Abstract: The Impact of Order-Splitting on Long-Memory in an Order-Driven Market

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We examine how traders' order splitting behavior is related to the long-memory properties in an order-driven market, i.e., long-memories in volume, volatility, and order signs (but yet, the market is informationally efficient in a sense that there is no persistence in returns). We conduct simulations on a simple automated order-splitting, and examine whether and under which conditions we can reproduce those properties with order-splitting.

LeBaron and Yamamoto (2007, 2008) show that that investors' imitative behavior is so important for the phenomena. Our order-splitting model does not assume any herding among agents; however, we show that it generated long-memories of order signs and volatility. This implies that imitation would not be the only source for the long-memories. However, order-splitting would matter in our market when agents split orders into so many pieces like 50 without allowing others to enter the market where there are only 100 agents. We conclude that we need to impose such a strict assumption to generate the long-memories with order-splitting, implying that order-splitting itself would not be the only source for these properties too.

We analyze a simple automated system of order splitting with an iceberg type limit order with no imitation. We have 100 agents who are each given 50 units of orders to split. They first determine their forecast and execution prices. This determines whether they are buyers or sellers, and their bid or ask price. For a buyer, if the bid price is larger than the best ask, the agent will execute 1 trade, and drops the block of orders by 1. The agent will continue executing buy orders until the best ask price on the book exceeds the agent's bid price. At this point the agent will submit a limit order for the next unit. The remaining part of the order is entered as an iceberg order at this bid price. It does not show up on the book directly, but when that order is removed, a unit of the iceberg order is moved onto the book. If the buyer's initial bid price is less than the best ask, then 1 unit is entered on the book, and the remaining 49 are entered as iceberg orders. A similar mechanism takes place for sell orders. We assume that other agents cannot enter the market while one agent is executing orders. Once the iceberg order is in place the next agent enters the market.

We found that signed order flows are persistent in our system mainly because agents are assumed to keep submitting their orders of the same sign without allowing others to enter the market. Volatility also shows long-memory. Our system implies that agents keep submitting the orders of the same sign unless the best prices cross the requested prices, persistently taking off liquidity. As a result, the book will become sparser, tending to have persistently larger price changes. However, once agents submit large size of iceberg orders without executing any of them, the book suddenly becomes thicker so that the price changes become smaller and such smaller changes will persist. We do not see volume persistence. In our system, we would see volume persistence only when the best price crosses their requested price after many agents execute *similar sizes* of market orders. However, it is not known when the best prices cross the requested prices and agents stop submitting market orders. Since there is no persistence on the timing at which the best prices cross the pre-specified price, we would not see long-memory of volume.