Sub-Penny and Queue-Jumping Online Appendix

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Online Appendix

Model

Order Submission Decision

Market orders are always executed at the best ask or bid price and their payoff depends on the traders' personal evaluation of the asset, β_t. Limit orders' payoff also depends on the execution probability that we indicate by $p_t(A_k|S_t)$ and $p_t(B_k|S_t)$ for a limit sell and for a limit buy order respectively submitted at the ask price A_k, or at the bid price B_k. The payoff are summarized in Table I.

Table I: **Order Submission Strategy Space.** This Table reports in column 3 the payoffs, $U(\cdot)$, of the order strategies H_t listed in column 1. In the case of market orders, $A_{k'}$ and $B_{k'}$ always refer to the best ask and bid prices.

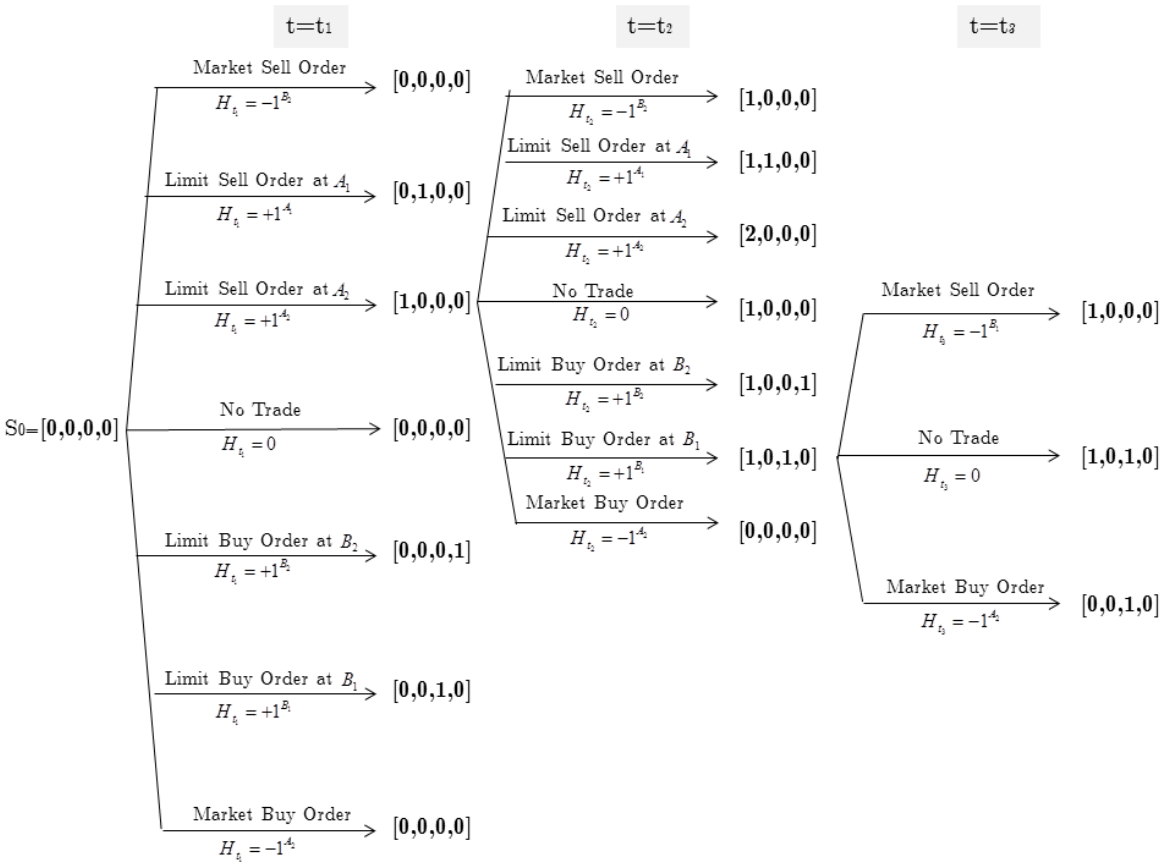
Strategy	H_t	$U(\cdot)$
Market Sell Order	$-1^{B_{k'}}$	$B_{k'} - \beta v$
Limit Sell Order	1^{A_k}	$p_t(A_k\|S_t)(A_k - \beta v)$
No Trade	0	0
Limit Buy Order	1^{B_k}	$p_t(B_k\|S_t)(\beta v - B_k)$
Market Buy Order	$-1^{A_{k'}}$	$\beta v - A_{k'}$

Figure I shows the extensive form of the game when the book opens empty at t_1, $S_0 = [0, 0, 0, 0]$. Assume that a trader arriving at the market at t_1 decides to submit a limit sell order at A_2, $H_{t_1} = +1^{A_2}$. The execution probability of this order depends both on the initial state of the book and on the future orders submitted by the other market participants. Because before submission no shares were standing at A_1 and A_2, this order is at the top of the queue on the sell side and would be executed as soon as a market buy order arrives in period t_2 or t_3. However, this order will not be executed if a trader arrives in period t_2 and gains price priority by submitting a limit sell order at A_1, $H_{t_2} = +1^{A_1}$. Figure I shows that a limit sell order at A_1 is one of the possible strategies of a trader arriving at t_2. If this order is actually chosen by the incoming trader, then at t_3 the book will open with one share at both the first and the second level of the ask side, $S_{t_2} = [1, 1, 0, 0]$, and only the order posted at A_1 will have positive execution probability. Recall that only one trader arrives at each trading round. Figure I focuses on the ask side, but the order execution probability also depends on the state of the other side of the book: for instance, a deep book on the bid side increases the incentive for a seller to post limit orders as he knows that incoming buyers will be more inclined to post a market rather than a limit order, due to the long queue on the bid side.

Equilibrium

The model is solved by backward induction. Because at time t_3 the execution probability of limit orders is zero, traders either submit market orders or decide not to trade. Therefore, traders' equilibrium strategies are:

Figure I: Public Limit Order book: example from the extensive form of the game. The book opens at t_1 empty: $S_{t_0} = [0, 0, 0, 0]$. H_t refers to the strategy of the trader who arrives at the market in period t. All available H_t are defined in Table 1.



$$H^*_{t_3}(\beta|S_{t_2})= \begin{array}{cl} -1^{B_{k'}} & \text{if } \beta \in [0,\ \frac{B_{k'}}{v}) \\ 0 & \text{if } \beta \in [\frac{B_{k'}}{v},\ \frac{A_{k'}}{v}) \\ -1^{A_{k'}} & \text{if } \beta \in [\frac{A_{k'}}{v}, 2] \end{array}$$

By using these equilibrium strategies together with the distribution of β, we calculate the equilibrium execution probabilities of limit orders submitted at t_2:

$$p^*_{t_2}(A_k|S_{t_2}) = \begin{array}{ll} \int_{\beta\in[\beta:H^*_{t_3}=-1^{A_{k'}}]} \frac{1}{2} d\beta = 1 - \frac{A_{k'}}{2v} & \text{if } A_k = A_{k'} \text{ and } Q^{A_k}_{t_1} = 0 \\ 0 & \text{otherwise} \end{array}$$

$$p^*_{t_2}(B_k|S_{t_2}) = \begin{array}{ll} \int_{\beta\in[\beta:H^*_{t_3}=-1^{B_{k'}}]} \frac{1}{2} d\beta = 1 - \frac{B_{k'}}{2v} & \text{if } B_k = B_{k'} \text{ and } Q^{B_k}_{t_1} = 0 \\ 0 & \text{otherwise} \end{array}$$

where $p_t(A_k|S_t)$ and $p_t(B_k|S_t)$ indicate the execution probability for a limit sell and for a limit buy order respectively submitted at the ask price A_k, or at the bid price B_k. These execution probabilities are the dynamic link between period t_3 and t_2. Because there is only one period left in the trading game, the execution probability of a limit order submitted at t_2 is positive only if the order is posted at the best ask ($A_{k'}$) or bid price ($B_{k'}$), and if there are no other orders already standing in the book at that price.

A trader arriving at t_2 can choose between a market and a limit order. The equilibrium strategies for t_2 depend on the state of the book. As an example, here we discuss the equilibrium strategies for the book opening with room for limit orders on both sides of the market, i.e., $p^*_t(A_k|S_t) \neq 0$ and $p^*_t(B_k|S_t) \neq 0$.

The trader's optimal strategies are:

$$H^*_{t_2}(\beta|S_{t_1})= \begin{array}{cl} -1^{B_{k'}} & \text{if } \beta \in [0, \beta_{-1^{B_{k'}},+1^{A_k},t_2|S_{t_1}}) \\ +1^{A_k} & \text{if } \beta \in [\beta_{-1^{B_{k'}},+1^{A_k},t_2|S_{t_1}}, \beta_{+1^{A_k},+1^{B_k},t_2|S_{t_1}}) \\ +1^{B_k} & \text{if } \beta \in [\beta_{+1^{A_k},+1^{B_k},t_2|S_{t_1}}, \beta_{+1^{B_k},-1^{A_{k'}},t_2|S_{t_1}}) \\ -1^{A_{k'}} & \text{if } \beta \in [\beta_{+1^{B_k},-1^{A_{k'}},t_2|S_{t_1}}, 2] \end{array}$$

where

$$\begin{aligned} \beta_{-1^{B_{k'}},+1^{A_k},t_2|S_{t_1}} &= \tfrac{B_{k'}}{v} - \tfrac{p^*_{t_2}(A_k|S_{t_2})}{1-p^*_{t_2}(A_k|S_{t_2})} \tfrac{A_k - B_{k'}}{v}, \\ \beta_{+1^{A_k},+1^{B_k},t_2|S_{t_1}} &= \tfrac{p^*_{t_2}(A_k|S_{t_2})A_k + p^*_{t_2}(B_k|S_{t_2})B_k}{p^*_{t_2}(A_k|S_{t_2}) + p^*_{t_2}(B_k|S_{t_2})} \tfrac{1}{v}, \\ \beta_{+1^{B_k},-1^{A_{k'}},t_2|S_{t_1}} &= \tfrac{A_{k'}}{v} + \tfrac{p^*_{t_2}(B_k|S_{t_2})}{1-p^*_{t_2}(B_k|S_{t_2})} \tfrac{A_{k'} - B_k}{v}. \end{aligned}$$

These thresholds are derived by taking into account that the trader arriving at the beginning of period t_2 observes the state of the book S_{t_1}. For instance $\beta_{-1^{B_{k'}},+1^{A_k},t_2|S_{t_1}}$ denotes the threshold between a market sell order hitting the best bid price, $B_{k'}$, and a limit sell order posted at the ask price, A_k, and it is derived by equating the payoffs of the two orders. Note that the greater the limit

order execution probability, $p^*_{t_2}(A_k|S_{t_2})$, the smaller this threshold and the higher will the probability that traders choose limit rather than market orders be. More generally, if the execution probability at time t is high enough for non-execution costs to be lower than price opportunity costs, the trader will submit a limit order. If instead the execution probability is low, he will choose a market order. This trade-off crucially depends on the value of the tick size and on the price of the stock, v.

When a trader chooses a limit order, he also has to decide how aggressively to submit this order at better prices next to v. The optimal price at which a trader submits a limit order is the result of the trade-off between non-execution costs and price opportunity costs: a more aggressive price implies a higher execution probability due to both the lower risk of being undercut by incoming traders and the fact that the order becomes more attractive for traders on the opposite side of the market. However, this is obtained at the cost of lower revenue once the order is executed.

From the equilibrium strategies at t_2, we can derive the execution probabilities for limit orders submitted at t_1 and the corresponding equilibrium strategies. Due to the recursive structure of the game and because traders are indifferent between orders with a zero execution probability a unique equilibrium always exists.

We provide a proof for liquid stocks, i.e., a PLB that opens at t_1 as $S_0^{PLB} = [0110]$. The illiquid case is solved in a similar way and omitted.

Transparent SPV (T)

When the SPV is transparent, RTs' equilibrium strategies depend on the initial state of the SPV. We present as an example the case with an empty SPV, $S_0^{SPV} = [0]$; the case in which the SPV has one share on the first level of the book, $S_0^{SPV} = [1]$, is available from the authors upon request. To compute market quality indicators that are comparable with the opaque SPV case, we take the average of the values obtained for the two cases.

Equilibrium strategies

At t_1 the traders' strategy space, considering both RTs and BDs, is $\left\{-1^B, +1^i, +1^j, -1^A, 0\right\}$ with $i = \{A_{1:2}, B_{1:2}\}$, $j = \{a_{1:5}, b_{1:5}\}$, and $A = A_{k'} \bigvee a_{l'}$ and $B = B_{k'} \bigvee b_{l'}$ the best prices across PLB and SPV. Therefore, at the beginning of t_2 there are 17 possible states of the books: one share added to the i-th level of the PLB and no shares added to the SPV (4 cases), one share added to the j-th level of the SPV and no shares added to the PLB (10 cases), one share taken from the PLB (2 cases) or no trading (1 case).

Period t_2. We compute the optimal equilibrium strategies of both RTs and BDs for each possible opening state of the book at t_2. Note that at t_3 the equilibrium strategies of RTs and BDs are the same: both can observe the best available price and, because traders submit only market orders, the BDs can't take advantage of their ability to post liquidity on the SPV. As a result, the orders' execution probabilities at t_2 do not depend on the type of trader arriving at t_3, for example: $p^{*RT}_{t_2}(A_k|S^{PLB}_{t_2}, S^{SPV}_{t_2}) = p^{*BD}_{t_2}(A_k|S^{PLB}_{t_2}, S^{SPV}_{t_2}) = p^*_{t_2}(A_k|S^{PLB}_{t_2}, S^{SPV}_{t_2})$. Suppose $H^*_{t_1} = +1^{A_2}$, so that at t_2 the book opens $S^{PLB}_{t_1} = [1110]$ and $S^{SPV}_{t_1} = [0]$. If a RT arrives at t_2, his payoffs are:

$$
\begin{array}{lcll}
H_{t_2}^{RT} = & -1^{B_1} & : & B_1 - \beta v \\
H_{t_2}^{RT} = & -1^{A_1} & : & \beta v - A_1 \\
H_{t_2}^{RT} = & 0 & : & 0
\end{array}
$$

and his equilibrium strategies are:

$$
H_{t_2}^{*RT}(\beta|[1110],[0]) = \begin{array}{ll}
-1^{B_1} & \text{if } \beta \in [0, \beta^{RT}_{-1^{B_1},0,t_2|[1110],[0]}) \\
0 & \text{if } \beta \in [\beta^{RT}_{-1^{B_1},0,t_2|[1110],[0]}, \beta^{RT}_{0,-1^{A_1},t_2|[1110],[0]}) \\
-1^{A_1} & \text{if} \beta \in [\beta^{RT}_{0,-1^{A_1},t_2|[1110],[0]}, 2)
\end{array}
$$

By using the optimal β-thresholds associated with these strategies, we compute the execution probability of $H_{t_1} = +1^{A_1}$ conditional on a RT arriving at t_2:

$$
p_{t_1}^{*RT}(A_2|[1110],[0]) = \frac{2 - \beta^{RT}_{0,-1^{A_1,t_2|[1110],[0]}}}{2} \cdot p_{t_2}^{*}(A_2|[1010],[0])
$$

If instead a BD arrives at t_2, his payoffs are:

$$
\begin{array}{lcll}
H_{t_2}^{BD} = & -1^{B_1} & : & B_1 - \beta v \\
H_{t_2}^{BD} = & +1^{a_l} & : & (a_l - \beta v) \cdot p_{t_2}^{*}(a_l|[1110],[Q^{a_l} = 1]) \\
H_{t_2}^{BD} = & +1^{b_l} & : & (\beta v - b_l) \cdot p_{t_2}^{*}(b_l|[1110],[Q^{b_l} = 1]) \\
H_{t_2}^{BD} = & -1^{A_1} & : & \beta v - A_1 \\
H_{t_2}^{BD} = & 0 & : & 0
\end{array}
$$

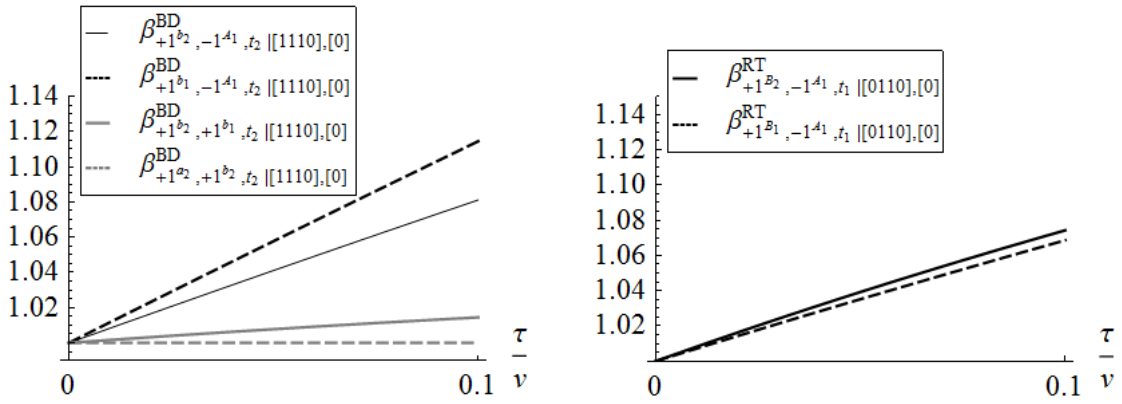
where for example $[Q^{a_l} = 1]$ indicates a SPV with one unit at a_l and empty at all other price levels. Both limit and market orders are equilibrium strategies because $p_{t_2}^{*}(a_l|[1110],[Q^{a_l} = 1]) \neq 0$ and $p_{t_2}^{*}(b_l|[1110],[Q^{b_l} = 1]) \neq 0$ for $l = 1, 2$. Traders need to determine the level of aggressiveness of their limit orders, we consider the bid side as an example. For $H_{t_2} = +1^{b_1}$ to be an equilibrium strategy, $\beta_{+1^{b_1},-1^{A_1},t_1|[1110],[0]} > \beta_{+1^{b_2},-1^{A_1},t_1|[1110],[0]}$. Figure 2 (Left) shows that this is always the case for $\frac{\tau}{v} \in (0, 1]$. Because $\beta_{+1^{b_2},+1^{b_1},t_1|[0000],[0]} > \beta_{+1^{a_2},+1^{b_2},t_1|[0000],[0]}$, also $H_{t_2} = +1^{b_2}$ is an optimal strategy. The equilibrium strategies for the BD are:

$$
H_{t_2}^{*BD}(\beta|[1110],[0]) = \begin{array}{ll}
-1^{B_1} & \text{if } \beta \in [0, \beta^{BD}_{-1^{B_1},+1^{a_1},t_2|[1110],[0]}) \\
+1^{a_1} & \text{if } \beta \in [\beta^{BD}_{-1^{B_1},+1^{a_1},t_2|[1110],[0]}, \beta^{BD}_{+1^{a_1},+1^{a_2},t_2|[1110],[0]}) \\
+1^{a_2} & \text{if } \beta \in [\beta^{BD}_{+1^{a_1},+1^{a_2},t_2|[1110],[0]}, \beta^{BD}_{+1^{a_2},+1^{b_2},t_2|[1110],[0]}) \\
+1^{b_2} & \text{if } \beta \in [\beta^{BD}_{+1^{a_2},+1^{b_2},t_2|[1110],[0]}, \beta^{BD}_{+1^{b_2},+1^{b_1},t_2|[1110],[0]}) \\
+1^{b_1} & \text{if } \beta \in [\beta^{BD}_{+1^{b_2},+1^{b_1},t_2|[1110],[0]}, \beta^{BD}_{+1^{b_1},-1^{A_1},t_2|[1110],[0]}) \\
-1^{A_1} & \text{if } \beta \in [\beta^{BD}_{+1^{b_1},-1^{A_1},t_2|[1110],[0]}, 2)
\end{array}
$$

It follows that, conditional on a BD arriving at t_2, the execution probability of the limit order posted at A_2 is:

$$
p_{t_1}^{*BD}(A_2|[1110],[0]) = \frac{2 - \beta^{BD}_{+1^{b_1},-1^{A_1},t_2|[1110],[0]}}{2} \cdot p_{t_2}^{*}(A_2|[1010],[0])
$$

Figure II: Left: BD's β-thresholds at t_2, $S_{t_1} = [1110]$ and $SPV_{t_1} = [0]$. Right: RT's β-thresholds at t_1, $S_0 = [0110]$ and $SPV_0 = [0]$.



We compute the total execution probability of the limit order posted at A_2 at t_1 as the weighted average of the two conditional probabilities:

$$p^*_{t_1}(A_2|[1110],[0]) = \alpha p^{BD*}_{t_1}(A_2|[1110],[0]) + (1-\alpha)p^{RT*}_{t_1}(A_2|[1110],[0])$$

Similarly, we compute the equilibrium strategies for all the other possible states of the book at t_2 and obtain the execution probabilities of the different order types available at t_1.
We follow an analoguos procedure to solve for the equilibrium order submission strategies at t_1.

Opaque SPV (O)

In this proof we only highlight the differences with the transparent PLB&SPV framework, therefore we focus only on RTs. Consider again the PLB that opens [1110] at t_2. If a RT arrives, he will infer the state of the SPV from the observed PLB. The RT knows that $H_{t_1} = +1^{A_2}$ is never an equilibrium strategy for a BD if the state of the SPV is $S^{SPV}_0 = [1]$. So he will update the probabilities associated with $S^{SPV} = [0]$ and $S^{SPV} = [1]$ from (1/2) to:

$$Pr(S^{SPV}_{t_1} = [0]|S^{PLB}_{t_1} = [1110]) = \frac{\frac{1}{2}[\alpha Pr(H^{*BD}_{t_1}=+1^{A_2})+(1-\alpha)Pr(H^{*RT}_{t_1}=+1^{A_2})]}{\frac{1}{2}\alpha Pr(H^{*BD}_{t_1}=+1^{A_2})+(1-\alpha)Pr(H^{*RT}_{t_1}=+1^{A_2})} > \frac{1}{2}$$

$$Pr(S^{SPV}_{t_1} = [1]|S^{PLB}_{t_1} = [1110]) = \frac{\frac{1}{2}(1-\alpha)Pr(H^{*RT}_{t_1}=+1^{A_2})}{\frac{1}{2}\alpha Pr(H^{*BD}_{t_1}=+1^{A_2})+(1-\alpha)Pr(H^{*RT}_{t_1}=+1^{A_2})} < \frac{1}{2}$$

To select his optimal trading strategy, he will then compute the expected payoffs using the Bayesian updated probabilities. For example:

$$H_{t_2} = -1^B : \; B_1 Pr\left\{S^{SPV}_{t_1} = [0]|[1110]\right\} + b_1 Pr\left\{S^{SPV}_{t_1} = [1]|[1110]\right\} - \beta v$$

Our results illustrate whether the effects of the competition from a SPV depend on the degree of transparency of the SPV. According to our model, when the stock is liquid, a decrease in the

transparency of the SPV has only a moderate effect on traders' order submission strategies (Figure 4). This moderate effect has a subtle explanation. When the SPV turns opaque, RTs choose fewer market orders because the uncertainty on the execution price increases price opportunity costs. They know that market orders can eventually be executed in the SPV but in this case they cannot observe the SPV**,** and hence they cannot condition their order choice on the state of the SPV. Therefore volume in the SPV decreases and hence the execution probability of limit orders posted to the SPV also decreases with the result that the liquidity provision to the SPV declines. However, even though total volume decreases as RTs switch from market to limit orders, the PLB volume increases. The reason is once more due to the uncertainty about the state of the SPV: because RTs cannot observe the liquidity available on the SPV, market orders bounce back to the PLB more frequently compared to the case with a transparent SPV. Moreover, because the stock is liquid and market orders play a dominant role, the feedback effect on the PLB volume - that increases - outweighs the small increase in the liquidity provision. So the overall positive effect on market quality of the competition from the SPV becomes weaker (Figure 5).[1] In the case of illiquid stocks, instead, when the SPV is opaque, the effects of QJ become stronger because the uncertainty on the SPV depth and on the actual level of competition makes RTs even more reluctant to post limit orders to the PLB. Hence when the stock is illiquid, a reduction in the transparency of the SPV makes the negative effects on the quality of the PLB even more problematic, especially for low priced stocks (Figure 6).

[1] If the PLB volume is higher following the introduction of an opaque SPV, its reduction compared to the benchmark PLB is smaller and so is the effect on market quality.

Figure III: **Trading Strategies -** This Figure reports - for $t = t_1$ - the equilibrium submission probabilities of limit orders posted on the ask side at different levels of the book, under the two states of the book "Liquid Stock" (Panel A) and "Illiquid Stock" (Panel B), and for 2 different asset values, $v = \{1, 10\}$. The submission probabilities of limit orders for the Public Limit Order Book (PLB) refer to the framework with tick size $\tau_{PLB} = \tau$, and price grid $\{A_1, A_2\}$. The submission probabilities of limit orders are instead indicated as SPV when posted to the Sub-Penny Venue with tick size $\tau_{SPV} = \frac{\tau}{3}$, and price grid $\{a_1, a_2, a_3, a_4, a_5\}$. They are indicated as (PLB&SPV) when posted to the PLB that competes with the SPV. The circle indicates the price at which the order is submitted in equilibrium. Under the state of the book "Liquid stock", both the book of the PLB and the book of the PLB&SPV open at t_1 with one share on the first level (A_1, B_1); while under the regime of "Illiquid stock" both the book of the PLB and the book of the PLB&SPV open empty. In both cases the SPV opens with equal probability either empty or with one share on the second level (a_2, b_2). The broker-dealers' arrival rate is $\alpha = 20\%$ and $\tau = 0.1$.

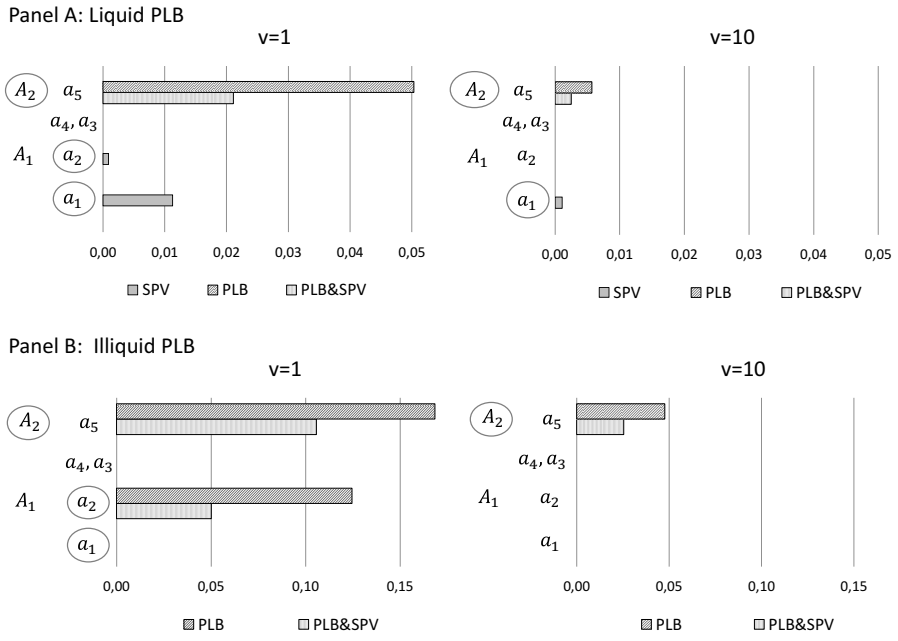


Figure IV: **Trading Strategies** - This Figure reports - for $t = t_1$ - the equilibrium submission probabilities of limit orders posted on the ask side at different levels of the book, under the two states of the book "Liquid Stock" (Panel A) and "Illiquid Stock" (Panel B), and for 2 different asset values, $v = \{1, 10\}$. The submission probabilities of limit orders for the Public Limit Order Book (PLB) refer to the equilibrium probabilities with tick size $\tau_{PLB} = \tau$, and price grid $\{A_1, A_2\}$. The submission probabilities of limit orders are instead indicated as SPV when limit orders are posted to the Sub-Penny Venue with tick size $\tau_{SPV} = \frac{\tau}{3}$ and price grid $\{a_1, a_2, a_3, a_4, a_5\}$. They are indicated as (PLB&SPV) when they are posted to the PLB that competes with the SPV. The circle indicates the price at which the order is submitted in equilibrium. Under the state of the book "Liquid stock", both the book of the PLB and the book of the PLB&SPV open at t_1 with one share on the first level (A_1, B_1); while under the regime of "Illiquid stock" both the book of the PLB and the book of the PLB&SPV open empty. In both cases the SPV opens with equal probability either empty or with one share on the second level (a_2, b_2). Results are reported for two regimes of transparency of the SPV, i.e., transparent (T) or opaque (O). The broker-dealer's arrival rate is $\alpha = 10\%$ and $\tau = 0.1$.

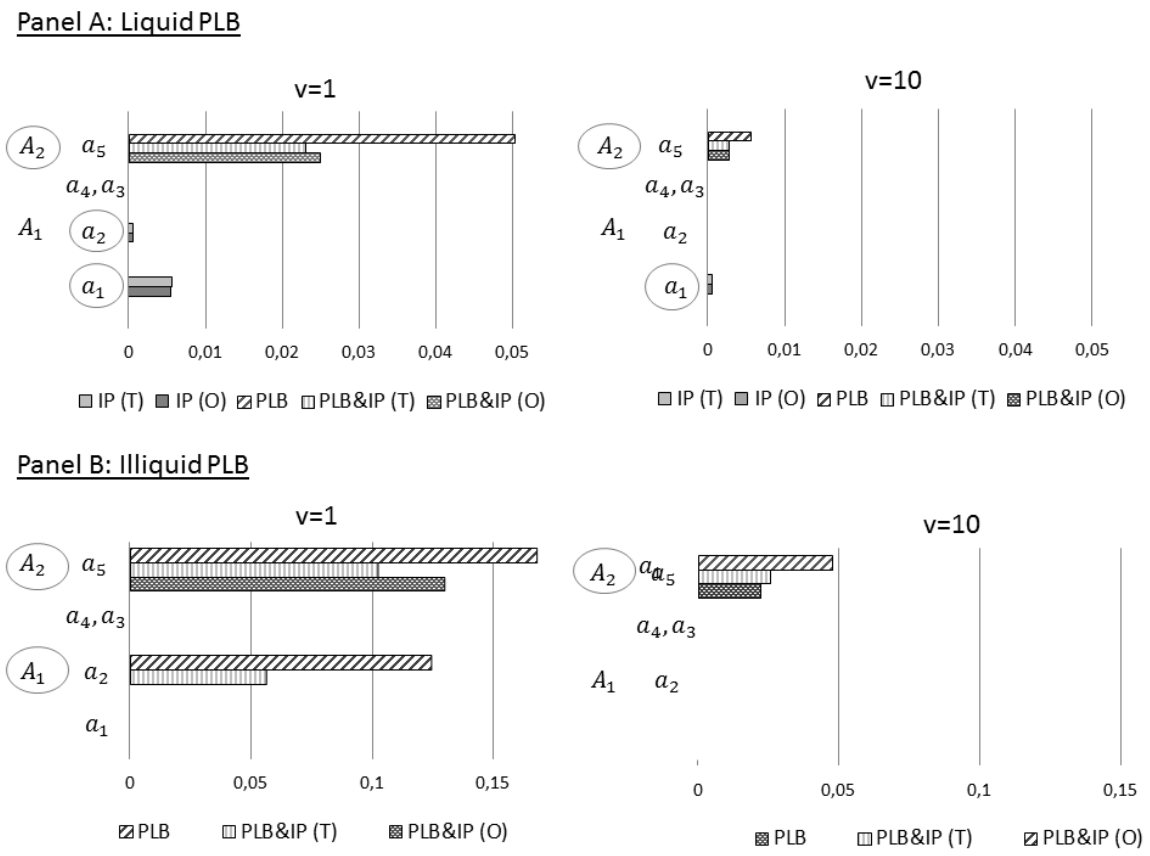


Figure V: **Order Flows and Market Quality - Liquid stocks -** This Figure reports statistics for order flows and market quality that result from the comparison between the benchmark Public Limit Order Book (PLB) with tick size $\tau_{PLB} = \tau$, and the extended model (PLB&SPV) in which a PLB with the same tick size as the benchmark model competes with a Sub-Penny Venue (SPV) characterized by a smaller tick size,$\tau_{SPV} = \frac{\tau}{3}$. We refer to "Liquid stock" as the regime under which both the benchmark PLB and the PLB that competes with the SPV open at t_1 with one share on the first level of both sides of the book$\{A_1, B_1\}$, and at the same time the SPV opens with equal probability either empty or with one share on the second level of the book (a_2, b_2). We present results for the broker-dealers' arrival rate $\alpha = 10\%$, $\tau = 0.1$ and for $v = \{1, 10\}$. For order flows this panel reports statistics on liquidity provision and trading volume both for the PLB (LP^{PLB} and VL^{PLB}) and for the SPV (LP^{SPV} and VL^{SPV}). For market quality we report statistics on total depth (DPT^{PLB}), depth at the best bid-offer (DPI^{PLB}) and spread (SP^{PLB}). The statistics are computed as the average difference between the value of the measure in the PLB that competes with the SPV, and the value of the same statistic in the benchmark PLB: $\Delta y = \frac{1}{k}\sum_{t=t_1}^{t_k}[y_t^{PLB\&SPV} - y_t^{PLB}] \times 100$, where $y = \left\{DPI^{PLB}, DPT^{PLB}, SP^{PLB}, VL^{PLB}, LP^{PLB}, VL^{SPV}, LP^{SPV}\right\}$, $k = 2$ for $\left\{DPI^{PLB}, DPT^{PLB}, SP^{PLB}, LP^{PLB}, LP^{SPV}\right\}$, and $k = 3$ for $\left\{VL^{PLB}, VL^{SPV}\right\}$. This difference is computed for both the Transparent and the Opaque regime.

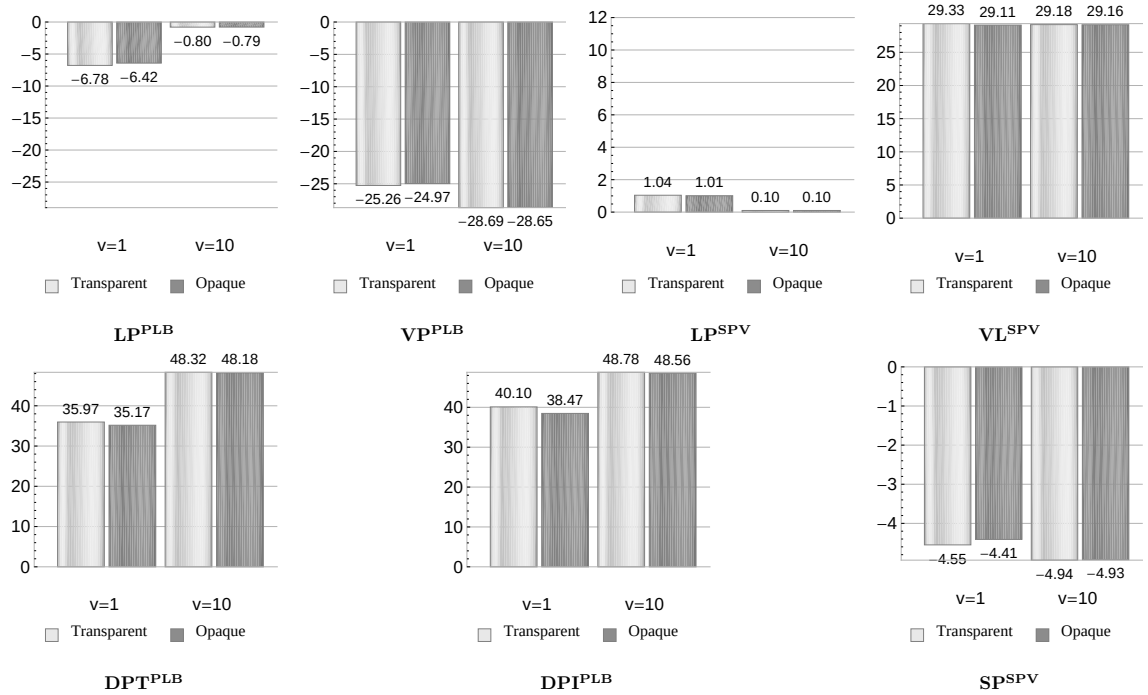


Figure VI: **Order Flows and Market Quality - Illiquid stocks -** This Figure reports statistics for order flows and market quality that result from the comparison between the benchmark Public Limit Order Book (PLB) with tick size $\tau_{PLB} = \tau$, and the extended model (PLB&SPV) in which a PLB with the same tick size as the benchmark model competes with a Sub-Penny Venue (SPV) characterized by a smaller tick size,$\tau_{SPV} = \frac{\tau}{3}$. We refer to "Illiquid stock" as the regime under which both the book of the benchmark PLB and the book of the PLB that competes with the SPV open empty at t_1, and at the same time the SPV opens with equal probability either empty or with one share on the second level of the book (a_2, b_2).We present results for the broker-dealers' arrival rate $\alpha = 10\%$, $\tau = 0.1$ and for $v = \{1, 10\}$. For order flows this panel reports statistics on liquidity provision and trading volume both for the PLB (LP^{PLB} and VL^{PLB}) and for the SPV (LP^{SPV} and VL^{SPV}). For market quality we report statistics on total depth (DPT^{PLB}), depth at the best bid-offer (DPI^{PLB}) and spread (SP^{PLB}). The statistics are computed as the average difference between the value of the measure in the PLB that competes with the SPV, and the value of the same statistic in the benchmark PLB: $\Delta y = \frac{1}{k}\sum_{t=t_1}^{t_k}[y_t^{PLB\&SPV} - y_t^{PLB}] \times 100$, where $y = \left\{DPI^{PLB}, DPT^{PLB}, SP^{PLB}, VL^{PLB}, LP^{PLB}, VL^{SPV}, LP^{SPV}\right\}$, $k = 2$ for $\left\{DPI^{PLB}, DPT^{PLB}, SP^{PLB}, LP^{PLB}, LP^{SPV}\right\}$, and $k = 3$ for $\left\{VL^{PLB}, VL^{SPV}\right\}$. This difference is computed for both the Transparent and the Opaque regime.

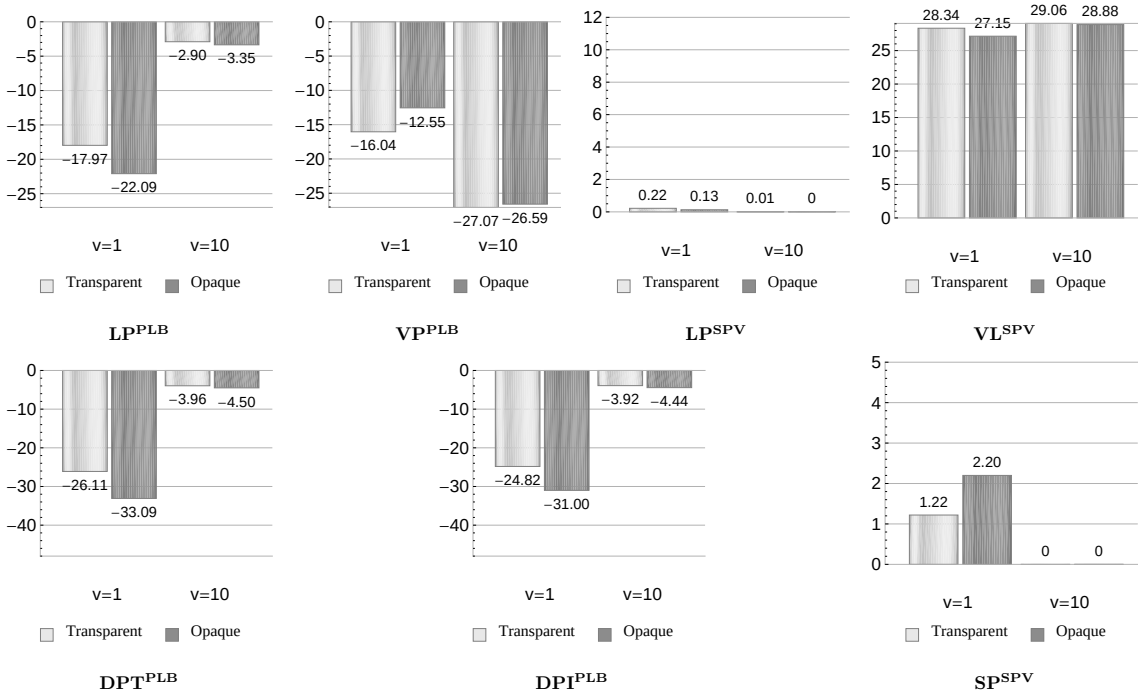


Table IV: **NASDAQ - FamaMacBeth regressions for queue-jumping**
This table reports the results of regressions of queue-jumping on contemporaneous market characteristics based on daily cross-sectional Fama-MacBeth regressions. Queue-jumping is 100 times daily queue-jumping dollar volume on Alternative Display Facility (ADF) divided by daily consolidated dollar volume (volume computed during trading hours 9:30 AM - 4:00 PM ET). We take the log of market capitalization, volume and bid depth. Cent spreads are multiplied by 100. We report the average daily coefficients on top and t-statistics below, computed accordingly Newey-West with 5 lags.

	(1) queue-jumping	(2) queue-jumping	(3) queue-jumping	(4) queue-jumping	(5) queue-jumping
market capitalization (CSRP)	-1.131***				
	(-28.49)				
share volume (TAQ)		0.008	-0.167	1.301***	
		(0.39)	(-0.94)	(10.02)	
closing price (CSRP)		-0.088***	-0.079***		
		(-32.78)	(-6.66)		
quoted spread cents (TAQ)			0.099		
			(1.72)		
time-weighted bid depth (TAQ)			0.452*	-0.303*	0.864***
			(2.09)	(-2.37)	(25.69)
quoted spread percent (TAQ)				25.781***	14.742***
				(18.08)	(19.17)
relative order imbalance in percent (TAQ)					-1.404*
					(-2.04)
(high-low)/high (TAQ)					47.121***
					(6.41)
Constant	31.146***	9.333***	8.947***	-18.343***	-2.278***
	(36.30)	(20.81)	(5.26)	(-10.99)	(-7.18)
Observations	3780	3780	3780	3780	3780
R^2	0.11	0.11	0.13	0.33	0.32

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table V: **NASDAQ - FamaMacBeth regressions for mid-crossing**
This table reports the results of regressions of mid-crossing on contemporaneous market characteristics based on daily cross-sectional Fama-MacBeth regressions. Mid-crossing is 100 times daily mid-crossing dollar volume on Alternative Display Facility (ADF) divided by daily consolidated dollar volume (volume computed during trading hours 9:30 AM - 4:00 PM ET). We take the log of market capitalization, volume and bid depth. Cent spreads are multiplied by 100. We report the average daily coefficients on top and t-statistics below, computed accordingly Newey-West with 5 lags.

	(1) mid-crossing	(2) mid-crossing	(3) mid-crossing	(4) mid-crossing	(5) mid-crossing
market capitalization (CSRP)	0.474***				
	(12.80)				
share volume (TAQ)		0.406***	0.838***	0.639***	
		(16.13)	(9.31)	(9.83)	
closing price (CSRP)		0.024***	-0.002		
		(6.94)	(-0.25)		
quoted spread cents (TAQ)			-0.009		
			(-0.31)		
time-weighted bid depth (TAQ)			-0.734***	-0.548***	0.002
			(-7.02)	(-8.11)	(0.09)
quoted spread percent (TAQ)				-2.500***	-6.193***
				(-5.10)	(-15.37)
relative order imbalance in percent (TAQ)					1.330*
					(2.27)
(high-low)/high (TAQ)					5.444*
					(2.05)
Constant	-6.888***	-4.860***	-6.989***	-4.339***	3.663***
	(-8.56)	(-9.16)	(-6.99)	(-5.20)	(18.35)
Observations	3780	3780	3780	3780	3780
R^2	0.08	0.09	0.14	0.13	0.11

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table VI: **NYSE - FamaMacBeth regressions for queue-jumping**
This table reports the results of regressions of queue-jumping on contemporaneous market characteristics based on daily cross-sectional Fama-MacBeth regressions. Queue-jumping is 100 times daily queue-jumping dollar volume on Alternative Display Facility (ADF) divided by daily consolidated dollar volume (volume computed during trading hours 9:30 AM - 4:00 PM ET). We take the log of market capitalization, volume and bid depth. Cent spreads are multiplied by 100. We report the average daily coefficients on top and t-statistics below, computed accordingly Newey-West with 5 lags.

	(1) queue-jumping	(2) queue-jumping	(3) queue-jumping	(4) queue-jumping	(5) queue-jumping
market capitalization (CSRP)	0.222***				
	(4.74)				
share volume (TAQ)		0.251***	0.047	0.195	
		(7.74)	(0.48)	(1.83)	
closing price (CSRP)		-0.016***	-0.009*		
		(-8.87)	(-2.28)		
quoted spread cents (TAQ)			-0.013		
			(-0.84)		
time-weighted bid depth (TAQ)			0.293**	0.270*	0.433***
			(2.71)	(2.59)	(17.24)
quoted spread percent (TAQ)				2.061	0.996
				(1.99)	(1.58)
relative order imbalance in percent (TAQ)					1.110
					(1.86)
(high-low)/high (TAQ)					1.004
					(0.31)
Constant	1.259	2.073**	3.667***	0.539	2.854***
	(1.21)	(3.32)	(3.66)	(0.41)	(16.43)
Observations	3780	3780	3780	3780	3780
R^2	0.02	0.05	0.07	0.06	0.07

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table VII: **NYSE - FamaMacBeth regressions for mid-crossing**
This table reports the results of regressions of mid-crossing on contemporaneous market characteristics based on daily cross-sectional Fama-MacBeth regressions. Mid-crossing is 100 times daily mid-crossing dollar volume on Alternative Display Facility (ADF) divided by daily consolidated dollar volume (volume computed during trading hours 9:30 AM - 4:00 PM ET). We take the log of market capitalization, volume and bid depth. Cent spreads are multiplied by 100. We report the average daily coefficients on top and t-statistics below, computed accordingly Newey-West with 5 lags.

	(1) mid-crossing	(2) mid-crossing	(3) mid-crossing	(4) mid-crossing	(5) mid-crossing
market capitalization (CSRP)	0.370***				
	(7.92)				
share volume (TAQ)		0.410***	0.840***	0.806***	
		(11.80)	(13.10)	(12.85)	
closing price (CSRP)		-0.005*	-0.021***		
		(-2.68)	(-7.29)		
quoted spread cents (TAQ)			0.053***		
			(9.48)		
time-weighted bid depth (TAQ)			-0.547***	-0.404***	0.339***
			(-5.44)	(-4.94)	(8.50)
quoted spread percent (TAQ)				3.059***	-1.763**
				(7.77)	(-3.09)
relative order imbalance in percent (TAQ)					1.542*
					(2.06)
(high-low)/high (TAQ)					-1.717
					(-0.60)
Constant	-4.444***	-3.680***	-7.508***	-8.722***	1.296***
	(-4.12)	(-5.23)	(-11.07)	(-11.07)	(3.84)
Observations	3780	3780	3780	3780	3780
R^2	0.04	0.08	0.10	0.09	0.08

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table VIII: **SMALL - FamaMacBeth regressions for queue-jumping**
This table reports the results of regressions of queue-jumping on contemporaneous market characteristics based on daily cross-sectional Fama-MacBeth regressions. Queue-jumping is 100 times daily queue-jumping dollar volume on Alternative Display Facility (ADF) divided by daily consolidated dollar volume (volume computed during trading hours 9:30 AM - 4:00 PM ET). We take the log of market capitalization, volume and bid depth. Cent spreads are multiplied by 100. NYSE is a dummy variable which takes the value of 1 for stocks whose primary listing exchange is NYSE. We report the average daily coefficients on top and t-statistics below, computed accordingly Newey-West with 5 lags.

	(1) queue-jumping	(2) queue-jumping	(3) queue-jumping	(4) queue-jumping	(5) queue-jumping
NYSE	-1.276***	-1.715***	-1.816***	-1.412***	-1.910***
	(-10.07)	(-10.72)	(-14.19)	(-8.34)	(-15.02)
market capitalization (CSRP)	-4.142***				
	(-46.18)				
share volume (TAQ)		1.093***	0.764**	1.437***	
		(15.71)	(3.26)	(6.76)	
closing price (CSRP)		-0.074***	-0.102***		
		(-19.11)	(-7.24)		
quoted spread cents (TAQ)			0.160***		
			(5.60)		
time-weighted bid depth (TAQ)			1.197***	0.983***	2.029***
			(3.99)	(4.55)	(24.93)
quoted spread percent (TAQ)				13.277***	8.502***
				(13.38)	(9.46)
relative order imbalance in percent (TAQ)					-4.260***
					(-3.94)
(high-low)/high (TAQ)					7.905
					(1.24)
Constant	90.705***	-7.500***	-9.539***	-24.590***	-5.288***
	(50.69)	(-6.32)	(-4.69)	(-9.92)	(-11.84)
Observations	2520	2520	2520	2520	2520
R^2	0.22	0.19	0.27	0.30	0.29

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table IX: **LARGE - FamaMacBeth regressions for queue-jumping**
This table reports the results of regressions of queue-jumping on contemporaneous market characteristics based on daily cross-sectional Fama-MacBeth regressions. Queue-jumping is 100 times daily queue-jumping dollar volume on Alternative Display Facility (ADF) divided by daily consolidated dollar volume (volume computed during trading hours 9:30 AM - 4:00 PM ET). We take the log of market capitalization, volume and bid depth. Cent spreads are multiplied by 100. NYSE is a dummy variable which takes the value of 1 for stocks whose primary listing exchange is NYSE. We report the average daily coefficients on top and t-statistics below, computed accordingly Newey-West with 5 lags.

	(1) queue-jumping	(2) queue-jumping	(3) queue-jumping	(4) queue-jumping	(5) queue-jumping
NYSE	-0.001	0.149	0.173	0.044	0.148*
	(-0.01)	(1.64)	(1.93)	(0.56)	(2.56)
market capitalization (CSRP)	0.266***				
	(7.90)				
share volume (TAQ)		0.492***	0.488***	0.693***	
		(15.63)	(5.05)	(8.98)	
closing price (CSRP)		0.002	0.000		
		(0.85)	(0.05)		
quoted spread cents (TAQ)			0.215*		
			(2.46)		
time-weighted bid depth (TAQ)			0.057	-0.314***	0.279***
			(0.60)	(-4.33)	(10.74)
quoted spread percent (TAQ)				10.191***	0.857
				(5.26)	(0.51)
relative order imbalance in percent (TAQ)					4.249***
					(6.15)
(high-low)/high (TAQ)					18.271*
					(2.52)
Constant	0.428	-3.298***	-3.890**	-5.353***	2.914***
	(0.53)	(-4.96)	(-3.21)	(-5.15)	(11.39)
Observations	2520	2520	2520	2520	2520
R^2	0.02	0.07	0.09	0.09	0.11

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table X: **SMALL - FamaMacBeth regressions for mid-crossing**
This table reports the results of regressions of mid-crossing on contemporaneous market characteristics based on daily cross-sectional Fama-MacBeth regressions. Mid-crossing is 100 times daily mid-crossing dollar volume on Alternative Display Facility (ADF) divided by daily consolidated dollar volume (volume computed during trading hours 9:30 AM - 4:00 PM ET). We take the log of market capitalization, volume and bid depth. Cent spreads are multiplied by 100. NYSE is a dummy variable which takes the value of 1 for stocks whose primary listing exchange is NYSE. We report the average daily coefficients on top and t-statistics below, computed accordingly Newey-West with 5 lags.

	(1)	(2)	(3)	(4)	(5)
	mid-crossing	mid-crossing	mid-crossing	mid-crossing	mid-crossing
NYSE	0.350*	0.772***	0.582**	0.681***	0.512**
	(2.13)	(4.03)	(3.19)	(3.70)	(2.73)
market capitalization (CSRP)	0.640***				
	(5.27)				
share volume (TAQ)		0.546***	1.085***	0.896***	
		(8.55)	(9.74)	(8.59)	
closing price (CSRP)		0.015***	-0.022***		
		(5.10)	(-5.05)		
quoted spread cents (TAQ)			0.050***		
			(8.49)		
time-weighted bid depth (TAQ)			-0.989***	-0.751***	-0.067
			(-9.43)	(-8.76)	(-1.23)
quoted spread percent (TAQ)				-0.738	-3.986***
				(-1.71)	(-7.99)
relative order imbalance in percent (TAQ)					2.187*
					(2.31)
(high-low)/high (TAQ)					9.293***
					(3.58)
Constant	-10.231***	-7.134***	-9.447***	-7.809***	3.114***
	(-4.24)	(-6.41)	(-6.88)	(-5.71)	(8.26)
Observations	2520	2520	2520	2520	2520
R^2	0.05	0.07	0.12	0.11	0.09

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table XI: **LARGE - FamaMacBeth regressions for mid-crossing**
This table reports the results of regressions of mid-crossing on contemporaneous market characteristics based on daily cross-sectional Fama-MacBeth regressions. Mid-crossing is 100 times daily mid-crossing dollar volume on Alternative Display Facility (ADF) divided by daily consolidated dollar volume (volume computed during trading hours 9:30 AM - 4:00 PM ET). We take the log of market capitalization, volume and bid depth. Cent spreads are multiplied by 100. NYSE is a dummy variable which takes the value of 1 for stocks whose primary listing exchange is NYSE. We report the average daily coefficients on top and t-statistics below, computed accordingly Newey-West with 5 lags.

	(1) mid-crossing	(2) mid-crossing	(3) mid-crossing	(4) mid-crossing	(5) mid-crossing
NYSE	0.447***	0.534***	0.544***	0.533***	0.565***
	(6.38)	(8.12)	(7.68)	(8.08)	(8.55)
market capitalization (CSRP)	0.126*				
	(2.39)				
share volume (TAQ)		0.192***	0.542***	0.348***	
		(4.49)	(11.06)	(7.48)	
closing price (CSRP)		-0.003	-0.015***		
		(-1.51)	(-4.51)		
quoted spread cents (TAQ)			0.012		
			(0.10)		
time-weighted bid depth (TAQ)			-0.414***	-0.101	0.215***
			(-4.59)	(-1.70)	(7.04)
quoted spread percent (TAQ)				-2.543	-7.981***
				(-1.63)	(-5.76)
relative order imbalance in percent (TAQ)					-1.150*
					(-2.27)
(high-low)/high (TAQ)					7.542
					(1.73)
Constant	0.947	0.127	-3.210***	-2.103**	2.696***
	(0.75)	(0.14)	(-4.28)	(-2.89)	(9.18)
Observations	2520	2520	2520	2520	2520
R^2	0.04	0.07	0.10	0.08	0.09

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table XII: **NASDAQ LOW-PRICED stocks descriptive statitstics**
Summary statistics (average daily), ordered by market capitalization of NASDAQ low-priced stocks.

SYMBOL	Market Cap (Million $)	Closing Price ($)	Time-weighted relative spread ($^0/_{000}$)	Time-weighted bid depth (UoT)	Price range (%)	Queue-jumping on D (%)	Mid-crossing on D (%)	Sub-penny on D (%)
DELL	27,392.90	14.02	7.12	195.36	2.28	6.16	3.81	9.97
NWSA	25,765.20	14.15	7.04	153.67	2.33	3.48	4.36	7.83
AMA	16,373.80	12.27	8.13	250.84	1.95	5.78	2.33	8.11
ATVI	14,292.50	11.43	8.75	146.18	2.16	6.61	3.07	9.68
MU	6,487.50	7.64	13.06	348.92	3.24	8.51	3.72	12.22
HCBK	6,171.30	11.72	8.53	123.33	1.54	8.99	3.28	12.28
WIN	5,557.50	12.73	7.87	118.49	1.39	14.08	2.78	16.85
HOLX	4,198.80	16.26	6.27	19.98	2.24	4.69	4.1	8.78
ATML	4,139.90	9.16	10.97	90.45	3.48	6.16	3.88	10.04
HBAN	4,127.90	5.77	17.29	352.42	3	8.81	2.77	11.59
ONNN	3,247.10	7.61	13.15	99.97	2.86	5.42	3.62	9.04
BRCD	2,538.80	5.77	17.25	231.56	3.19	7.25	2.67	9.92
CDNS	2,171.00	8.09	12.4	44.03	2.9	4.92	2.96	7.88
JBLU	1,992.10	6.84	14.6	85.19	3.29	9.29	3.41	12.7
TQNT	1,565.20	10.24	9.88	29.51	3.72	9.81	3.38	13.2
ISBC	1,401.90	12.25	13.37	4.20	3.93	3.62	0.6	4.23
ACXM	1,369.60	17.32	10.26	3.47	3.49	2.73	5.56	8.29
CIEN	1,340.30	14.58	6.93	23.68	3.13	6.88	3.58	10.46
SVN	1,023.90	16.01	7.83	11.08	5.03	9.47	3.13	12.6
COCO	432.6	5.01	20.46	73.32	5.42	14.8	2.53	17.33
SAIA	232	14.63	31.3	2.21	5.39	4.71	2.45	7.15
AVII	211.4	1.92	52.15	111.59	4.47	16.45	0.81	17.26
TOMO	206.18	3.69	0.31	6.66	0.06	6.92	3.67	10.59
FTEK	156.03	6.45	0.35	6.11	0.04	15.11	0.77	15.88
URRE	152.75	1.87	0.64	8.83	0.11	18.70	1.13	19.83
NHWK	150.95	6.41	0.16	9.41	0.01	3.95	1.83	5.78
AMSW	146.04	6.36	0.42	5.86	0.04	13.19	1.06	14.25
SYNM	141.66	1.87	0.61	7.76	0.05	16.21	0.50	16.71
FSII	92.63	2.94	0.35	7.85	0.06	17.83	2.18	20.00
RXII	51.68	3.19	0.61	6.94	0.08	21.11	0.44	21.55
Average	4437.71	8.94	0.22	8.34	0.04	9.39	2.68	12.02

Table XIII: **NASDAQ HIGH-PRICED stocks descriptive statitstics**
Summary statistics (average daily), ordered by market capitalization of NASDAQ high-priced stocks.

SYMBOL	Market Cap (Million $)	Closing Price ($)	Time-weighted relative spread ($^0/_{000}$)	Time-weighted bid depth (UoT)	Price range (%)	Queue-jumping on D (%)	Mid-crossing on D (%)	Sub-penny on D (%)
DTV	40,647.00	42.49	2.45	19.39	1.48	3.83	3.88	7.71
NTAP	17,421.80	51.85	2.55	5.84	3.06	6.02	3.75	9.77
ADBE	14,749.40	28.24	3.54	26.70	2.5	8.04	3.5	11.54
CHRW	11,978.30	71.69	2.93	3.24	1.69	3.45	4.14	7.59
PRGO	5,802.20	63.75	5.16	2.68	2.25	5.87	4.47	10.34
BUCY	5,658.80	75.86	4.49	3.88	2.57	8.73	3.45	12.19
HSIC	5,267.40	58.13	5.05	2.65	1.99	4.62	4.12	8.74
SBAC	4,582.00	39.15	3.83	4.24	2.14	2.67	5.03	7.71
HANS	4,433.80	50.33	4.63	2.81	2.4	5.13	4.66	9.78
TECD	2,190.40	43.08	6.23	2.45	2.24	2.7	3.91	6.61
SYNT	2,011.60	48.65	11.27	1.94	2.39	4.56	2.56	7.12
SLAB	1,816.20	39.75	5.81	2.84	2.35	3.11	4.7	7.81
AAWW	1,424.20	55.48	14.77	1.91	3.83	6.52	2.87	9.4
USTR	1,394.30	58.2	16.3	1.78	3.56	2.57	2.47	5.04
GMCR	1,393.90	32	5	5.61	3.89	9.63	4.88	14.51
CBRL	1,229.60	53.75	8.93	2.19	2.21	4.81	4.03	8.84
CSGP	1,052.00	51.05	13.54	2.00	3.05	1.95	2.48	4.43
PRAA	1,022.00	65.89	22.63	1.71	3.48	4.55	3.42	7.97
MNRO	955.8	48.18	16.49	1.78	3.09	4.52	2.26	6.78
CMTL	848.5	30.06	8.4	3.02	2.67	4.4	2.37	6.77
MSTR	821.2	88.74	19.6	1.91	3.64	4.74	2.34	7.08
DECK	746.2	58.37	8.77	2.81	3.71	10.63	2.31	12.94
LUF	722	48.56	12.66	2.09	3.39	3.08	3.52	6.6
ALOG	593.2	46.08	30.62	1.74	3.62	3.81	2.91	6.73
BCPC	574.7	30.83	19.26	1.98	3.99	5.66	1.66	7.32
AIRM	539.3	43.35	25.47	1.76	4.16	3.25	2.03	5.28
CHCO	515.7	32.63	33.18	1.72	4.31	2.32	1.37	3.69
MDVN	396	11.72	14.2	4.83	3.84	6.27	3.69	9.97
AFAM	302	33.07	23.3	2.17	3.54	7.64	2.07	9.72
EBIX	262.7	23.26	15.62	4.20	4.36	18.83	3.59	22.42
Average	4378.4	47.47	12.22	4.13	3.05	5.46	3.28	8.75

Table XIV: **NYSE LOW-PRICED stocks descriptive statitstics**
Summary statistics (average daily), ordered by market capitalization of NYSE low-priced stocks.

SYMBOL	Market Cap (Million $)	Closing Price ($)	Time-weighted relative spread ($^0/_{000}$)	Time-weighted bid depth (UoT)	Price range (%)	Queue-jumping on D (%)	Mid-crossing on D (%)	Sub-penny on D (%)
C	95,878.70	4.19	23.75	20431.43	2.36	6.48	5.82	12.3
F	47,846.30	14.84	6.75	300.31	2.64	11.37	2.62	13.99
MOT	18,651.50	8.07	12.36	366.80	2.58	7.47	4.73	12.21
DFS	9,686.20	17.86	5.71	30.41	2.6	5.19	5.21	10.4
EP	9,320.20	13.3	7.58	62.48	2.47	6.35	4.63	10.97
GNW	5,988.20	12.28	8.26	42.73	3.4	8.67	5.21	13.88
TSN	4,768.40	15.56	6.55	37.90	2.67	5.93	5.01	10.94
MAS	4,000.20	11.17	9.12	41.88	3.08	4.94	4.88	9.82
LSI	3,326.40	5.12	19.78	253.36	3.14	6.94	4.17	11.11
CIE	3,304.00	9.85	15.22	5.13	4.61	9.19	2.39	11.58
FNF	3,207.00	13.93	7.45	24.90	3.03	5.64	3.83	9.47
DYN	2,871.10	4.78	20.98	146.18	3.88	3.85	3.16	7.01
THC	2,121.50	4.41	22.71	233.89	3.36	6.65	4.71	11.35
JNS	2,036.00	11.19	9.14	33.28	3.74	4.01	4.75	8.76
TSO	1,982.70	14.18	7.2	28.36	3.39	5.62	2.98	8.6
CNK	1,917.80	17.54	8.42	5.84	2.67	5.39	3.06	8.45
HXL	1,717.40	17.79	9.16	4.59	3.29	5.38	3.85	9.22
KAR	1,665.30	12.64	27.17	3.40	3.69	7.21	7.83	15.03
FCS	1,397.80	11.38	9.2	23.22	3.78	5.65	3.94	9.59
ANN	1,346.50	22.97	5.82	5.13	4.31	4.71	4.1	8.81
CAR	1,249.10	12.29	8.7	13.26	4.15	7.43	3.65	11.08
MIC	830.7	18.22	14.34	2.73	2.95	9.82	1.71	11.53
FIG	641.6	4.43	23.2	31.03	5.27	13.47	2.11	15.59
BGS	564.8	11.95	14.83	5.28	2.51	20.56	2.01	22.57
PGI	427.3	7.12	20.64	7.42	4.4	5.71	5.77	11.47
CBZ	373.5	6.07	18.08	14.08	3.64	6.04	3.56	9.6
SMP	258	11.75	31.27	2.93	5.76	9.62	1.84	11.46
PRO	254.8	9.92	38.04	2.73	6.57	3.99	4.05	8.04
MNI	194.3	3.27	32.59	23.45	7.68	9.1	2.93	12.03
KCP	145.7	14.52	28.82	2.33	6.5	5.38	2.89	8.27
Average	7599.1	11.42	15.76	739.55	3.80	7.26	3.91	11.17

Table XV: **NYSE HIGH-PRICED stocks descriptive statitstics**
Summary statistics (average daily), ordered by market capitalization of NYSE high-priced stocks.

SYMBOL	Market Cap (Million $)	Closing Price ($)	Time-weighted relative spread ($^0/_{000}$)	Time-weighted bid depth (UoT)	Price range (%)	Queue-jumping on D (%)	Mid-crossing on D (%)	Sub-penny on D (%)
IBM	176,426.50	142.04	1.43	3.95	1.28	9.06	2.47	11.53
DIS	66,662.60	35.77	2.81	28.93	1.77	5.83	4.53	10.37
UPS	48,359.10	68.48	2.03	5.56	1.53	6.29	4.7	11
CL	38,130.10	76.7	2.03	6.33	1.42	7.14	5.62	12.76
BDX	18,133.90	76.55	2.56	3.58	1.49	6.01	3.05	9.06
COH	15,612.40	49.17	3.03	5.50	2.35	6.37	3.71	10.08
WEC	6,920.80	59.2	3.6	3.30	1.52	5.75	3.1	8.84
TIF	6,636.80	53.5	3.99	4.12	2.57	5.17	2.61	7.78
RL	6,418.50	98.92	5.5	2.40	2.45	3.51	4.31	7.82
PNW	4,190.00	41.37	3.42	5.67	1.49	5.15	3.59	8.74
DRQ	2,765.30	70.28	10.53	1.98	4.11	3.73	1.78	5.52
COO	2,260.70	49.98	5.09	2.68	2.21	3.39	5.13	8.52
DST	2,193.90	44.14	4.97	2.68	1.86	3.9	4.72	8.62
NEU	1,837.10	120.84	22.1	1.53	3.75	5.73	2.88	8.61
SJI	1,507.90	50.61	11.08	2.09	2.07	5.52	1.18	6.7
TGI	1,368.30	82.21	12.75	1.76	2.91	2.93	1.81	4.74
AOS	1,311.60	53.02	9.93	2.21	3.53	3.03	2.46	5.49
CRK	1,113.70	23.92	9.04	3.47	3.79	4.48	3.48	7.96
WMK	1,055.20	39.23	28.14	2.40	8.35	3.79	2.42	6.21
CSH	1,053.70	35.98	11.5	2.15	3.35	4.47	1.2	5.67
UVV	1,023.20	41.46	10.46	2.02	3.47	6.05	1.75	7.8
CLW	927.5	81.62	26.21	1.56	3.93	4.64	2.15	6.79
LG	783.9	35.23	14.97	2.37	2.79	6.57	0.83	7.4
SCL	668.8	67.69	35.87	1.66	8.71	4.69	2.57	7.26
NC	658.4	98.52	69.01	1.45	12.49	4.52	2.96	7.48
PPD	655.8	59.93	24.99	2.02	6.36	5.56	1.44	7
CGX	518.3	46.47	30.96	1.71	5.01	5.41	3.52	8.93
MFW	503.7	26.09	41.39	1.87	7.96	3.4	2.38	5.78
AZZ	469.2	38.15	23.95	2.00	3.41	6.57	1.75	8.31
BTH	384.9	43.29	55.13	1.71	10.37	5.3	3.27	8.57
Average	13685.1	60.35	16.28	3.69	3.94	5.13	2.91	8.04