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Order flow, dealer profitability, and price formation ☆

Peter Locke [a], Zhan Onayev [b]

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Abstract

We analyze the dynamics of the S&P 500 futures price, finding both short- and long-run effects of order flow on price. While price moves strongly with the order flow in the short-run, the long-run impact is slightly negative, attributable to costly slippage from a hedging propensity in futures markets. We find strong evidence of a state dependence in the relation between price and order flow, using both volume and floor trader income measures as states. We also find that both the long- and short-run impacts of order flow are greater when dealer income is higher.

Introduction

We analyze the dynamic link between the S&P 500 futures price and the futures order flow. Our study employs a high-frequency analysis of transactions data to investigate whether the relation between price and order flow varies in different information states of the market as represented by volume and floor trader income. The effect of order flow on price has been extensively studied in equity markets (e.g., Lakonishok, Shleifer, and Vishny, 1992; Wermers, 1999; Stoll, 2000; Chordia, Roll, and Subrahmanyam, 2002) and foreign exchange markets (e.g., Evans, 2002; Evans and Lyons, 2002). In both equity and FX studies, order flow conveys otherwise unobservable private information to market participants. The general finding of these studies is that order flow has a permanent effect on price, suggesting a link between information, order flow, and, by extension, dealer profitability.[1]

While there are a large number of studies that document a permanent price impact from order flow in FX and securities markets, there are only a few studies that examine the relation between price and order flow in futures markets. Ferguson, Mann, and Wetsburd (2004) analyze the impact of customer trades on futures prices and find that they have a larger impact on price than other types of trades. These findings are consistent with Manaster and Mann, 1996, Manaster and Mann, 1999, Ferguson and Mann (2001), and Kurov and Lasser (2004). On the other hand, Chakravarty and Li (2003) find that futures floor traders,

when dual trading, do not profit from their access to order flow. This seems to leave open the question of how (or even what) futures floor traders learn from order flow, and this paper continues that quest.

Order flow generally means changes in dealer inventory, and a companion question to dealer information processing is dealer inventory management. Here, previous results regarding futures floor traders' inventory management are particularly interesting. Manaster and Mann (1996) provide evidence of weak inventory effects in futures markets: trader inventories mean revert, but the relation to price seems counterintuitive in that on average traders unwind positions at favorable prices. Further evidence is provided by Ferguson and Mann (2001), who show that while average futures spreads are similar in magnitude to those in other markets, effective spreads are often negative. The authors interpret these results as evidence that floor traders are often proactive traders, rather than passive order fillers, who might take positions based on inferences from and predictions about order flow, using a more elaborate analysis than that assumed in typical microstructure models. Futures floor traders have an informational advantage over customers due to the ability associated with their physical location to infer the pending order flow of off-exchange customers. Note that if this advantage derives from observing the phone activity on the floor and general hand waving and shouting, it need not be fraudulent, as would be the case if a particular dealer had access to particular pending customer orders. Chakravarty and Li (2003) find no evidence of such particular advantages. Kurov and Lasser (2004) provide further support for Ferguson and Mann (2001). They show that trades initiated by floor traders have a greater impact on price than those initiated by off-exchange customers, strengthening evidence in favor of the existence of trading in these markets related to inferences of anticipated order flow. In the absence of reported quotes, Kurov and Lasser (2004) infer trade initiation by the price of a trade relative to recent prices. Kurov and Lasser (2004) build on Ready (1999), who shows that NYSE specialist discretionary participation is clearly informative. While these studies provide support for some type of information-based floor trading in futures markets, none of them indicates the source of the information, the type of information, or whether the effect of order flow on price is permanent or transient.

The S&P 500 index futures price is linked to the current value of the S&P 500 index through a zero-arbitrage relation. Thus, information (other than changes in the cost of carry, i.e., near-term dividends and the short-term interest rate) related to the S&P 500 index futures is also information about the S&P 500 index. If the S&P 500 futures order flow proves to be a source of information, this can be interpreted as an indication that at least some index trading in general is related to information, which we assume to be private information such as changes in risk preferences, or perhaps very costly macroeconomic research.

The term "order flow" has taken on different meanings in different settings. The common feature of these definitions is a measure of the net trading of some group (e.g., customers) or the inference of trade direction through components of some mechanism trading at quoted prices). For example, some research uses the implied difference between trading at bid and ask quotes to calculate an order flow, irrespective of who the trade participants might be. We are interested in the extent to which futures floor traders provide a price discovery function, and hence the order flow we are interested in is the net proprietary trading by futures customers on the floor. Of course, in addition to the S&P 500 futures there is much more trading in S&P 500 stocks and mutual funds as well as in exchange-traded funds and other derivative instruments based on the S&P 500, including the 100% electronic E-mini S&P 500 futures on the Chicago Mercantile Exchange (CME). The E-mini, one-fifth the size of the floor-traded S&P 500, has gained in importance as shown, for example, by Kurov and Lasser (2004), although this growth has

occurred beyond the timeframe of our data.The trading in this plethora of S&P 500 surrogates clearly biases against our finding any permanent price effect from customers trading in S&P futures.

We also seek to learn the extent to which both the permanent impact and the short-run sensitivity of price to order flow vary in different market states, measured by trading volume and dealer profitability. This is motivated by FX studies (e.g., Evans, 2002; Luo, 2001) that find a nonlinear relation between order flow and exchange rate movements. For example, Luo (2001) finds that order flow has a larger impact in periods of large bid-ask spreads, high volatility, and low trading volume. Since the order flow in equity futures markets, similar to the FX market, is non-constant and arrives with a degree of periodicity, we expect to find state-dependency in the relation between order flow and price. We first use the traditional measure of the information flow, trade volume. We next employ a measure of floor trader income, the cash flow to and from floor traders' proprietary accounts, as a proxy for information flows.

The use of volume as an information proxy has been studied extensively. For example, the intraday variation in equity and FX volume has been attributed to a change in liquidity demand or a time-varying percentage of asymmetric information. Recently, Chae (2005) provides evidence that volume decreases before and increases after scheduled corporate announcements. These results are based on the strategic informed trader models of Admati and Pfleiderer (1988) and Foster and Viswanathan (1990), where information *per trade* declines with volume. One of our contributions is to introduce a high-frequency measure of floor trader income as a measure of the information flow. To be consistent with traditional microstructure models, we should find that dealers earn larger profits when the order flow is unusually less informative. For example, the Kyle (1985) dealer forms a supply of liquidity function based on a rationally expected level of information and flow of noise trading. Conditional on this fixed supply function, if liquidity-based trading is unusually high (low), then dealers come out ahead (behind), while on average, dealers break even. In these types of models, the dealer mechanism transfers money from uninformed customers to those better informed.

There are other possibilities regarding the relations between order flow and information. In Easley and O'Hara (1992), due to the assumption of a trickle of information, dealers could earn higher revenue when the order flow is most informative. Similarly, Ferguson and Mann (2001) suggest that futures floor traders might be able to infer semifundamental private information due to their privileged physical access to order flow, and thus their revenue should be higher at times of a more informative order flow. Semifundamental private information, a term developed by Ito, Lyons, and Melvin (1998), refers to knowledge about such things as other market participants' short-term trading strategies and objectives. For example, knowledge about inventories across traders and associated inventory management techniques can be considered semifundamental information. If floor traders actually infer semifundamental information from the market, then this should affect the information and floor trader income relation in a manner different than that implied by traditional microstructure.

To investigate these relations, we use a high-frequency measure of dealer income and decompose this into two components, spread and speculative income, expanding on a technique used in Manaster and Mann (1999) and Chakravarty and Li (2003). Spread income is representative of a dealer's order processing income. Speculative dealer income is the income earned from carrying inventory across time periods. In this latter measure, a temporal element is added to dealing, allowing for a speculative strategy in addition to the traditional, mechanical role of liquidity provision. According to Easley and O'Hara (1992), and consistent with the predictions of Ferguson and Mann (2001), speculative income would vary in different information states, such that dealer income would rise with an increased information flow.[2]

We analyze the interaction between trading volume, dealer profitability, and the informativeness of order flow with the help of a logistic smooth transition regression (LSTR) framework, as in Granger and Teräsvirta (1993), Teräsvirta (1994), and Van Dijk, Teräsvirta, and Franses (2000). This framework allows for two regimes, associated with extreme information states, where the transition from one regime to the other is smooth. On the other hand, the LSTR model can be said to allow for a continuum of regimes. The regimes are associated with changes in the sensitivity of price to order flow, with measures of volume and floor trader income identifying the market states.

Our first result establishes that while the temporary effect of customer buy orders on price is large and positive, the permanent effect is small and negative. The transient effect is as expected: in the presence of an increased order flow floor (customer buy pressure), trades occur at substantially higher prices. The slightly negative (though significant) long-run effect might seem odd in light of previous literature showing that the S&P 500 futures leads the cash market. Given the lead of futures over cash, one might expect to find informed trading in the futures, and hence a positive long-run relation between order flow and the futures price. However, the arbitrage and quasi-arbitrage motives that link the cash and futures markets and drive the intermarket dynamics are independent of the information structure. In particular, transient as well as permanent price movements will be transferred across markets through arbitrage.

Nevertheless, there remains a slight puzzle regarding our finding of a negative long run relation between order flow and price. One explanation relies on a traditional hedging motive for customer trading, on average, in the S&P 500 futures. The traditional theory of hedging in futures markets, such as the early research by Working (1953), is that derivatives such as these are used as temporary substitutes for cash positions, with the timing of the trades related to some underlying commercial activity. Trades such as anticipatory hedge trades and their offset by pension funds or other indexed funds are considered risk reducing, and thus the hedger is expected to pay for this reduction in the form of some price slippage or long-run contrary movement. While this type of reasoning seems easiest to apply to agricultural markets such as pork bellies and soybeans, we should not be surprised to find such a similar effect in financial futures. In our results, the long-run negative price impact of the customer order flow is consistent with such slippage, or costly trading.

Our second result is that both the short-run and long-run price impacts vary with the flow of information, with volume and floor trader income as our proxies for information. For example, when volume is high (low), order flow has a strong positive (negative) permanent price impact. Our novel finding is that price dynamics also vary significantly with floor trader income, with this finding especially noticeable for the short-run price impact. For example, we show that when floor trader income is high, the temporary impact of order flow on price shifts from the contemporaneous order flow to the lead, suggesting higher profitability associated with an anticipation of the order flow by floor traders. This anticipation of semifundamental information, in the form of customer trading intentions, is suggested by Ferguson and Mann (2001) and Kurov (2005). We also find that the permanent order flow effect is larger and positive at times when floor trader income is highest.

The rest of the paper is organized as follows. Section 2 describes the data. Section 3 presents our empirical model and estimation techniques. Section 4 reports results of the estimation. Section 5 concludes.

Section snippets

Data

Our analysis uses S&P 500 futures market transactions data over the period from January 1998 through December 2001. Through the generosity of the Commodity Futures Trading Commission we have obtained transactions records from the S&P 500 and E-mini S&P 500 futures contracts. Trades are executed exclusively by members (or their leaseholders). Each transaction record provided to us contains the date and time of the trade, the delivery month, the trade direction (i.e., whether the trader is buying ...

Empirical model

Development of the empirical model requires some description of the institutional details of futures trading and a discussion of possible information flows. Floor trading of the S&P 500 futures market is a centralized multiple-dealer market where trades are executed by exchange members in plain view. The members present can execute trades for others, as agents, or for their own accounts, subject to natural priorities and fiduciary responsibilities. Our model is adapted from Evans (2002), who...

Analysis of order flow and returns

In this section we describe the data and present initial results on the relationship of order flow to price changes. First we discuss the trading day. While the advent of electronic trading has made it possible to trade 24 hours a day, the vast majority of S&P 500 futures transactions in our sample take place during the time when US equity trading occurs. This gives rise to extreme 24-hour intraday patterns in volume and price volatility, and motivates the choice of estimation technique. Evans...

Conclusions

We analyze price discovery on the floor of the futures exchange, looking at the role of the futures floor trader as a market maker who makes inferences regarding price from order flow. We find that there is an equilibrium distribution of transaction prices across these traders on the futures floor at any point of time. The variability in price across these traders is small relative to fundamental price volatility, a finding substantially different than FX studies such as Evans (2002). Order...

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