



## Limit-order submission strategies under asymmetric information

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### ABSTRACT

This paper provides evidence that informed traders dominate the response of limit-order submissions to shocks in a pure limit-order market. In the market we study, informed traders are highly sensitive to spreads, volatility, momentum and depth. By contrast, uninformed traders are relatively insensitive to all these market conditions. The dominance of the informed over limit-order submissions is magnified by contrasts between them and the uninformed in the use of aggressively-priced limit orders.

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### 1. Introduction

This paper undertakes an empirical investigation of limit-order submissions by informed and uninformed traders in a pure limit-order market. The main conclusion is that informed traders dominate the response of aggregate limit orders to market shocks. Informed traders are highly sensitive to changes in spreads, volatility, depth, and momentum while uninformed traders respond very little, if at all, to all these market conditions. A secondary finding is that the dominance of the informed over limit-order submissions partly reflects differences between the informed and the uninformed in their use of aggressively-priced limit orders.

Academic understanding of the influence of information on limit-order submission and thus on a core aspect of liquidity provision has changed dramatically over time. Initially, researchers using static models assumed that uninformed traders would be content to place limit orders and wait for execution while informed traders would impatiently place market orders (e.g. Glosten, 1994; Seppi, 1997). This assumption has been challenged by empirical work (Keim and Madhavan, 1995) and by theory (Chakravarty and Holden, 1995; Harris, 1998; Kaniel and Liu, 2006). We now understand that informed traders may provide more liquidity than uninformed

traders, on average, since the informed do not face picking-off risk (Bloomfield et al., 2005).<sup>1</sup>

The field's focus has by now shifted to the inter-temporal determinants of limit-order submission (e.g. Parlour, 1998; Foucault, 1999; Goettler et al., 2005, 2009; Rosu, 2008, 2009; Foucault et al., 2005), including the response of limit orders to changes in spreads, depth, volatility, and other market conditions. Progress has been hindered by the difficulty of constructing theoretical models of dynamic limit-order markets under asymmetric information, since the models quickly become analytically intractable (Goettler et al., 2005, 2009; Rosu 2009): "A model that incorporates the relevant frictions of limit-order markets (such as discrete prices, staggered trader arrivals, and asymmetric information) does not readily admit a closed-form solution" (Goettler et al., 2009, p.68).<sup>2</sup> The focus of this literature has primarily been on the influence of time-to-execution and trader arrival rates, but many other factors are potentially important. In consequence, we investigate the response of limit-order submissions to changing market conditions empirically rather than theoretically.

<sup>1</sup> The informed also provide more liquidity on average in the theoretical model of Goettler et al. (2009). In this setting, however, information itself – which is costly to acquire – does not influence the placement of limit orders. Instead, both choices are the result of a third factor, private valuations.

<sup>2</sup> To date, there are only two models of limit-order markets with endogenous order-choice under asymmetric information, neither of which directly addresses the issue on which we focus. Back and Baruch (2007) compares the equilibrium properties of limit order and floor traded-markets, while Goettler et al. (2009) focuses on stationary, symmetric equilibria where strategies are independent of market conditions.

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We compare the trading of informed and uninformed agents using comprehensive transactions data from the Moscow Interbank Currency Exchange (MICEX), an electronic interdealer market for rubles. Our data permit us to identify individual participants – and to characterize them as informed or uninformed – an advantage that appears to be unique among market-wide limit-order datasets.<sup>3</sup> We base this characterization on either trading activity or location. The relevance of both criteria is supported in the literature and, more critically, is supported for this particular dataset (Menkhoff and Schmeling, 2008, 2010). Both criteria produce the same qualitative results, so we take no position on which is best.

Though much of the information essential to understanding exchange rates is public, asymmetric information is nonetheless central to the functioning of currency markets. Bjonnes et al. (2008) present clear evidence of information asymmetries in the interdealer market. Evans and Lyons (2007) provide evidence of asymmetric information among foreign exchange end-users with respect to the state of the macroeconomy. Clearly the origins of foreign exchange and equity-market information asymmetries must differ. Existing evidence shows that those in foreign exchange arise in part from differences in traders' willingness and ability to forecast macro statistical releases (Osler and Vandrovych, 2009; Rime et al., 2010) and other fundamentals; other sources may be relevant as well (Bacchetta and van Wincoop, 2006). Osler (forthcoming) provides a summary of the evidence for information asymmetries in currency markets, and a discussion of how these asymmetries influence spreads and price discovery.

Our comparison of informed and uninformed traders reveals that the informed dominate the average market-wide response of order placement to changes in spreads, volatility, depth (same- and opposite-side), and momentum. Informed agents respond to these market conditions similarly to the overall market but more intensely, while uninformed agents respond either modestly or not at all. Widening spreads and higher volatility, for example, bring a strong shift towards limit orders among informed traders and a far smaller shift among uninformed traders. A similar asymmetry applies to changes in market momentum. The contrast is most extreme for changes in depth, which bring strong responses from the informed and zero estimated response from the uninformed. The contrast is least extreme for expected time to execution. The conclusion that the informed dominate the market's overall response to changing market conditions extends our appreciation of the importance of informed traders in the provision of limit orders and appears to be new to the literature.

Information asymmetries can in most cases explain the stronger responses of the informed to market conditions. Consider, for example, a rise in volatility. If it reflects a transitory rise in order flow, then the reduction in non-execution risk encourages limit-order placement for all agents. If, instead, the rise in volatility reflects a higher information arrival rate, the response will be asymmetric since the intensified uncertainty discourages the uninformed, but not the informed, from placing limit orders (Foucault, 1999). The response of the uninformed would thus be smaller than that of the informed.

We also identify a striking contrast between the informed and the uninformed in their use of limit orders priced within the spread. These orders represent an intermediate level of aggressiveness – less aggressive than market orders but more so than other limit orders. We find that the informed treat them as a substitute for market orders while the uninformed treat them as a substitute for patient limit orders. These opposing tendencies intensify the effect of the informed on limit-order submissions and volatility, and further mute the effect of the uninformed, an effect best clarified by considering once again a rise in volatility. This prompts both

agent types to reduce their placement of market orders and increase their placement of patient limit orders, thus helping volatility return to normal levels (Handa and Schwartz, 1996). However, the informed accompany this overall shift by placing more aggressive limit orders, which magnifies their contribution to price stability. The uninformed, by contrast, accompany this overall shift by placing fewer aggressive limit orders, which reduces their contribution to price stability. This contrasting treatment of aggressive limit orders is also, we believe, new to the literature.

Our results suggest that the informed are primarily responsible for the general stability of limit-order submissions and volatility. With respect to resiliency, sometimes defined as the speed with which spreads revert after a shock, we find that traders shift towards limit orders after spreads widen, thus providing resiliency, and that the shift is far stronger for the informed. Likewise we find that the informed are primarily responsible for the stability of depth: After a market order reduces, say, bid depth, informed traders will tend to place more buy limit orders and fewer sell market orders, both of which help restore bid depth. The uninformed, by contrast, are largely unresponsive to changes in depth. Our results are likewise relevant to volatility dynamics. When volatility spikes upward, for example, traders shift towards limit orders which tend to dampen volatility. This shift is far more pronounced for the informed than the uninformed.

Numerous studies examine how aggregate liquidity, in the sense of limit-order submissions, responds to market conditions in limit-order markets (e.g. Griffiths et al., 2000; Hollifield et al., 2004; Ellul et al., 2007; Foucault et al., 2007; Linnainmaa and Rosu, 2008; Lo and Sapp, 2008; Hasbrouck and Saar, 2009). To our knowledge, this paper is the only one to compare the order choices of informed and uninformed traders after changes in a broad range of conditions. Beber and Caglio (2005) examine the response of market-wide liquidity to a similarly wide range of market conditions, but distinguishes periods when trading is likely to be information-based from other periods. Unfortunately, an analysis of market-wide patterns cannot identify differences between the informed and the uninformed. Anand et al. (2005) does examine how order choice varies between informed and uninformed traders, but that paper focuses on the influence of time. In that study of TORQ data, institutional traders are considered informed and others are considered uninformed. Anand et al. (2005) confirms Bloomfield et al.'s (2005) conclusion that the informed shift from market orders to limit orders over the course of the trading day, while the uninformed make the reverse shift. Ranaldo (2004) shows that traders who place large market orders are more sensitive to market conditions than those placing small market orders. However, results in Chakravarty (2001) indicate that trade size is not necessarily a good indicator of information.

Section 2, which follows, describes the interdealer ruble market and presents our data. Section 3 explains our empirical methodology. Section 4 compares the response of informed and uninformed agents to market conditions and shows that the market's overall response is dominated by the informed. Section 5 presents robustness tests and Section 6 concludes.

## 2. Data and market structure

Our data represent the entire record of order placement and trading on the Moscow Interbank Currency Exchange, or MICEX.<sup>4</sup> The MICEX serves as the primary electronic interdealer market for the Russian ruble, which is otherwise traded by Russian banks on non-integrated regional exchanges.<sup>5</sup> The market sets each day's

<sup>4</sup> Goldberg and Tenorio (1997) analyze an earlier market structure of the MICEX.

<sup>5</sup> The domestic market was segmented from foreign participation by trading restrictions.

<sup>3</sup> We have anonymous codes of traders but not names of institutions.

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