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1. Introduction

On July 25, 2016, The Stock Exchange of Hong Kong Limited (SEHK) changed its market structure by introducing a Closing Auction Session (CAS) to the Hang Seng Composite LargeCap Index (HSLI) and Hang Seng Composite Midcap Index (HSMI). The closing auction is designed to facilitate trade execution at closing price, as many market participants need to transact a lot of volume near the market close. Some institutional investors and index trackers are mandated to execute at the closing price, so that a significant amount of securities market order flow comes from these market participants every day and especially on index rebalancing days. Through the closing auction, buyers and sellers who need to trade at the close are brought together to determine the market clearing closing price, which is used as a benchmark price for the settlement of many financial securities, such as mutual funds' NAV, the asset value of exchange-traded funds, derivatives prices, etc. Since its inception, the closing auction in Hong Kong has experienced steady growth. Figure 1 shows the time trend of the closing auction for Hang Seng Composite LargeCap and Midcap Index. The trading volume in the closing auction increased to more than 8% in June 2018.

This paper seeks to assess the impact of the closing auction on the market quality and efficiency in the continuous trading session in Hong Kong. Causal assessment of any market structure change is difficult to obtain. But an important feature of the introduction of CAS to the Hong Kong securities market is its staggered implementation. The closing auction was introduced to HSLI and HSMI constituents, H shares which have corresponding A shares listed on the exchanges in Mainland China and all Exchange Traded Funds on July 25, 2016, and was extended to Hang Seng Composite Small Index (HSSI) on July 24, 2017, and to nearly all securities on

October 8, 2019.[2] This feature allows us to make a causal inference about liquidity and efficiency changes due to closing auction. In our analysis, the treatment group consists of a total of 305 stocks in the HSLI and HSMI, and the control group consists of 188 stocks in the HSSI. We focus on the introduction of the closing auction to HSLI and HSMI and compute daily liquidity and efficiency measures from July 1, 2015, to July 23, 2017.

This paper's main finding is that the closing auction reduces the spike of trading volume in the continuous market, and the effect is most pronounced around the last minutes of the continuous trading session. We find volatility and price impact decline toward the end of the trading session, relative to the rest of the day. After the adoption of closing auction, prices at the end of the continuous trading session become less noisy and more efficient.

We begin our analysis by testing whether the volume shifts from the continuous session to the closing auction session. We find that after the introduction of the closing auction, 5.21% of the trading volume moves to the closing auction, which is associated with a decline of 4.83% of trading volume in the last 15 minutes of the continuous session. The volume migration is in line with the trading strategies of passive index funds, who prefer to trade at the closing price, based on which the benchmark returns are calculated. The funds also need to accommodate inflow and outflow on a daily basis, and the size of the flow is with the least uncertainty at the day end.

Using a difference-in-differences analysis, we find that the closing auction reduces the liquidity in the continuous session. Relative to the control group, the percentage bid-ask spread of the stocks with the CAS implementation increases by 0.045% during the 9:45-15:45 time interval, and 0.047% during the 15:45 – 16:00 time interval. As we need to isolate the period-specific

[2]Short selling with uptick rule was also allowed in CAS Phase 2. Leveraged and inverse products were excluded from CAS at the launch of Phase 3 but only included subsequently when the Pre-opening Session was enhanced in October 2020.

effect, we normalise the spread in the 15:45 to 16:00 time interval by the spread from in the 9:45 to 15:45 time interval. The denominator controls the differences in the level of liquidity among stocks. Results show that spread widens more in the last 15-minutes of the continuous session than the rest of the session. We further examine the market depth, the sum of shares at the best bid and ask prices. Depth also decreases slightly during the continuous session, and the reduction is again bigger in the last 15-minutes than the rest of the day. These findings are consistent with the theoretical predictions of Admati and Pfleiderer (1988). In equilibrium, discretionary traders cluster to transact at the points with the lowest transaction cost. The concern about tracking errors may serve as a coordination device that makes most index funds herd to the closing auction. The migration of the discretionary traders from the continuous market to the closing auction plausibly contributes to the liquidity deterioration in the continuous market.

Finally, we investigate how the closing auction affects the price efficiency, that is, how efficient the closing prices are incorporating information. If the uninformed traders migrate to the closing auction from the continuous session, we expect the temporary price pressure near the close of the continuous session to reduce and a weaker subsequent reversal. To test this conjecture, we compute the correlation of returns from 15:00 to 16:00 on day *t* and 16:00 to 15:00 on day *t+1*. We find this is indeed the case: the correlation becomes less negative after introducing the closing action, which implies a reduction in noises and more efficient prices at the end of the continuous trading. We further examine the impact of the closing auction on the closing price efficiency by computing the correlation between the 15:00-to-close and close-to-15:00 returns and find no change in the efficiency of the closing price[3].

[3] We take the close auction price as the closing price after the close auction implementation and use the last midpoint price at 16:00 as the closing price before the close auction implementation.

The closing auction has been introduced to a large number of stock exchanges around the world. Bogousslavsky and Muravyev (2020) focus on the mechanism of the closing auction in the US stock markets and find the auction price tends to deviate from the last midpoint in the continuous phase, whereas Wu (2019) shows that the rise of passive indexing is associated with more market-on-close orders, and the order imbalance at the close can generate a temporary price impact.

Our work is related to Kandel, Rindi, and Bosetti (2012), who analyse how the introduction of the closing auction to the Italian stock exchange changes investors' intention and strategy to trade in the continuous market preceding the close. The authors find the closing auction has no effect during most trading hours but has a drastic impact on the last minutes' trading in the continuous market. Pagano and Schwartz (2003) study the introduction of the closing auction in Paris Bourse and find that the price discovery improves and no deterioration of market liquidity in the continuous market. Our study finds that although the bid ask spread (depth) increases (decrease) slightly during the continuous session after the introduction of CAS by the Hong Kong Stock Exchange, the price impact is smaller and prices become more efficient near the market close.

The paper proceeds as follows. We introduce the institutional background in section 2. Section 3 presents the data, and Section 4 presents the analysis on how closing auction changes the continuous market liquidity and the implications on market efficiency. Section 5 concludes.

2. Institutional Background

The Hong Kong Stock Exchange introduced the Closing Auction Section to the securities market over three phases. CAS was introduced to Hang Seng Composite LargeCap Index and Hang

Seng Composite Midcap Index in the first phase commencing on July 25, 2016, and was extended to Hang Seng Composite SmallCap Index in the second phase starting on July 24, 2017. In the last phase, CAS was expanded to all equities and funds in the Hong Kong Stock Exchange on October 8, 2019.

Hang Seng Composite Index (HSCI) measures the stock performance of the top 95th percentile of the total market capitalisation of companies listed on the Main Board of the Stock Exchange of Hong Kong. It is a major index that provides a comprehensive benchmark for the Hong Kong market. The Hang Seng Composite Index is composed of 493 stocks. It is sub-divided into three size indexes: the Hang Seng Composite LargeCap Index, the Hang Seng Composite MidCap Index, and the Hang Seng Composite SmallCap Index. The Hang Seng Composite LargeCap, Midcap, and SmallCap indexes have 112, 193, and 188 constituents, respectively, representing target coverage of the top 80%, the next 15%, and the remaining 5% in terms of the cumulative market capitalisation of the HSCI.

The CAS lasts about 10 minutes and comprises four periods: a Reference Price Fixing Period, an Order Input Period, a No-cancellation Period, and a Random Closing Period. In the Reference Price Fixing Period from 16:00 to 16:01, a reference price is formed based on the median of 5 nominal prices in the last minute. The closing price is allowed only to be within $\pm 5\%$ of the reference price. In the Order Input Period from 16:01 to 16:06, at-auction orders and at-auction limit orders in the ±5% reference price range recorded at the end of the Order Input Period can be entered. Orders can be amended or cancelled within the period. In the No-cancellation Period from 16:06 to 16:08, only at-auction orders and at-auction limit orders between the lowest bid and highest ask can be entered. Neither amendment nor cancellation is allowed. In the final Random Closing Period from 16:08 to 16:10, a closing price is formed at a random moment in the period.

3. Data

In this paper, we deploy the historical full book data on the Hong Kong Stock Exchange (HKEX). The dataset is a series of messages that describe orders added to, removed from, and executed on the HKEX. The timestamp is at nanosecond precision. We use the sequence of messages to construct a limit order book, from which we compute the liquidity and price efficiency measures.

Percentage bid-ask spread measures the difference between the best bid and best ask at any time interval divided by the midpoint of the two. Following Holden and Jacobsen (2014), we weigh the spread by the length of time the spread persists. We compute the time-weighted spreads from 9:45 to 15:45 ($Spread_{day}$), and the time-weighted spread from 15:45 to 16:00 ($Spread_{last15}$). We then compute the ratio of the two $(Spread_{ratio})$ [4]. We study the market depth, the quantity dimension of liquidity, and calculate the variable as the logarithm of the sum of shares at the best bid and the best ask. We also compute the realised variance, the sum of the squared returns over the period. Returns are calculated as the change in midpoints every 30 seconds. Further, we follow Amihud (2002) to construct price impact, the absolute stock return to its dollar volume. The same as the spread, we construct variables over two intraday intervals from 9:45 to 15:45 and from 15:45 to 16:00 and then calculate their ratios.[5]

Across most of our tests, we use data from July 2015 to June 2017 and focus on Phase 1 implementation. We restrict our sample to 493 constituent stocks in the Hang Seng Composite Index. The treatment group consists of 305 stocks (i.e., 112 +193) in the Hang Seng Composite LargeCap

[4] We drop the first 15 minutes to exclude the effect from market open.

[5] One exception is $Volatility_{prop}$, for which we compute as the ratio of realised variance from 15:45 to 16:00 to the realised variance from 9:30 to 16:00. $Volatility_{prop}$ captures the fraction of the cumulative squared returns near the market close.

and MidCap Index, and the control group consists of 118 stocks in the Hang Seng Composite SmallCap Index. We postulate that Hang Seng Composite Index constituents share similar firm characteristics, and the subset index HSSI can serve as a control sample for the subset HSLI and HSMI to produce unbiased estimates in the analysis. We divide the sample into two periods: the pre-period from July 1, 2015, to July 24, 2016, and the post-period from July 25, 2016, to July 24, 2017. Table 1 reports the summary statistics of the key variables for each group.

Panels (a) and (b) in Figure 2 present the volume distribution for stocks in the HSLI and HSMI over the trading day. The sample period is from July 24, 2017, to June 30, 2018, one year after the closing auction was implemented for all constitutes in the Hang Seng Composite Index. We segment the day into the open auction, 66 5-minute trading intervals from 9:30 to 16:00 in the continuous trading session, and the closing auction[6]. The blue bar presents the fraction of trading volume in each 5-minute in the continuous trading session, which confirms the classical U-shaped intraday trading volume distribution found in McInish and Wood (1992), Lee et al. (1993), Engle and Russell (2010), etc. The orange bars present the fraction of trading volume in the open and closing auctions. The figure shows that trading is concentrated at the end of the day: for stocks in the HSLI and HSMI, over 7% of the daily volume occurs in the closing auction, and over 3% of the daily volume occurs in the last 5 minutes of the continuous trading session, which are high given that an evenly distributed pattern suggests only 1.5% for each interval. The pattern is less prominent for stocks in the HSSI, but the end of the day still represents a significant proportion of the trading volume.

[6] Trading hours in the Hong Kong Securities Market during the continuous trading session are from 9:30 to 12:00 and from 13:00 to 16:00.

4. Results

4.1 Volume

We first present a non-parametric test for the allocation of trading volume over the course of the day for the Hang Seng Composite LargeCap and MidCap Index constituents. Table 2 shows the summary statistics for the volume proportion over five intraday periods—the open auction, 9:30 to 9:45, 9:45 to 15:45, 15:45 to 16:00, and the closing auction. Panel A presents the summary for the period before Phase 1 implementation from July 1, 2015, to July 24, 2016. Panel B presents summary statistics for the period after Phase 1 implementation from July 25, 2016, to July 23, 2017. Changes are noticeable. On average, 5.53% (i.e., decline from 16.05% to 10.52%) of the daily volume from 15:45 to 16:00 shift to other intraday periods, while the closing auction attracts 5.59% of the daily volume after its introduction. Changes in volume during other intraday intervals are minor. Table 2 provides evidence for the trading volume shift from the last 15-minute in the continuous session to the closing auction session.

We expect the changes in volume at different intraday intervals around the implementation dates to reflect actual investor behaviours derived from the introduction of the closing auction. One may have concerns that changes in trading activities are driven by cross-sectional and time-series variations in firm characteristics, making results subject to endogeneity issues. To address these concerns, we rely on the implementation of the closing auction to exploit its exogenous changes and adopt a difference-in-differences regression. The regression takes the following specification:

$$DepVar_{i,t} = \alpha_i + \beta \times Post_t \times Pilot_i + \gamma_t + controls + \epsilon_{i,t}, \quad (1)$$

where $DepVar_{i,t}$ is the percentage trading volume over a specific intraday period for stock i in on day t. $Pilot_i$ is a dummy variable equal to one if stock i is included in Phase 1, and zero otherwise.

$Post_t$ equals one for days after the launch and zero for days before the launch. We control stock and day fixed effect, market capitalisation, and the inverse of the stock price in the regression. We are interested in β, the coefficient of the interaction term, which captures the effect of the closing auction on Phase 1 stocks after CAS implementation. Columns (1)-(5) present the regression estimates over five periods in the day (i.e., open auction, intervals from 9:30 to 9:45, from 9:45 to 15:45, from 15:45 to 16:00, and the closing auction). Results are consistent with the non-parametric tests. Trading volume from 9:45 to 15:45 and in the last 15-minute continuous session decrease by 0.48% and 4.83%, respectively (columns (3) and (4)), while the closing auction attracts 5.20% of the trading volume (column (5)). The changes are both economically and statistically significant. In contrast, trading volume during other intraday periods experiences insignificant or few changes, as indicated in columns (1) and (2). Put together, Tables 2 and 3 show that the trading volume during the continuous session is reallocated to the closing auction, and the migration of the trading volume primarily comes from the last 15-minute in the continuous market.

The results are consistent with predictions in Admati and Pfleiderer (1988), who present a theory where discretionary liquidity traders choose to endogenously cluster and concentrate their orders in certain periods to minimise the adverse selection, and they render the possible role of the market's close as the unique clustering points. The closing auction provides market participants with another opportunity to trade after the continuous session (Kandel, Rindi, and Bosetti (2012)). The introduction of the closing auction attracts a significant proportion of volume to shift from the end of the continuous session to the closing auction, leading to a reduction of trading volume in the continuous session.

4.2 Market Quality

Next, we examine the impact of the closing auction on the market quality. The regression specification follows Eq. (1). Table 4 presents the changes in the quoted bid-ask spread after the introduction of the closing auction. The effects are economically and statistically significant and sizable: the spread from 9:45 to 15:45 increases by 0.045% (column (1)), and the spread from15:45 to 16:00 increase by 0.047% (column (2)), compared to the control group. The changes represent increases of 13.72% and 15.18% relative to the mean spread before the closing auction implementation. As we need to control for period-specific market condition, column (3) presents the bid-ask spread from 15:45 to 16:00 normalised by the spread from 9:45 to 15:45. The point estimate is positively significant with a t-statistic of 6.63, suggesting bid-ask spread near the close of the continuous session widens relative to the rest of the session.

To complement the analysis on the price dimension of liquidity, we exam depth, the quantity dimension suggested by Lee et al. (1993). Depth has been a relevant measure of liquidity for liquid stocks in recent years, as many of them have hit the lower bound of the bid-ask spread (i.e., one cent). Columns (4) and (5) report the regression results of the logarithm of time-weighted depths from 9:45 to 15:45 and from 15:45 to 16:00, respectively. The coefficients of the interaction terms are negatively significant in both columns, suggesting depths decrease in both intraday intervals after the initiation of the closing auction. Column (3) reports regression estimate for the depth from 15:45 to 16:00 normalised by depth from 9:45 to 15:45. The strongly negative coefficient implies that the reduction in depth is stronger near the market close than in the other daytime. The results are consistent with those using bid-ask spreads.

The results so far suggest that after the implementation of CAS, there is a slight decline in liquidity during the continuous trading session, especially in the last 15-minute interval. However,

this can be easily explained that the trading volume migrates from the continuous session to the closing auction session. In order to investigate the full effect of closing auction, we should include the trading volume and closing auction prices into the analysis as well.

We examine the volatility and price impact after the introduction of the closing auction in Table 5. Volatility declines significantly in the last minutes when controlling for the average volatility during the day (column (3)). The Amihud price impact can be interpreted as the price response associated with one dollar of the trading volume. To have a fair assessment of the closing auction, after the implementation of CAS, $PrcImpact_{last15}$ is computed as the return from 15:45 to the closing auction divided by the total dollar volume in the last 15 minutes of the continuous trading session and the closing auction session. On the other hand, before the implementation of CAS, $PrcImpact_{last15}$ is simply computed as the return from 15:45 to 16:00 divided by the total dollar volume in this time interval. As Table 5 indicates, the coefficient associated with the interaction term (Post × Pilot) for $PrcImpact_{ratio}$ is negative (column 6). This indicates that after the implementation of CAS, the price impact at the end of the trading session decreases relative to the rest of the day. . The finding shows that the introduction of CAS will reduce price impact near the close of the trading.

4.3 Market Efficiency

Lastly, we examine the implications of market efficiency. If uninformed traders migrate from the continuous market to the closing auction, fewer transitory demand shocks get incorporated into stock prices at the end of the continuous market, which can increase price efficiency and reduce the extent of prices shifting away from the fundamental. To investigate this issue, we compute the reversal as the correlation between the stock return from 15:00 to 16:00 on day *t* and the return from 16:00 on day *t* to 15:00 on day *t+1* for each stock month, that is,

$$RevM_{15:00} = correlation\left(r_{15:00_t \to 16:00_t}, r_{16:00_t \to 15:00_{t+1}}\right) \quad (2)$$

where $r_{15:00_t \to 16:00_t}$ is computed as the log change of the stock's midpoint prices at 15:00 and 16:00 on day *t*, and $r_{16:00_t \to 15:00_{t+1}}$ is computed as the log change of stock's midpoint price at 16:00 on day *t* and midpoint price at 15:00 on day *t+1*.[7] $RevM_{15:30}$ and $RevM_{15:45}$ are defined analogously.

Table 7 report the results. Panel A shows that the means of the $RevM$ appear to be negative for both the treatment and control groups, suggesting the temporary price pressure is in place at the end of the continuous trading session. Columns (1)-(3) in Panel B shows that the coefficients of the interaction terms are all positive with a t-statistic range from 3.62 to 4.15. The finding suggests that prices near the end of the continuous trading session contain fewer noises, and the subsequent price reversal is smaller after the implementation of closing auctions.

To further explore the closing price's efficiency, we re-compute the return reversal measure using the closing price.

$$RevC_{15:00} = correlation\left(r_{15:00_t \to close_t}, r_{close_t \to 15:00_{t+1}}\right) \quad (3)$$

where $close_t$ is the closing auction price after the implementation of the closing auction and is the midpoint price at 16:00 before the implementation of the closing auction.

Column (4-6) shows that the introduction of closing auction has an insignificant impact on the return correlation from the close to the next day. Before the introduction of the closing auction, traders with the demand to benchmark against the closing prices trade at the end of the continuous session. It is plausible that the closing auction draws the same group of traders, resulting in no change in the closing price efficiency after adopting the closing auction as the closing mechanism.

[7] The midpoint price at 16:00 is computed using the last bid and ask quotes in continuous trading session in the day.

Results are also consistent with the notion that the introduction of the closing auction does not change the fundamental information stemming from the arrival of the news about the firms' prospects.

5. Conclusion

The Hong Kong Stock Exchange began introducing a Closing Auction Session to its listed securities on July 25, 2016. The implementation was rolled out over three phases. The closing auction was first launched to the Hang Seng Composite LargeCap and MidCap Index and later expanded to other securities in the market. This paper examines the impact of this innovation on the continuous trading session, particularly the moment near the end of the trading day. We investigate this question by exploiting the staggered implementation of the closing auction, adopting a difference-in-differences regression.

We find that the closing action draws volume from the continuous market, with the last 15-minutes contributing the largest volume migration. Using order-level data from the Hong Kong Stock Exchange, we construct the limit order book and study the effects of the closing auction on market quality and efficiency in the continuous market. Bid ask spread increases while market depth decreases during the continuous trading session, and the effect is bigger in the last 15 minutes of the session. However, the introduction of the closing auction generally decreases volatility and reduces price impact near the end of the trading day.

This finding is in line with the index funds shifting from the continuous session to the closing auction. Index funds are incentivised to trade at the close, as they benchmark against the index they track based on the closing price. We show that the introduction of the closing auction makes the

price more efficient and less noisy at the end of the continuous session. Overall, the introduction of closing auction by HKEX is beneficial to many market participants who use the closing price as a reference price for the day-end settlement of many financial securities.

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Figure 1. Time-Trend of the Closing auction Volume

This figure presents the time-series pattern for the volume proportion in the closing auction for Hang Seng Composite LargeCap Index (HSCI) and Hang Seng Composite MidCap Index (HSMI) constituents. We compute the daily proportion of closing auction volume for each stock and average across all stocks within the month. The closing auction was implemented for stocks in HSCI and HSMI on July 25, 2016.

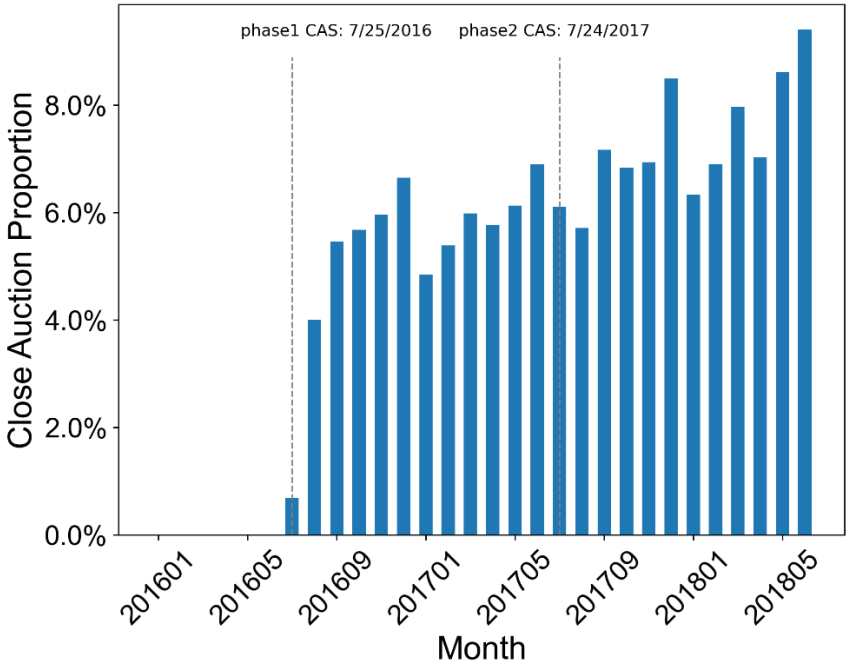

Figure 2. Intraday Volume Distribution

Panel A in this figure presents the intraday volume distribution for stocks in the Hang Seng Composite LargeCap Index (HSLI) and Hang Seng Composite MidCap Index (HSMI), and Panel B presents the intraday volume distribution for stocks in the Hang Seng Composite SmallCap Index (HSSI). The sample period is from July 24, 2017, to June 30, 2018. We segment the course of the day into the open auction, 66 5-minute intervals in the continuous session, and the closing auction. The blue bars represent the volume proportion in each 5-minute interval in the continuous session, and the orange bars represent the volume proportion in the open auction and the closing auction.

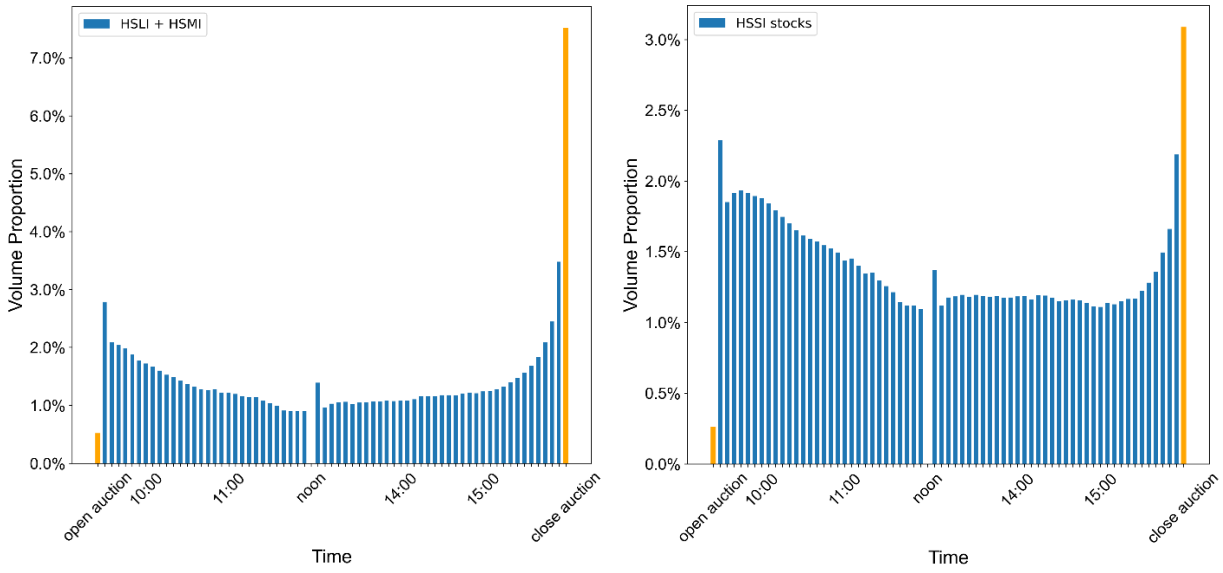

Table 1. Summary Statistics for Key Variables

This table presents descriptive statistics for the test and control groups from July 1, 2015, to July 24, 2016. Panel A reports the summary statistics for the test group, the Hang Seng Composite LargeCap and MidCap Indexes, and Panel B reports the summary statistics for the control group, the Hang Seng SmallCap Index. $Spread_{day}$(%) is the time-weighted average of percent quoted spread from 9:45 to 15:45. $Spread_{last15}$(%) is the time-weighted average of percent quoted spread from 15:45 to 16:00. $Spread_{ratio}$ is the ratio of the $Spread_{day}$ to $Spread_{last15}$. $Depth_{day}$ is the logarithm of time-weighted average of depth from 9:45 to 15:45. $Depth_{last15}$ is the logarithm of time-weighted average of depth from 15:45 to 16:00. $Depth_{ratio}$ is the ratio of the $Depth_{day}$ to $Depth_{last15}$. $Volatility_{day}$ is the realised variance from 9:45 to 15:45. $Volatility_{last15}$ is the realised variance from 15:45 to 16:00. Volatilities are multiplied by 10^4 for the ease of reading. $Volatility_{ratio}$ is the ratio of realised variance from 9:45 to 15:45 to the realised variance from 9:30 to 16:00. $Volatility_{prop}$ is the ratio of realised variance from 15:45 to 16:00 to the realised variance from 9:30 to 16:00 in percent. $PrcImpact_{day}$ is the average price impact of each 15-minute interval from 9:45 to 15:45. $PrcImpact_{last15}$ is the price impact from 15:45 to 16:00. The price impact measures follow Amihud (2002), which equals the absolute stock return to its dollar volume. The measures are multiplied by 10^6 for the ease of reading. $PrcImpact_{ratio}$ is the ratio of the $PrcImpact_{day}$ to $PrcImpact_{last15}$. *1/price* is the inverse of stock price, and *size* is the logarithm market capitalisation.

Panel A: Test Group HSLI and HSMI					
	mean	sd	p10	p50	p90
$Spread_{day}$(%)	33.08	28.40	13.31	23.71	62.03
$Spread_{last15}$(%)	30.75	28.01	11.91	21.33	58.98
$Spread_{ratio}$	0.9304	0.1931	0.7144	0.9370	1.1078
$Depth_{day}$	11.9911	1.4702	10.2698	11.8415	13.8602
$Depth_{last15}$	12.3249	1.5362	10.4679	12.2228	14.2644
$Depth_{ratio}$	1.6535	0.9122	0.7283	1.4526	2.8231
$Volatility_{day}$	16.2238	28.3088	2.6852	8.5450	31.8016
$Volatility_{last15}$	1.6637	3.4551	0.1934	0.7486	3.2541
$Volatility_{prop}$(%)	7.84	6.37	2.16	6.38	14.76
$PrcImpact_{day}$	0.0461	0.1487	0.0007	0.0071	0.1004
$PrcImpact_{last15}$	0.0171	0.1159	0.0000	0.0009	0.0175
$PrcImpact_{ratio}$	0.3084	0.5469	0.0175	0.1805	0.6316
1/Price	0.2718	0.7775	0.0274	0.1387	0.4808
Size	10.2707	1.1101	9.0730	10.0644	11.8962

Panel B: Control Group HSSI					
	mean	sd	p10	p50	p90
$Spread_{day}$(%)	83.20	56.99	27.23	66.94	165.80
$Spread_{last15}$(%)	76.49	55.09	22.18	61.16	157.48
$Spread_{ratio}$	0.9329	0.2739	0.6077	0.9320	1.2458
$Depth_{day}$	12.0700	1.5646	10.1543	11.9177	14.1765
$Depth_{last15}$	12.1862	1.6150	10.1513	12.0968	14.3312
$Depth_{ratio}$	1.3405	0.8344	0.5585	1.1470	2.3066
$Volatility_{day}$	31.0733	45.0494	4.0818	17.0308	69.9835
$Volatility_{last15}$	3.7834	6.0503	0.1066	1.6201	9.6445
$Volatility_{prop}$(%)	10.34	10.27	0.95	7.48	23.01
$PrcImpact_{day}$	0.3236	0.5562	0.0110	0.1159	0.8656
$PrcImpact_{last15}$	0.1306	0.3946	0.0000	0.0123	0.2992
$PrcImpact_{ratio}$	0.5020	1.0368	0.0000	0.1758	1.1976
1/Price	0.8853	1.5405	0.1287	0.4367	1.8868
Size	8.5529	0.5950	7.7598	8.5842	9.2610

Table 2. Volume Allocation over the Course of the Trading Day

This table presents the volume allocation over the course of the trading day for Hang Seng Composite LargeCap and MidCap Index constituents. We segment the trading day into the five sessions: the open auction, 9:30 to 9:45, 9:45 to 15:45, 15:45 to 16:00, and the closing auction. Panel A presents the descriptive statistics for the percentage volume in each segment in the pre-event period from July 1, 2015, to July 24, 2016, and Panel B presents the descriptive statistics for the percentage volume in each segment in the post-event period from July 25, 2016, to July 23, 2017.

Panel A: Pre-period 07/01/2015-07/24/2016					
	(1) mean	(2) sd	(3) p10	(4) p50	(5) p90
Opening auction	0.50%	1.01%	0.00%	0.15%	1.33%
9:30-9:45	8.05%	8.55%	1.13%	5.92%	16.29%
9:45-15:45	75.40%	12.05%	60.70%	77.00%	88.74%
15:45-16:00	16.05%	9.94%	5.75%	14.35%	27.90%
Closing auction	0.00%	0.00%	0.00%	0.00%	0.00%
Panel B: Post-period 07/25/2016-07/23/2017					
Open auctioning	0.43%	1.10%	0.00%	0.10%	1.14%
9:30-9:45	8.23%	8.81%	1.10%	5.88%	17.32%
9:45-15:45	75.22%	12.43%	59.88%	76.87%	89.14%
15:45-16:00	10.52%	6.90%	3.93%	9.23%	18.11%
Closing auction	5.59%	6.73%	0.35%	3.71%	12.54%

Table 3. The Impact of Closing Auction on Volume Allocation over the Course of the Trading Day

This table reports estimates from the difference-in-differences regression for the impact of closing auction on the volume allocation over the course of the trading day. In Panel A, the dependent variables in columns (1)-(5) are the percentage volume in the open auction, from 9:30 to 9:45, from 9:45 to 15:45, from 15:45 to 16:00, and the closing auction, respectively. In Panel B, the dependent variable is the turnover ratio, computed as the trading volume in the corresponding interval divided by the total number of shares outstanding. The variable is multiplied by 10^4 for the ease of reading. *Post×Pilot* equals one for stocks in the HSLI and HSMI after July 24, 2016, and zero otherwise. We control the inverse of the stock price, the logarithm of market capitalisation, and day and stock fixed effects. Standard errors are clustered by day and stock. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The sample period is from July 1, 2015, to July 23, 2017.

Panel A: Volume Distribution					
	(1) Opening auction	(2) 9:30-9:45	(3) 9:45-15:45	(4) 15:45-16:00	(5) Closing auction
Post×Pilot	-0.0407***	0.1020	-0.4837***	-4.8289***	5.2052***
	(-6.29)	(1.34)	(-4.53)	(-61.28)	(184.46)
Size	0.0629***	1.4709***	-2.1096***	0.4529***	0.1276***
	(8.13)	(16.10)	(-16.54)	(4.81)	(3.78)
1/Price	0.0152***	0.0698	-0.0529	0.0204	-0.0488***
	(4.73)	(1.84)	(-1.00)	(0.52)	(-3.48)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes
N	233363	233363	233363	233363	233363
R-sq	0.250	0.090	0.231	0.225	0.531

Panel B: Turnover					
	(1) Opening auction	(2) 9:30-9:45	(3) 9:45-15:45	(4) 15:45-16:00	(5) Closing auction
Post×Pilot	-0.0002***	0.0007	0.0014	-0.0126***	0.0129***
	(-9.05)	(1.80)	(0.70)	(-36.57)	(59.48)
Size	0.0005***	0.0087***	0.0182***	0.0028***	0.0012***
	(19.57)	(19.81)	(7.49)	(6.88)	(4.71)
1/Price	0.0002***	0.0052***	0.0341***	0.0042***	-0.0000
	(20.74)	(28.36)	(33.71)	(24.48)	(-0.32)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes
N	233596	233471	233471	233363	233596
R-sq	0.232	0.232	0.440	0.374	0.167

Table 4. The Impact of Closing Auction on Stock Liquidity

This table reports estimates from the difference-in-differences regression for the impact of closing auction on the volume allocation over the course of the trading day. Columns (1) to (6) report regression results for $Spread_{day}$, $Spread_{last15}$, $Spread_{ratio}$, $Depth_{day}$, $Depth_{last15}$, and $Depth_{ratio}$. *Post×Pilot* equals one for stocks in the HSLI and HSMI after July 24, 2016, and zero otherwise. We control the inverse of the stock price, the logarithm of market capitalisation, and day and stock fixed effects. Standard errors are clustered by day and stock. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The sample period is from July 1, 2015, to July 23, 2017.

	(1) $Spread_{day}$	(2) $Spread_{last15}$	(3) $Spread_{ratio}$	(4) $Depth_{day}$	(5) $Depth_{last15}$	(6) $Depth_{ratio}$
Post×Pilot	0.0454***	0.0466***	0.0131***	-0.0502***	-0.0955***	-0.0777***
	(25.19)	(24.73)	(6.63)	(-9.01)	(-13.87)	(-10.15)
Size	-0.1861***	-0.1857***	-0.0232***	-0.6851***	-0.5866***	0.1585***
	(-86.45)	(-82.45)	(-9.84)	(-102.88)	(-71.26)	(17.32)
1/Price	0.0224***	0.0226***	-0.0029**	0.0291***	0.0471***	0.0223***
	(24.96)	(24.16)	(-2.91)	(10.50)	(13.76)	(5.85)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	233596	233596	233596	233596	233596	233596
R-sq	0.827	0.796	0.058	0.856	0.795	0.103

Table 5. The Impact of Closing Auction on Volatility and Price Impact

This table reports estimates from the difference-in-differences regression for the impact of closing auction on the volume allocation over the course of the trading day. Columns (1) to (6) report regression results for $Volatility_{day}$, $Volatility_{last15}$, $Volatility_{prop}$, $PrcImpact_{day}$, $PrcImpact_{last15}$, and $PrcImpact_{ratio}$, respectively. *Post×Pilot* equals one for stocks in the HSLI and HSMI after July 24, 2016, and zero otherwise. We control the inverse of the stock price, the logarithm of market capitalisation, and day and stock fixed effects. Standard errors are clustered by day and stock. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The sample period is from July 1, 2015, to July 23, 2017.

	(1)	(2)	(3)	(4)	(5)	(6)
	$Volatility_{day}$	$Volatility_{last15}$	$Volatility_{prop}$	$PrcImpact_{day}$	$PrcImpact_{last15}$	$PrcImpact_{ratio}$
Post×Pilot	5.5413***	0.6189***	-0.3568***	0.0135***	0.0037***	-0.0106*
	(26.30)	(19.75)	(-5.10)	(8.08)	(6.30)	(-1.97)
Size	-4.9368***	-0.7320***	-1.2947***	-0.0636***	-0.0118***	-0.0155*
	(-19.60)	(-19.53)	(-15.47)	(-32.17)	(-16.87)	(-2.42)
1/Price	2.4018***	0.3285***	-0.2593***	0.0143***	0.0016***	-0.0015
	(22.92)	(21.08)	(-7.45)	(17.36)	(5.44)	(-0.54)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	233596	233596	233352	227134	226662	226434
R-sq	0.508	0.389	0.126	0.401	0.139	0.038

Table 6. The Effect of Closing Auction on Return Reversal

Panel A in this table reports descriptive statistics for the return reversal measures, and Panel B reports the estimates from the difference-in-differences regression for the impact of the closing auction on return reversal. $RevM_{15:00}$ is defined as the correlation between the stock return from 15:00 to 16:00 on day *t* and the return from 16:00 on day *t* to 15:00 on day *t+1* for each stock month. $RevC_{15:00}$ is defined as the correlation between the stock return from 15:00 to the day close on day *t* and the return from the day close on day *t* to 15:00 on day *t+1* for each stock month. $RevM_{15:30}$, $RevM_{15:45}$, $RevC_{15:30}$, and $RevC_{15:45}$ are defined analogously. *Post*×*Pilot* equals one for stocks in the HSLI and HSMI after July 24, 2016, and zero otherwise. We control the inverse of the stock price, the logarithm of market capitalisation, and day and stock fixed effects. Standard errors are clustered by day and stock. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The sample period in the regression is from July 1, 2015, to July 23, 2017.

Panel A: Descriptive Statistics for Reversal Measure

	mean	sd	p10	p50	p90		mean	sd	p10	p50	p90
Pre-period HSLI+HSMI											
$RevM_{1500}$	-0.094	0.166	-0.298	-0.089	0.120	$RevC_{1500}$	-0.094	0.166	-0.298	-0.089	0.120
$RevM_{1530}$	-0.097	0.166	-0.301	-0.104	0.112	$RevC_{1530}$	-0.097	0.166	-0.301	-0.104	0.112
$RevM_{1545}$	-0.098	0.159	-0.300	-0.095	0.107	$RevC_{1545}$	-0.098	0.159	-0.300	-0.095	0.107
Post-period HSLI+HSMI											
$RevM_{1500}$	-0.073	0.158	-0.277	-0.070	0.124	$RevC_{1500}$	-0.105	0.154	-0.300	-0.102	0.091
$RevM_{1530}$	-0.093	0.158	-0.301	-0.084	0.097	$RevC_{1530}$	-0.129	0.153	-0.324	-0.129	0.061
$RevM_{1545}$	-0.092	0.152	-0.288	-0.088	0.086	$RevC_{1545}$	-0.130	0.144	-0.320	-0.127	0.054
Pre-period HSSI											
$RevM_{1500}$	-0.172	0.189	-0.395	-0.182	0.078	$RevC_{1500}$	-0.172	0.189	-0.395	-0.182	0.078
$RevM_{1530}$	-0.159	0.188	-0.388	-0.165	0.090	$RevC_{1530}$	-0.159	0.188	-0.388	-0.165	0.090
$RevM_{1545}$	-0.143	0.173	-0.362	-0.142	0.066	$RevC_{1545}$	-0.143	0.173	-0.362	-0.142	0.066
Post-period HSSI											
$RevM_{1500}$	-0.190	0.178	-0.415	-0.186	0.034	$RevC_{1500}$	-0.192	0.178	-0.415	-0.188	0.026
$RevM_{1530}$	-0.200	0.174	-0.422	-0.192	0.008	$RevC_{1530}$	-0.202	0.173	-0.422	-0.195	0.006
$RevM_{1545}$	-0.181	0.161	-0.384	-0.183	0.023	$RevC_{1545}$	-0.183	0.159	-0.385	-0.183	0.022

Panel B: Regression Estimate

	(1) $RevM_{15:00}$	(2) $RevM_{15:30}$	(3) $RevM_{15:45}$	(4) $RevC_{15:00}$	(5) $RevC_{15:30}$	(6) $RevC_{15:45}$
Post×Pilot	0.0418***	0.0433***	0.0467***	0.0115	0.0102	0.0104
	(3.62)	(3.75)	(4.15)	(1.00)	(0.89)	(0.93)
Size	0.0306*	0.0354*	0.0513***	0.0281	0.0316*	0.0465**
	(2.04)	(2.36)	(3.52)	(1.89)	(2.12)	(3.23)
1/Price	0.0039	-0.0001	0.0056	0.0044	0.0006	0.0063
	(0.52)	(-0.01)	(0.77)	(0.59)	(0.08)	(0.88)
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Stock Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	3719	3719	3719	3719	3719	3719
R-sq	0.373	0.354	0.299	0.360	0.340	0.285