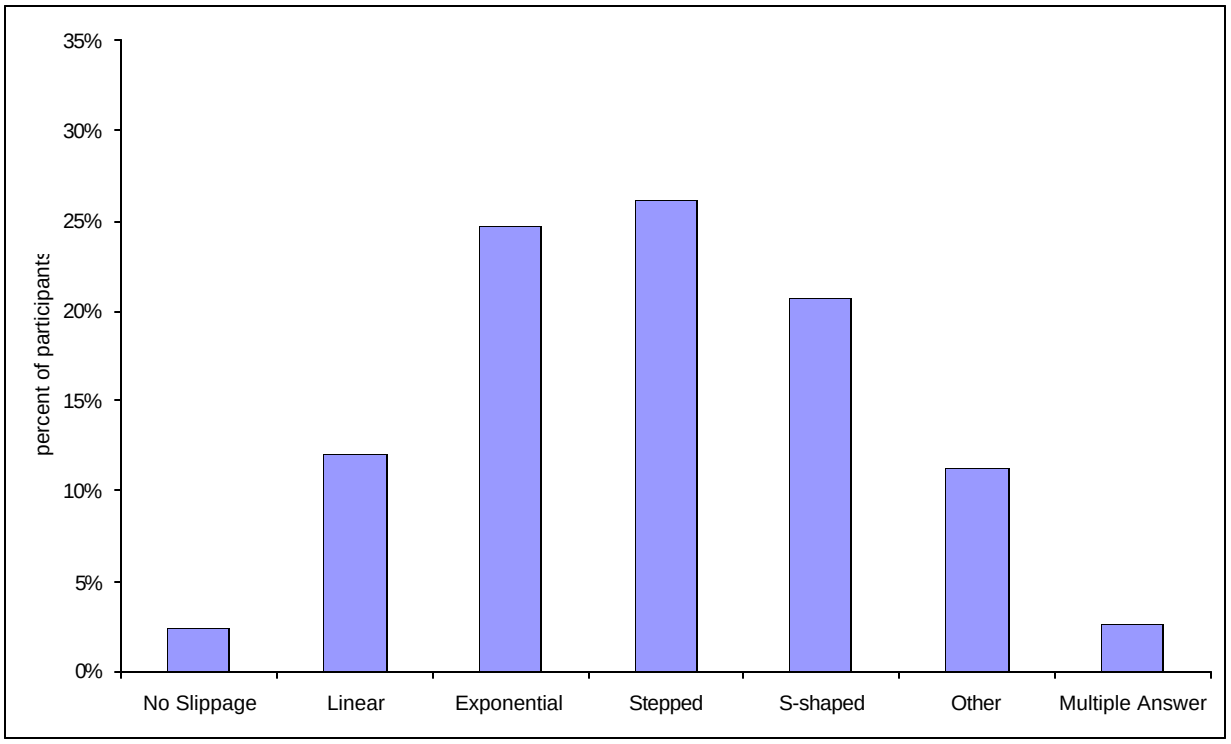
How long do you hold your positions?		Classify yourself as a trader?		What is your primary source of income?	
Seconds	15%	Broker	18%	Profits from scalping	14%
Minutes	18%	Commercial hedger	1%	Broker salary	12%
Less than 1 hour	13%	Scalper	22%	Broker commissions	16%
Hours	7%	Day trader	8%	Commercial positions	1%
Less than a day	10%	Position trader	16%	Profits from spread trading	17%
Less than a week	11%	Spread trader	13%	Profits from outright trading	29%
Less than 1 month	6%	Multiple answer	22%	Multiple answer	12%
Longer than 1 month	10%				
Multiple answer	10%				

The survey also asked, "What is the primary source of your income?" The purpose of this question was to help disentangle some of the multiple answers from the traders' self-classification. Many traders utilize the market in multiple ways such as brokering and scalping. While 22% of traders classified themselves as scalpers, only 14% indicated that scalping profits were the primary source of the income. Nevertheless, there still was a significant association between trader classification and income ($?^2 = 768.657$, $p = 0.00$), and between length of positions held and income ($?^2 = 177.235$, $p = 0.00$). Traders who classified themselves as scalpers also indicated that they hold their positions for less than 1 hour and that their primary source of income is from scalping, while traders who classified themselves as position traders indicated that they hold their positions for a month or longer and that their primary source of income is from outright trading.

Perceptions of the price path due to order imbalance

There was considerable variability in traders' perceptions of the price path. As seen in Figure 2, 2.4% of the participants perceived the price path due to order imbalances as no slippage, while 12.1% perceived a linear price path, 24.7% perceived an exponential price path, 26.1% perceived a stepped price path, and 20.7% perceived a S-Shaped price path. These results show that there is heterogeneity in traders' perceptions regarding the price path due to order imbalances. Hence, the current market-depth measures, which assume either a linear or S-shaped price path, may not reflect traders' perceptions.

Figure 2. Traders' perceptions of the price path due to order imbalances



Perceptions during imbalances

The vast majority (85.7%) of traders believe that the shape of the price path due to an order imbalance varies with the magnitude of the imbalance. Additional questions were asked about a small imbalance and a large imbalance. Traders were asked how many contracts create a small or large imbalance, the magnitude of price changes, and the speed of price changes. A wide variety of responses are expected on the aggregate level, because each contract has its own normal trading and liquidity levels. The results are shown for nine contracts with the largest number of traders responding. The responses in Table 2 show the magnitude of price change, the change necessary to bring about the price change, and the speed at which price changes increase between small and large order imbalances for each contract. In general, the results are skewed to the right because of large outsiders in the data (e.g. mean vs. median).

If traders' responses to the survey are consistent, we would expect traders who perceive an exponential price path, also to perceive the fastest changes in price during an imbalance. Table 3 shows that exponential traders did in fact see the fastest price changes on the aggregate level. The traders who saw the slowest price changes perceived a stepped price path, which does not have any price changes until its first jump.

Table 2. Differences between a small and large order imbalance

Characteristics of imbalance	Small Imbalance		Large Imbalance	
	Mean	**Median**	**Mean**	**Median**
Number of contracts causing imbalance		*Number of Contracts*		
Corn Futures	397	200	1511	1000
Corn Options	460	500	1500	1500
Soybean Complex	171	100	633	500
Eurodollar	2573	1500	10341	5000
10 yr notes	985	600	2367	1000
30 yr bonds	554	300	1861	1000
S&P500 futures	133	75	335	200
S&P 500 options	236	100	643	500
Dow Jones	97	100	337	200
Magnitude of price change		*Ticks*		
Corn Futures	3.4	2.0	8.0	6.5
Corn Options	2.6	2.0	6.8	4.0
Soybean Complex	5.2	4.0	14.0	10.0
Eurodollar	1.5	1	4.9	3.8
10 yr notes	2.5	2.0	6.6	4.0
30 yr bonds	3.7	3.5	12.6	9.5
S&P500 futures	8.7	5.0	28.0	20.0
S&P 500 options	4.3	3.0	11.3	7.0
Dow Jones	13.2	10.0	25.8	20.0
Speed of price change		*Scale (1 very slow - 7 very fast)*		
Corn Futures	3.8	3.0	5.5	5.0
Corn Options	3.1	3.0	5.3	5.0
Soybean Complex	3.8	4.0	6.2	6.0
Eurodollar	3.3	3.0	5.4	6.0
10 yr notes	3.5	3.0	5.9	6.0
30 yr bonds	3.8	3.5	6.1	6.0
S&P500 futures	4.3	4.0	5.7	6.0
S&P 500 options	3.2	3.0	5.3	6.0
Dow Jones	4.2	4.0	6.0	6.0

Table 3. Perceptions of the speed of price changes and shape of price path

Characteristic	Linear	Exponential	Stepped	S-shaped	Other	Sig.*
All Traders						
How fast does slippage occur when there is a large order imbalance? (1-very slow - 7-very fast)						0.02
	5.5	6.0	5.4	5.8	5.9	

*Based on ANOVA

Perceptions in relation to trader characteristics

We identified considerable heterogeneity in traders' perceptions of the price path during an order imbalance. How a trader perceives price movements during order imbalances may depend on his/her personal background. Most commonly traders are classified as speculators and hedgers or financial and agricultural traders. However, their education level, the importance they place on execution costs, and numerous other factors, may drive their perceptions. First, we examined whether trader characteristics are associated with particular perceptions of the price path on an aggregate level. Subsequently, traders are segmented by markets to examine if there are trader characteristics that are associated with a particular price path in specific markets.

In the survey, traders were asked which graph accurately describes the price path during order imbalances. No particular shape of the price path dominated traders' perceptions, but exponential, stepped and S-shaped price paths each received over 20% of the responses.

Fewer than 10 participants choose either no slippage or chose multiple answers. By choosing no slippage, the traders indicated that they perceived no change in price due to an order imbalance. Closer examination of these traders revealed that they were experienced agricultural traders, particularly in the corn market. Traders who chose multiple answers had a wide variety of backgrounds. They generally indicated different price paths for differently-sized order imbalances. Due to the low level of responses in the no-slippage and multiple-answer categories, they were not included in the subsequent analysis.

In the initial analysis, the entire sample was examined to see if particular trader characteristics were associated with how traders perceived the price path. The results are presented in Table 4. The limited number of significant relationships suggests that trader characteristics are not a driving factor behind traders' perceptions on the aggregate level. At the 5% level, the percentage of futures contracts traded is the only significant trader characteristic. Traders were asked what percent of their trading was in futures markets and what percent was in options contracts. Traders associated with the highest level of futures trading chose to draw their own price path, while traders who used options the most were associated with perceiving a linear price path.

None of the other characteristics were associated with a particular perception regarding the price path during order imbalances at the 5% level. However, at the 10% level, the type of market the trader uses was significant. Financial traders are more often associated with a stepped perception of the price path, while agricultural traders are associated most with an exponential or S-shaped price path. Informal conversations with financial traders revealed one possible explanation for financial traders' stepped perceptions of the price path. These traders preferred to make trades in specific normal-sized lots (i.e. 100, 500, or 1000 contract lots). Therefore, traders may perceive a stepped price path where each step is a different normal lot size with its associated bid-ask spread. Knowing the normal lot sizes may give an indication of where prices will drop and hence total expected execution costs.

Table 4. Perceptions of the price path associated with particular characteristics

Characteristic	Linear	Exponential	Stepped	S-shaped	Other	Significance*
			Mean			
Age	39.3	40.6	42.3	40.3	39.8	0.354
Began Trading	1990.4	1988.1	1987.8	1989.1	1988.9	0.501
Market capitalization	436,964	3,523,974	495,073	22,770,543	447,500	0.464
Average Daily Volume	1200.9	2104.5	1614.2	1378.8	1553.0	0.691
% Trades that are Futures	**72.7%**	**85.3%**	**78.3%**	**79.8%**	**92.2%**	**0.042**
			Percent of responses			
Exchange						
CME	14.0	24.8	25.5	21.7	14.0	0.737
CBOT	11.7	27.0	29.1	21.9	10.2	
Market						
Agricultural	**9.4**	**28.2**	**26.5**	**28.2**	**7.7**	**0.078**
Financial	**13.3**	**24.3**	**27.6**	**19.0**	**15.7**	
Both	**18.8**	**37.5**	**37.5**	**6.3**	**0.0**	
Education level						
None	0.0	0.0	0.0	0.0	100.0	0.579
High school	9.1	36.4	45.5	9.1	0.0	
Some college	12.7	21.8	27.3	21.8	16.4	
College graduate	11.1	26.0	27.9	22.6	12.5	
Some graduate school	13.8	34.5	31.0	17.2	3.4	
Masters degree	21.7	23.9	21.7	21.7	10.9	
Doctorate	0.0	50.0	0.0	50.0	0.0	
Time positions held						
Seconds	12.5	30.4	26.8	14.3	16.1	0.783
Minutes	13.1	27.9	26.2	23.0	9.8	
Less than 1 hour	6.7	20.0	28.9	31.1	13.3	
Hours	15.4	38.5	26.9	11.5	7.7	
Less than a day	12.5	28.1	21.9	25.0	12.5	
Less than a week	16.2	24.3	29.7	16.2	13.5	
Less than 1 month	4.2	12.5	29.2	33.3	20.8	
Multiple answer	10.3	31.0	34.5	13.8	10.3	
Greater than 1 month	18.8	21.9	21.9	34.4	3.1	

For the variables: age, year began trading, average daily volume, and % of trades that were futures a one-way ANOVA test was performed. For all other factors $?^2$ tests were utilized.

It is also interesting to identify some of the insignificant trader characteristics. While many studies of trader behavior divide traders into different trader classifications, there is no relationship between type of trader (e.g. scalper, spreader, etc.) and how one perceives the price path during order imbalances. The time traders tend to hold positions, nor their self-classification, nor their primary source of income are related to the perceived price path. Another non-related trader characteristic is at which one of the Chicago exchanges the trader operates. The market-structural differences between the exchanges appear not to be associated with a particular price path perception either.

Table 4. Continued

Characteristic	Linear	Exponential	Stepped	S-shaped	Other	Significance*
			Percent of responses			
Classification						
Broker	12.7	23.8	30.2	25.4	7.9	0.697
Commercial hedger	20.0	40.0	0.0	20.0	20.0	
Scalper	11.7	28.6	26.0	20.8	13.0	
Day trader	10.3	20.7	20.7	27.6	20.7	
Position trader	22.4	22.4	27.6	22.4	5.2	
Spread trader	10.0	32.0	30.0	20.0	8.0	
Multiple answer	8.5	25.4	29.6	18.3	18.3	
Income						
Broker salary	11.6	30.2	23.3	23.3	11.6	0.824
Broker commissions	13.0	14.8	37.0	24.1	11.1	
Commercial positions	16.7	50.0	0.0	33.3	0.0	
Profits from spread trading	4.9	31.1	27.9	24.6	11.5	
Profits from outright trading	17.0	25.0	25.0	21.0	12.0	
Profits from scalping	11.8	31.4	23.5	17.6	15.7	
Multiple answer	13.9	22.2	33.3	19.4	11.1	

For the variables: age, year began trading, average daily volume, and % of trades that were futures a one-way ANOVA test was performed. For all other factors $?^2$ tests were utilized.

Overall, the results from Table 4 do not help much in explaining the heterogeneity in perceptions of the price path during an order imbalance. However, they do indicate that it may be useful to study a trader's market to see how the nature of the markets is related to perceptions. The type of market (i.e. agricultural or financial) the respondent trades in is significant at the 10% level, but there is still much heterogeneity within the different markets. By aggregating the data, some trader characteristics that are significant on the market level may be hidden. Therefore, traders' perceptions of price paths were examined by market segment. The market segments chosen were agriculture, financial, exchange rates, interest rates, and stock indexes. The agricultural market was not subdivided, as grain traders dominate that segment. The financial markets were subdivided, since three distinct types of financial contracts are traded in Chicago.

As shown in Table 5, several characteristics relevant on a market level were not significant on an aggregate level. Trading venue, the importance of execution costs, and contract traded are related within a specific market. However, trader classification is not a driving force in determining traders' perceptions about the price path during an order imbalance. In none of the market segments was type of trader (i.e. broker, scalper, spreader, etc.) or duration of holding contracts significant. While these are common trader classification systems, they are not associated with particular price path perceptions.

Similar to the findings on an aggregate level, the percentage of futures contracts used by the trader is related to traders' perceptions for all financial markets and within stock index markets themselves. In each case, traders that were more active in the futures markets drew their own price path, and traders who were more active in options had a linear perception of the price path during an order imbalance.

Table 5. Perceptions of the price path associated with particular characteristics by market

Characteristic	Linear	Exponential	Stepped	S-shaped	Other	Significance*
All Traders						
What percent of trades are futures contracts?						0.042
	72.7%	85.3%	78.3%	79.8%	92.2%	
Segments						
Agricultural						
What is your trading venue?						0.058
Open outcry	9.1%	28.6%	26.0%	33.8%	2.6%	
Electronic	100.0%	0.0%	0.0%	0.0%	0.0%	
Both, prim. outcry	8.1%	27.0%	27.0%	18.9%	18.9%	
Both, prim. elect.	0.0%	100.0%	0.0%	0.0%	0.0%	
Both, equal	0.0%	0.0%	100.0%	0.0%	0.0%	
Financial						
What percent of trades are futures contracts?						0.041
	70.3%	86.9%	79.1%	85.2%	93.8%	
How important are execution costs? (1 least important - 7 most important)						0.065
	3.5	4.4	4.7	4.5	4.2	
Exchange Rates						
None						
Interest Rates						
None						
Stock Indexes						
What is your primary contract?						0.013
S&P500 futures	12%	33%	21%	9%	24%	
Russell	33%	0%	0%	0%	67%	
Nasdaq100	0%	0%	50%	50%	0%	
Mid-cap	0%	0%	0%	100%	0%	
Dow Jones	15%	42%	8%	23%	12%	
S&P500 options	55%	18%	9%	18%	0%	
What percent of trades are futures contracts?						0.087
	68.5%	91.8%	82.9%	79.1%	98.2%	
How important are execution costs? (1 least important - 7 most important)						0.014
	2.9	4.6	5.0	4.1	4.6	

For the variables: % of trades that were futures and importance if execution costs a one-way ANOVA test was performed. For all other factors $?^2$ tests were utilized.

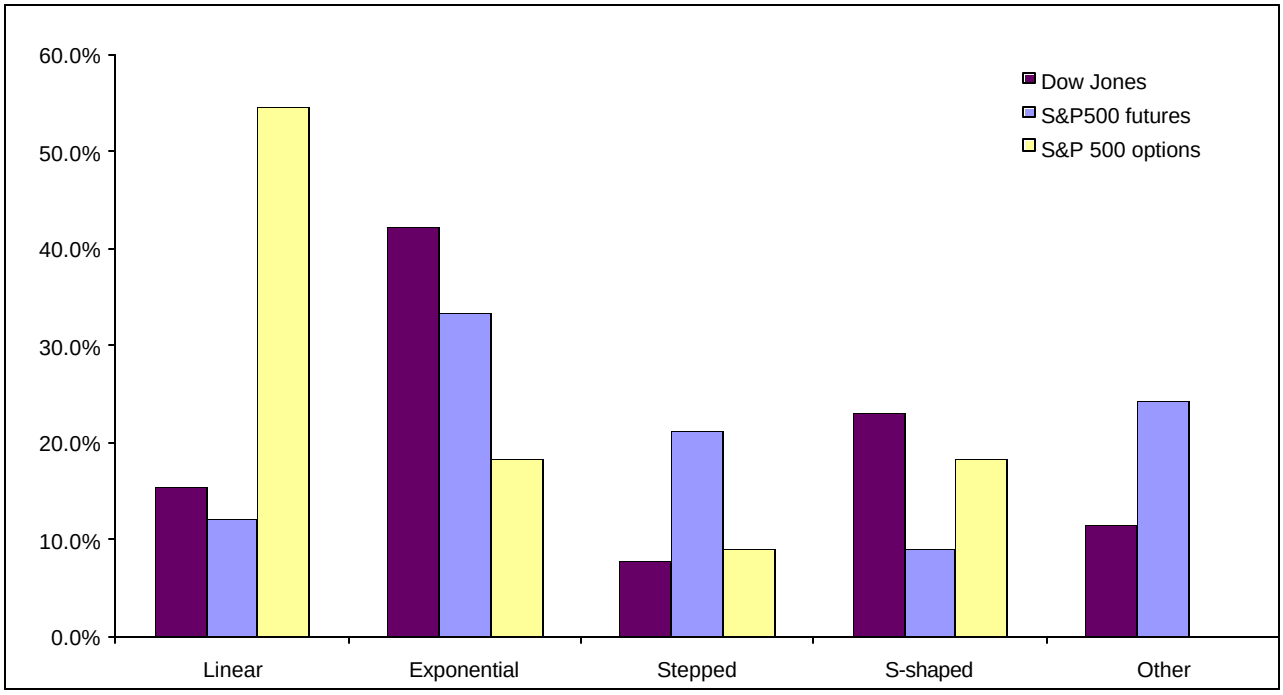
In the agricultural markets, the use of electronic trading is controversial and is a discriminating characteristic in explaining the heterogeneity of traders' perceptions. Traders, who use only open outcry, perceive the price path to be exponential (28.6%), stepped (26.0%), or S-shaped (33.8%), while traders, who use electronic systems only perceive a linear price path. These differences may be due to the information available to the traders. Open-outcry traders do

not have any information regarding market depth and rely on changes in the bid-ask spread, but electronic traders can see part of the order book, which could affect their perceptions.

We asked traders to rank how important execution costs were to their trading activity. This factor is a significant determinant of perceptions for all financial traders, as well as for stock index traders. In each segment, the ranking and perceptions followed a similar pattern. On average, the traders indicate that execution costs are of average importance to their trading. However, traders who place the least importance on execution costs are associated with a linear perception of the price path, while traders who place the most importance on execution costs are associated with a stepped perception of the price path. A linear price path would indicate a steady consistent change in prices during an imbalance, which makes it very easy to calculate execution costs. A stepped price path, instead, has steep price jumps that may be unpredictable. Therefore, it is logical that traders with linear perceptions place lower importance on execution costs than traders with stepped perceptions.

In the stock index segment, the specific contract a respondent trades is a significant determinant of a trader's perception of the price path. The differences of the main three contracts are illustrated in Figure 3. Even within the S&P500 stock index there are large differences between how futures traders perceive the price path versus how options traders perceive the price path.

Figure 3. Index contracts associated with perceptions of the shape of the price path



Overall, trader characteristics, even within different market segments, do not seem to explain a significant portion of the heterogeneity of perceptions of the price path during order imbalances. None of the characteristics were significant in all of the different market segments, and the ones that are statistically significant are not always economically meaningful. For example, while there is association between the importance of execution costs and perceptions of the price path, there is only a 1.2 unit difference on a 7-point scale between the differences of

importance placed on execution costs. The stock index segment, however, indicated that market characteristics, not trader characteristics, may be the driving force behind the heterogeneity in traders' perceptions of the price path. This could suggest that market microstructure and the characteristics of the underlying commodity may be influencing perception of the price path and that the heterogeneity in traders' perceptions is a reflection of that.

Perceptions in relation to market characteristics

To this point, we have shown that traders' characteristics do not explain the heterogeneity in perceptions of the price path during an order imbalance. However, there was some indication that the characteristics of markets could be related to perceptions. This would mean that market microstructure and the characteristics of the underlying market are the driving forces behind traders' perceptions.

To access this notion, we examined the top-ten contracts traded by the respondents, the results of which are reported in Table 6. The specific contract a trader utilizes is associated with a particular perception of the price path. This means that traders' perceptions in a specific market are similar. This finding might be explained by the market microstructure of the specific market. For example, the type of trading system, contract specification, and the market's mix of traders are all features of the market microstructure, which could lead to different and market-specific price paths. Characteristics of the underlying market on which the futures contract is based may also influence traders' perceptions.

Table 6. Major contracts and the perceptions of the price path*

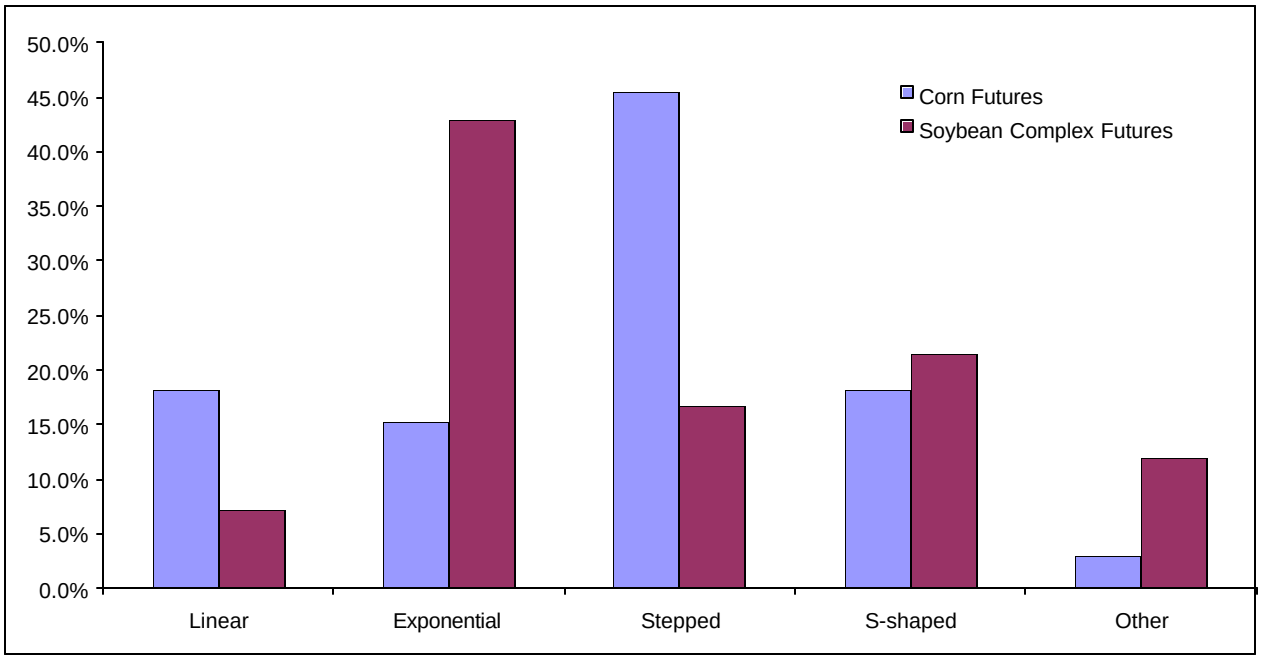
Contract	Linear	Exponential	Stepped	S-shaped	Other
Corn futures	18.2%	15.2%	45.5%	18.2%	3.0%
Corn options	28.6%	0.0%	28.6%	28.6%	14.3%
Soybean complex	7.1%	42.9%	16.7%	21.4%	11.9%
Eurodollar	7.5%	20.8%	30.2%	22.6%	18.9%
10 yr notes	11.8%	23.5%	23.5%	23.5%	17.6%
30 yr bonds	10.0%	30.0%	30.0%	10.0%	20.0%
30 yr bond options	16.7%	0.0%	50.0%	16.7%	16.7%
S&P500 futures	12.1%	33.3%	21.2%	9.1%	24.2%
S&P 500 options	54.5%	18.2%	9.1%	18.2%	0.0%
Dow Jones	15.4%	42.3%	7.7%	23.1%	11.5%

*($?^2 = 56.462, p = 0.016$)

Corn traders are associated with stepped perceptions of the price path, while traders in the soybean complex contracts are associated with exponential perceptions of the price path (See Figure 4). Differences in market microstructure may explain the difference between corn traders' and soybean-complex traders' perceptions of the price path. Both commodities trade at the same exchange, and therefore share most of the trade regulations. They also use the same trading system, but the composition of the traders is different in each market. The soybean complex markets has a high concentration of spread traders (26.9% vs. corn's 17.6%), who are constantly trading the three soybean contracts to keep the soybean crush in proper proportion, while the corn market has a high proportion of brokers (32.3% vs. soybean's 23.0%). The difference may also lie in the underlying nature of the market. Traditionally, the soybean complex has been

considered a much more volatile market than corn, which would explain the exponential price moves in the soybean complex.

Figure 4. Difference in perceptions of the price path between corn and soybean traders



In the past two years, CBOT has instituted a designated market marker to provide liquidity and smooth price movements in the Dow Jones Index. However, 42.3% traders perceive an exponential price path during an order imbalance. This indicates that traders still believe order imbalances to drop rapidly. Traders of the S&P500 Index futures also perceive an exponential price path. Both groups of traders may be responding to factors characteristic of their stock market index.

While particular markets are associated with particular perceptions of the price path during an order imbalance, they do not explain all of the heterogeneity. For example, equal numbers of traders of the 10-year note contract perceive exponential, stepped, and S-shaped price paths. Additional research is needed to understand the heterogeneity with in each particular market and to determine which market microstructure factors are driving the perceptions.

Conclusion

The main objective of this study was to gain a better understanding of liquidity by investigating how traders perceive the price path during temporary order imbalances. Traders' perceptions ultimately drive trader behavior, and thus the dynamics of liquidity. Surveying 420 traders at the CBOT and CME shows that there is a great deal of heterogeneity among the perceptions of traders. Approximately 2.4% of traders perceive no price change due to order imbalances, 12.1% perceive a linear price path, 24.7% perceive a exponential price path, 26.1% perceive a stepped price path, 20.7% perceive a S-shaped price path, and 11.3% of the traders indicated none of these price paths describe the price path due to order imbalances. Previous

liquidity research has developed models to measure liquidity, which have not explicitly considered the shape of the price path due to order imbalances and have generally assumed a linear price path. However, this research indicates that only 12.1% of the traders perceived a linear price path during a temporary order imbalance. This indicates that these models might not accurately reflect trader perceptions and consequently traders' behavior.

In order to explain the heterogeneity of perceptions, we first investigated whether trader characteristics were associated with a particular price path perception. However, the only characteristic that proved to explain the heterogeneity on an aggregate level is the proportion of futures in all trades. Even with the traders disaggregated into market segments, trader characteristics could not explain the differences in price path perceptions.

However, the particular market, or contract traded, is a significant factor in explaining the heterogeneity of perceptions due to order imbalances. Traders of a particular contract are associated with specific perceptions of the price path during an order imbalance. While the market does not explain all of the heterogeneity of perceptions, it does indicate that micro-market structure may drive trader perceptions of the price path.

Most of the previous research has looked at only one or two contracts when developing a liquidity measure. This study shows that perceptions of the price path are specific to each market.

As the futures industry continues to consolidate and as electronic trading allows for globalization of trades, futures exchanges are increasingly worried about improving and/or maintaining liquidity, and thus providing the lowest transaction costs. This study shows the importance of studying markets separately, because traders react to the micro-market structure of each contract.

There is a need of further research into liquidity, particularly how traders perceive and respond to order imbalances. While we have shown that perceptions are associated with particular markets, there is a need to study a market more in-depth to help explain the heterogeneity within the market. Also more research is needed to find which micro-market structure factors are most critical in driving perceptions and improving liquidity.

Second, further research should consider the interpretation of the heterogeneous market response. If a proportion of traders perceive an exponential price path and others a stepped function, the aggregate perception may prove to be linear. This would prove consistent with Kyle's linear price path.

In this study, we have only examined traders' perceptions. This is only the first step to understanding the dynamics of liquidity. Traders' perceptions drive their behavior. Further research needs to investigate trader behavior, as well as trader response and interaction during temporary order imbalances.

Finally, traders' perceptions of the price path need to be tested against transaction-specific data to see if they are an accurate reflection of the true shape of the price path. Moreover, it is important to find out whether the data indicates a linear price path, as assumed by current measures, or the price path as perceived by traders. A challenge for such research would be to distinguish a temporary order imbalance from a fundamental shift.

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