Inverted Exchanges: Higher Leakage or Higher Quality?

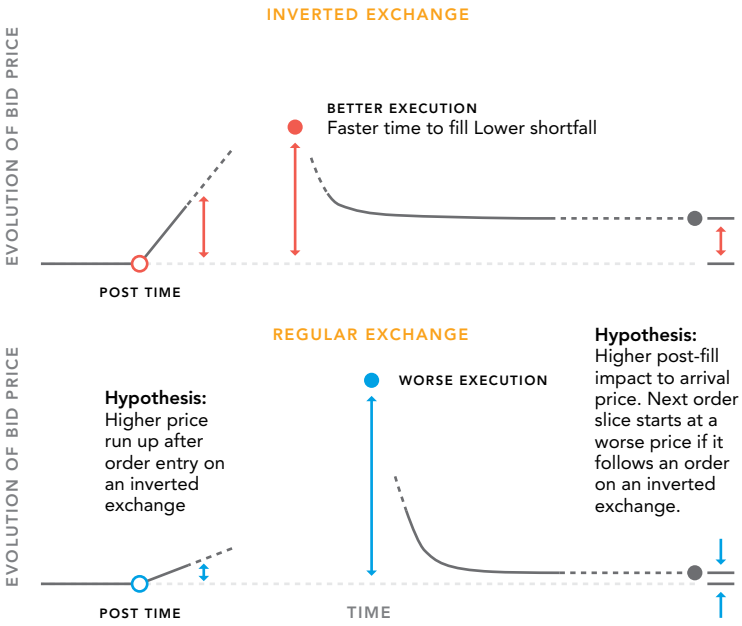

FIGURE 1 STYLIZED ILLUSTRATION

Stylized illustration of the hypothesized higher leakage on inverted exchanges using fictitious buy orders. The order is posted at the bid and potentially repegged on an inverted (top) and regular (bottom) exchange. If the residual impact is greater on inverted venues, as illustrated, it might more than offset the better execution price.

The benefit of posting on an inverted exchange—one that pays a rebate to liquidity takers rather than charging the standard fee—has long been observed in venue TCA reports and research articles from various market participants.[1] Orders on inverted exchanges effectively hop the inter-market queue and have a higher probability of fill, lower adverse selection, and ultimately less shortfall relative to the arrival of the child order.[2] Despite the evidence of these benefits, some traders have a lingering doubt as to whether posting orders on an inverted exchange may degrade performance by leaking more information than orders on regular exchanges. The idea is that though the inverted order itself may get better execution quality, the presence of the order may "push the market," causing subsequent child orders to trade starting from a worse price point, and overall performance might therefore be worse.

This concern is stylistically illustrated in Figure 1. A buy order is posted on an inverted exchange (red) and on a regular exchange (blue). Though the execution of the child order on an inverted exchange is at a better price, the fear is that posting the order on an inverted exchange will result in higher price run up and less post-fill reversion such that the next scheduled order slice will start at a higher price relative to the arrival of the first order.

1 *Inverted-Price Destinations and Smart Order Routing*, Pragma, 2011

2 Of course, these benefits come at a cost: the liquidity provider must pay a rebate to the taker on an inverted venue, as well as lose the opportunity to earn a rebate by posting at a regular exchange.

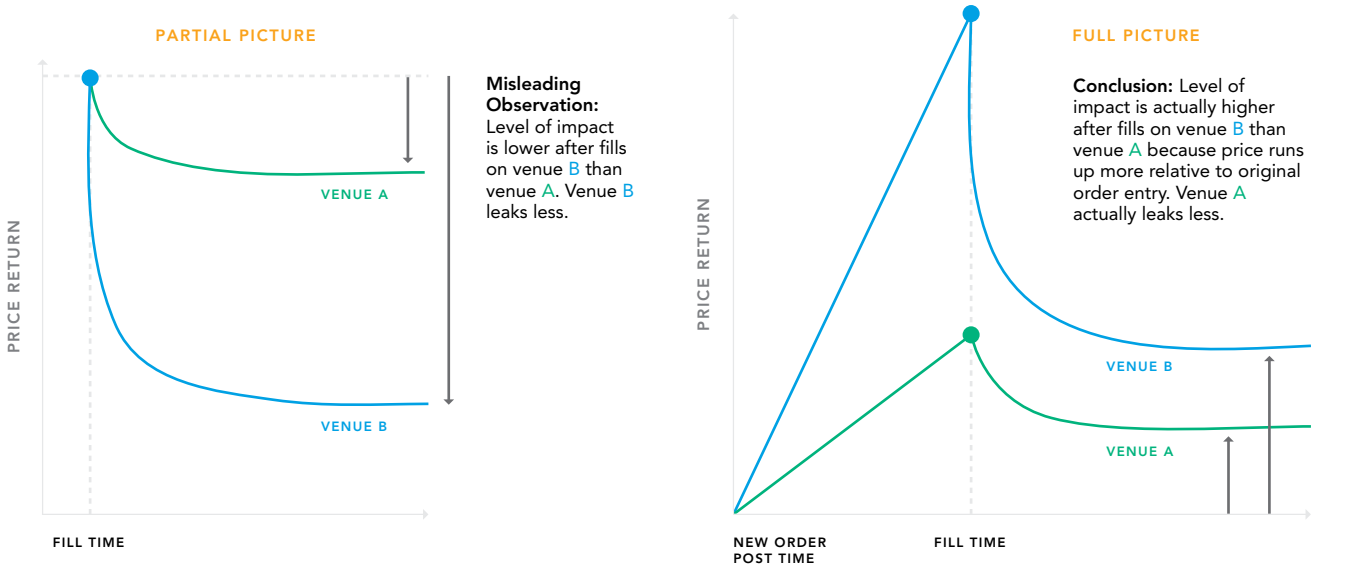

FIGURE 2 STYLIZED ILLUSTRATION Stylized example of buy orders at two venues A (green) and B (blue). The left chart illustrates the price return info just around the fill, which may suggest a misleading conclusion that orders on venue B cause less leakage because the price drops to a lower level than after fills on venue A. However, the error in this misleading conclusion becomes clear when considering the whole picture of the orders, shown in the right chart, from original order entry, through any repegs to the fill or cancel. Though the price drops more after a fill on venue B, the price runs up much more during the life of the order posted on venue B, offsetting the price drop difference. Venue B, therefore, has more impact than venue A because the post-fill (post-cancel) price relative to when the order was originally posted is higher for venue B.

In this research note, we identify some inherent problems with trying to use open market data (TAQ) to address the question of whether inverted exchanges have worse information leakage, as has been done in some recent studies that try to support the idea that inverted venues leak more. We offer our own analysis based on a rich data set of passive orders from Pragma's VWAP algo. Our findings show that **no worse leakage results from posting on inverted exchanges**. **Our results confirm the performance benefits of hopping the queue on regular exchanges** by posting on inverted exchanges for brokerage clients to whom exchange fees and rebates are not passed through.

Defining and measuring leakage

In the context of a long-running algo, the question is whether a 100 share slice of a VWAP algo routed to an inverted exchange results in more information leakage than if it were routed to a regular exchange. Information leakage results in the price moving up for a buy order. This might happen either (a) pre-fill, with more price run-up after order entry but before execution; or (b) post-fill, with more residual impact after the order is executed (again relative to order entry).

Open market data

The open-market TAQ may seem like a natural source of plentiful data that could help answer the question of whether inverted exchanges have more leakage than regular exchanges. For example, we could try to compare pre-fill leakage, as defined above, between orders posted on inverted and regular exchanges. Unfortunately, this implicitly assumes that, in the market as a whole, orders are posted randomly either at inverted venues or regular exchanges. In fact, quite the opposite is true. Many market participants post on inverted exchanges—a very expensive proposition from a fee perspective—only when they believe the price is likely to run away, say because there is a large quote imbalance. The price return after a new order is posted on an inverted exchange will be higher exactly because of this selection bias: market participants choose to post on inverted exchanges because the price is likely to run away and they want to increase the chance of being filled before that happens. Naïve open-market studies get this true causality backward, leading to the mistaken conclusion that orders on inverted venues cause the market to move through information leakage. While posting an order on any exchange does have some impact on the market, saying that posting on inverted causes the market to move is like saying umbrellas cause rain. In general,

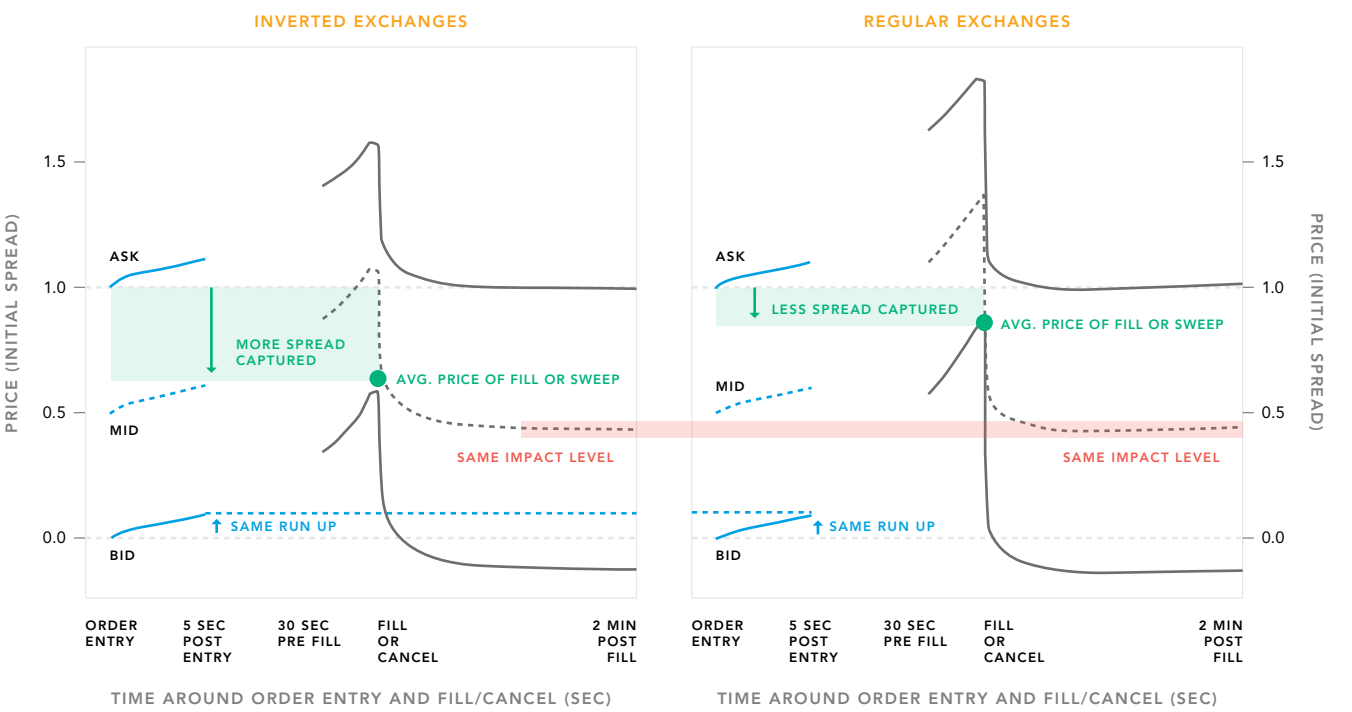

FIGURE 3 Average buy-normalized price returns (solid lines are bid and ask, dashed line is mid) and the execution price (green dot) relative to the near-touch price at the time of child order entry, normalized by the spread at order entry. For orders that are not filled, the execution price is the far touch price at the time of cancel, corresponding to the execution price of a clean-up sweep. The green shaded area designates the real spread capture of orders relative to the spread at the original order entry. Pre-Fill Leakage: the dashed blue line shows the level of price run up after order entry is the same. Post-Fill Leakage: the pale red line shows the level of post-fill impact relative to the price at order entry is the same.

we cannot know or control the intent of the market participants who submitted the quotes, so we cannot ensure equivalent conditions for when quotes appear on inverted and regular exchanges.

The same problem exists in trying to measure post-fill leakage using open market data. A bigger price drop after fills on regular exchange would not necessarily indicate lower leakage because the price might run up more before the fill, as illustrated in a stylized example in Figure 2. It's like relishing the savings you got from a big discount on a new winter coat without realizing how much the original price was marked up above true value. Venue performance and leakage based on information just around the fill time, without incorporating the pricing information at the time the order was originally posted, is dangerously incomplete and can lead to wrong conclusions on which venues have the best quality.[3]

This means TAQ quotes and trades cannot be used in isolation for a fair comparison of leakage. We must, instead, use a controlled data set from a randomized routing decision to ensure an apples-to-apples comparison.

An unbiased study

To escape the unknown biases of open market data and answer the question of whether inverted exchanges have more information leakage, we use a proprietary data set of Pragma's passive child orders from a VWAP algo set up to make a randomized decision of whether to post on a regular or an inverted exchange, in order to allow for a fair apples-to-apples comparison. The data set includes all the information about the algo's microtrading, including new orders, any modification to the orders, and fills and cancels. The orders in the data set were entered at the near touch price, and repegged to the near touch if the price moved away. If a passive order is not executed within an allocated time, the algo order falls behind its schedule, cancels the passive

3 *To (Spread) Capture or Not to (Spread) Capture*, Pragma, 2011

order and crosses the spread. Unfilled passive orders, therefore, are charged the far touch at the time of cancel as a clean-up cost.

Figure 3 shows the price returns at various points in the lifecycle of passive orders relative to the prices at the arrival of the child order, on average across more than one million child orders. Note that all price returns are normalized by the arrival bid-ask spread, a scaling factor that allows us to directly compare executions of higher-spread and lower-spread names directly. The original order is posted at the prevailing bid price at the "Order Entry" time. The green dot shows the average execution price at "Fill" time, and the green shaded area shows the amount of spread captured relative to when the order was first posted. The orders posted on inverted exchanges capture notably more spread, once again confirming the performance benefits of inverted exchanges. **Pre-fill** returns, shown in blue, show no difference in the level of price run up between orders on inverted and regular exchanges. The **post-fill** residual impact relative to the price at order entry time, highlighted in red, is the same for inverted and regular exchanges. The equivalence of pre-fill returns and post-fill residual impact between the two venue types confirm that there is no higher leakage from posting on inverted exchanges.

The primary question we address in this paper is whether posting on an inverted exchange leaks more information than posting on a regular exchange. Figure 3 shows that the residual impact even up to 2 minutes after a fill is no greater on inverted than regular exchanges. Thus, subsequent orders do not start from a worse price, and there is no negative consequence to offset the benefit of the lower pre-fill runup on inverted venues, which is again clearly illustrated in this data set. The results—better spread capture and no evidence of higher leakage on inverted exchanges—are consistent across time of day, price, spread and volatility.

Conclusion

The execution quality benefits of posting on inverted venues are, by now, well documented. This research note addresses a lingering concern of some market participants—that inverted venues might "signal the market" and compromise execution quality by making subsequent orders start at an inferior price. We provide direct evidence from a controlled experiment that this concern is unfounded. We find no evidence of worse residual information leakage when posting on inverted exchanges, and, consistent with previous reports, observe better execution quality, exclusive of exchange fees.