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Quote-Based manipulation of illiquid securities

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ABSTRACT

We document the effects of a manipulation akin to *marking the close*, conducted without any manipulative trades. Using prosecuted cases, we examine how manipulators can utilize periods of order-book illiquidity to navigate ill-conceived market design rules and influence security prices. Reference pricing, which has gained significant attention recently in interest rate and metals markets, is shown to contribute to significant increases in end of day returns for affected securities, with no observable subsequent reversals. We show that the price effects continue in the manipulated direction over extended periods, with average excess returns over 80% in the six months after manipulation.

1. Introduction

The last decade has been witness to a wave of allegations of manipulation around the pricing of financial benchmarks. The many instances of market abuse reported in the popular press have revealed significant vulnerabilities in the construction of reference prices, particularly for instruments and securities that are characterized by low liquidity, an opaque market structure and a form of price determination involving an appraisal of market forces.[1] This paper documents a form of price manipulation akin to *marking the close* that is shaped by the institutional structure of the Stock Exchange of Hong Kong (HKEx). Manipulation of closing prices reduces market fairness, impacts investor confidence, decreases liquidity and increases transaction costs for market participants (Aitken et al., 2005). It is for this reason that allegations of manipulation in financial markets warrant the attention of academics, practitioners, and financial market regulators.

The establishment of an accurate and resilient reference price at the market close is a pertinent issue for exchanges (Comerton-Forde and Putniņš, 2011). Their use in determining mutual fund asset values, derivative settlement values, and as a reference price for seasoned equity offerings, ensures that market participants are reliant on its accuracy. There is however, a lack of uniformity about the type of closing mechanism that achieves accurate reference pricing whilst preserving market integrity. Cordi et al. (2015) discuss three closing mechanisms typically used by exchanges such as the use of the last traded price, a volume weighted average price, and a price obtained via a batch auction. Despite the popularity of a closing price auction, Comerton-Forde and Rydge (2006) identify over twenty instances of closing price manipulation, highlighting the difficulty in achieving a market design that eliminates the incentive to manipulate.

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[1] Manipulation is not confined to only small and illiquid securities. Leinweber and Madhavan (2001), for example, document the successful manipulation of the multibillion dollar company Lucient Technologies and (Aspris et al., 2020) precious metals pricing benchmarks.

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This paper contributes to the literature using prosecuted cases of market misconduct.[2] Using a hand-collected set of prosecuted manipulations, we examine 123 cases and present evidence of large-scale market abuse. This abuse is facilitated by a market mechanism that allowed manipulators to exploit instances of market illiquidity to drive prices higher. Although the manipulation exploits of each case are not identical, they all rely on influencing prevailing market quotes in illiquid securities. As an example of how a manipulator could influence the closing price, on a day absent of any trading activity, the closing price would simply be recorded as the price it held on the previous day unless that price stood outside the bounds of prevailing market quotes. If the manipulator was able to identify an opportunity characterized by a significantly wide bid-ask spread, and be able to drive the prevailing bid price above the previous close, then that manipulator would have been able to successfully engineer a trading outcome that resulted in a higher close-to-close return, absent any trading activity. That these manipulations are concentrated in illiquid securities is not unusual. Aggarwal and Wu (2006) show that other forms of manipulation like pump-and-dump cases are also concentrated in illiquid stocks. Gandal et al. (2018) similarly conclude that the potential for fraud within thinly traded securities in opaque and unregulated markets allows market abuse to be committed at a far higher frequency than would otherwise be possible.[3]

In quantifying the effect of this manipulation on price and various trade characteristics, we show that manipulators on average generate abnormal returns in excess of 11% on manipulated days. This return is generated within the last few minutes of trade and manipulated stocks exhibit no reversal over the subsequent trading day. Unlike other types of closing price manipulation that have been examined in the literature (see Hillion and Suominen (2004) and Comerton-Forde and Putniņš (2011)), we show that these market integrity violations are associated with no change in trading activity on manipulated days, a temporary drop in market depth, and a narrowing of quoted spreads. Whilst standard market microstructure theory suggests that this type of manipulation may induce trading by sophisticated investors and arbitrageurs who recognize the opportunity to profitably counteract the manipulator, we present evidence of long-term price persistence with average excess returns of over 80% in the six-months following the end of the manipulation period. A possible explanation for this finding can be found in the detailed prosecutions, which suggest that in many cases, the fraud was perpetrated by insiders for the purpose of borrowing against the paper value of their listed share portfolios. Our findings therefore have important implications for the design of market structures, especially given the diversity of closing price mechanisms worldwide.

An important caveat to these findings is that the characterisations and impact of this market violation are based on prosecuted cases only. Examining prosecuted cases of manipulations means we have a limited ability to identify the pure effect of price manipulation.Aggarwal and Wu (2006), for instance, point out that such data misses those cases in which (1) price can be manipulated but it does not occur, (2) price is manipulated but the regulator fails to detect it, and (3) manipulation is investigated by the regulator but it is not penalized. Comerton-Forde and Putniņš (2013) estimate that for each prosecuted case of manipulation, approximately 300 instances of manipulation remain undetected or not prosecuted. Having noted these caveats, our examination of these prosecuted cases allows us to draw valuable conclusions on the characteristics and impact of these types of manipulations.

2. HKEx market structure and the closing price procedure

Approximately one half of the securities listed on the HKEx are penny stocks, trading below HK$ 1.00 per share with a significantly high proportion of retail order flow. The HKEx operates a fully electronic combined limit order market that uses a call auction to open trading, followed by a continuous auction throughout the day. Trading during our sample period occurred in two continuous sessions: the morning session from 10:00 to 12:30; and the afternoon session from 14:30 to 16:00.

Importantly for this study, the HKEx also has a “24-tick” rule applied to orders submitted during the continuous (and hence closing) portion of trading. This rule restricts limit orders to prices within $\pm$ 24 ticks of the current best bid or ask (or previous closing price at the open). This rule is relevant for closing price manipulation, as it places a maximum bound on daily quote manipulation in the case where no ask price exists.

2.1. The closing procedure and quote-Based manipulation

The closing price of a stock on the HKEx is determined by taking the median of five nominal prices at 15-second intervals in the last minute of the continuous trading session. If there is only one trade after 15:59:00 (or for the day), this trade price will become the closing price if it is between the closing best bid and ask quotes. Where the last trading price sits outside the current closing best bid or ask, the closing price will be set as either the best bid or ask, respectively. In an environment where there are no executed trades for a given stock-day, the closing price is maintained as the previous days closing price as long as that price is between the closing best bid and ask prices. If the previous close is above (below) the closing ask (bid), then the closing price becomes the prevailing ask (bid) quote, respectively. On the occasion that one side of the market did not present any depth, the closing price would be set to the best available quote.

For large, liquid stocks, choosing the median of five snapshots in the last minute of trading avoids the closing price being biased

[2] See, for example, Aggarwal and Wu (2006), McInish et al. (2011), Comerton-Forde and Putniņš (2011), Frino et al. (2013), Altunbaş et al., 2018 and Cumming et al. (2019).

[3] In similarly directed research, Smales (2019) also identifies the issue of manipulation in cryptocurrency markets, especially for indices that underlie derivatives while Canh et al. (2019) find that volatility spillovers in cryptocurrency markets tend to move from small to large markets, consistent with manipulation strategies.

by any single trade (i.e. the last trade). For smaller, less liquid stocks however, this process could facilitate a scenario whereby manipulators engage in costless price manipulation. Consider the case of a stock with no trading on a given day. If there is no prevailing ask (as is the case in 23% of our sample manipulation days), a manipulator can place a limit buy order at a price up to 24 ticks above the higher of the previous closing price or current bid price. In very low-priced stocks this can result in closing price movements in excess of 50%. Manipulators executing this type of strategy would optimally use limit orders of the minimum lot size in order to reduce the risk of a counterparty executing against their standing limit order prior to the close of the market. If the stock is not traded the next day, this inflated price will be maintained and there may be limited price reversion, with the new close offering further opportunities from which to continue manipulations in subsequent days.

3. Data

This study examines prosecuted cases of closing price manipulation on the HKEx. We manually construct a database of manipulation from the Hong Kong Security and Futures Commission (HKSFC) Enforcement News during the usage of the quote-based closing price system which was in place between 1999 and 2016. We identify 37 prosecuted cases of manipulation, of which 26 refer to closing price manipulation with identifiable manipulation dates. Trade and quote data are obtained from the Thomson Reuters Tick History (TRTH) Database, provided by the Securities Industry Research Centre of Asia-Pacific. The trade and quote data are stamped to the nearest millisecond and contain fields identifying the security code, date, time, price and volume.

3.1. Sample construction

The sample of prosecuted closing price manipulations consists of 123 instances (or stock-days) of manipulation across 26 individual stocks.[4] The specific offence date for each manipulation instance is provided by the HKSFC. In all cases, the manipulator attempted to inflate the closing price, typically by using small limit buy orders, seemingly without an intention to trade. No attempted price deflation was prosecuted by the HKSFC. This is consistent with the sample of exclusively upwards closing price manipulations reported in Canada and the US by Comerton-Forde and Putniņš (2011).

Prosecution for manipulation tends to be concentrated when the trading activities of stocks is particularly low. Table 1 describes the manipulated securities in our sample, including the duration of the manipulation, the number of single board-lots used to influence the closing reference price and the number of executions against these bids. Only 13 out of 170 manipulative bid orders were executed.

Comparing manipulated firms to the constituents of the Hang Seng Index (HSI) gives insight into the characteristics of manipulated stocks. Table 2 shows that manipulated firms tend to have low market capitalizations, less frequent trading, lower volume and higher spreads than the average HSI listed stock. This stands in contrast to Comerton-Forde and Putniņš (2011) who find that manipulated stocks tend to be larger and more liquid on average. This difference can be explained by the motivations of the manipulators. HKEx manipulators profit from the manipulation of the underlying stock rather than contracts that reference the closing price. Their motivations are therefore more akin to the “pump and dump” strategies documented in Aggarwal and Wu (2006), who find that illiquid stocks are easier to manipulate. This is consistent with the fact that under the current closing procedure on the HKEx, quote-based closing price manipulation can allow the profitable unwinding of positions in illiquid stocks. Even in the absence of the ability to sell illiquid stocks, the ability to externally borrow against these listed assets presents a potentially lucrative incentive for large shareholders to undertake persistent manipulation.

4. Research method

Using intraday data, we conduct an analysis of the periods of manipulation utilizing a control group to mitigate potentially confounding factors and to isolate the effects of the manipulation. We construct our control group using propensity score matching (PSM) which matches manipulated firms with a set of control firms that have similar characteristics. This technique is also used in Neupane et al. (2017) in the study of IPO manipulation on the Indian market. We identify the single nearest neighbor match, without replacement, based on the number of days the firm traded, average share turnover, average volatility, and market capitalization. Table 3 provides the mean differences across the listed confounders and shows that manipulated stocks and their matched controls are not statistically different across these dimensions.

For a given variable, Y, the impact of manipulation is measured via a difference-in-differences (DID) approach similar to that employed by Comerton-Forde and Putniņš (2011). We compute the before-after difference for both the manipulated stocks and the corresponding control stocks as identified in our PSM procedure. Our test statistic, $\hat{\alpha}_{DID}$, is given by Eq. (1),

$$\hat{\alpha}_{DID} = \underbrace{\left(Y^{M}_{i,t_1} - Y^{M}_{i,t_0}\right)}_{\text{Manipulation}} - \underbrace{\left(Y^{C}_{i,t_1} - Y^{C}_{i,t_0}\right)}_{\text{Control}} \tag{1}$$

where, for the ith manipulation, Y^{M}_{i} and Y^{C}_{i} the mean of an end-of-day variable for the manipulated stock and a group of corresponding non-manipulated control stocks. The time subscript t_1 represents the time of manipulation and t_0 the benchmark period of

[4] All but seven of these prosecuted cases are carried out over multiple days, hence a subsample analysis of single-day manipulations cannot be carried out with any statistical precision.

Table 1
Descriptive statistics on the sample of manipulated stock days This table summarizes the number of total stock-days on which manipulation occurred, the number of manipulation days occurring at month-end, stock-days when no ask side was quoted at the close, the number of single-board-lot bid orders used to manipulate the closing price, and the number of executions of those bid orders submitted during the manipulation.

Stock Ticker	Stock-days	Month-end Stock-days	Stock-days Without Ask	Single Board Lot Bids	Executions Against Manipulator
181	1	1	1 (100%)	13	0
205	3	1	1 (33%)	9	0
224	3	0	2 (67%)	3	0
385	3	0	2 (67%)	6	2
439	8	1	2 (25%)	12	0
487	13	0	1 (8%)	15	2
529	4	0	0	4	0
542	9	0	4 (44%)	19	0
544	1	0	1 (100%)	1	0
567	5	0	0	5	2
704	1	0	0	1	0
725	3	1	3 (100%)	4	0
759	1	0	0	1	1
856	29	3	0	30	0
938	7	1	0	7	0
986	5	0	0	7	1
8009	4	0	0	4	0
8019	2	0	0	2	0
8037	1	0	0	1	1
8065	2	0	0	2	0
8163	1	0	1 (100%)	2	0
8171	5	1	3 (60%)	7	4
8175	4	0	0	4	0
8182	2	0	2 (100%)	2	0
8239	1	0	1 (100%)	2	0
8250	5	0	5 (100%)	7	0
Total	123	9	29 (23%)	170	13

Table 2
Characteristics of manipulated and HSI stocks This table reports daily trading summaries for manipulated stocks and HSI stocks during a 30-trading day period, ending 15 days prior to the manipulation. These include average stock price, traded value, number of trades, average relative quoted spread and average market capitalization. The last column reports the difference in means between the manipulated and control samples. ***, ** and * indicate statistical significance using a two-tailed t-test at the 1%, 5% and 10% levels, respectively.

	Manipulated Stocks	HSI Components	Difference
Stock Price (HK$)	0.16	23.61	-23.45***
Traded Value (HK$000)	101.18	122,999.02	-122,897.84***
Number of Trades	6.08	282.01	-275.93***
Spread (%)	13.68	0.56	13.12***
Market Cap (HK$000,000)	133.13	90,500.00	-90,366.87***

Table 3
Characteristics of manipulated and matched control stocks This table reports the difference in means for manipulated stocks and the control stocks identified via PSM across the confounders Trade days (no. of days in the year the stock is traded), average share turnover, average volatility and market capitalization. None of the differences reported are statistically differenct from 0.

	Manipulated	Control	Difference
No. Trade Days	131.28	125.52	5.76
Av. Share Turnover (000)	235.21	281.04	-45.83
Av. Volatility (%)	4.09	4.52	-0.43
Market Cap (HK$000,000)	276.59	250.49	26.09

30 trading days ending 15 days prior to the date of the first manipulation. To compute Y_i^C we use the matched stocks from our PSM. The significance of the $\hat{\alpha}_{DID}$ estimator is ascertained via a two-tail t-test using pooled variance estimates. We analyse the complete sample of manipulations using the DID methodology described above.[5]

[5] This is in contrast to Comerton-Forde and Putniņš (2011) who additionally analyze a subset of securities to confront the issue of month-end influences associated with the settlement of derivative contracts or the actions of mutual funds. Our sample of mainly "penny stocks", do not have listed derivatives or make up a significant proportion of mutual fund holdings, hence eliminating any confounding effects.

Table 4

Impact of quote-based manipulation on trading behavior This table reports the effect of manipulation on trading characteristics by isolating the effects of this end-of-day manipulation from unrelated day-end phenomena using a difference-in-difference method. Treatment are the difference in manipulated stocks observed on the days in which the manipulation is reported to occur and a clean period of 30 trading days, ending 15 days prior to the first instance of a reported manipulation. Control is calculated in an identical manner from PSM-matched (non-manipulated) firms. Panel A reports returns (prior to close, and over the trading day), the number of trades, share turnover (trade volume relative to shares outstanding), and quoted bid-ask spread (percentage) for the treatment and control groups for a five-minute period prior to the close. We report the same characteristics over an identical period in the following morning session in Panel B. Differences between the treatment and control groups are reported in the last column and levels of significance at the 10%, 5% and 1% levels are indicated by *, **, and ***, respectively.

Panel A: Close	Manipulated $(Y^M_{i,t1} - Y^M_{i,t0})$	Control $(Y^C_{i,t1} - Y^C_{i,t0})$	Difference
Return (5min)	11.48%***	-0.28%	11.76%***
Return (day)	8.34%***	-1.05%	9.39%***
Trade Execution (No. Trades)	0.87***	-0.01	0.88***
Share Turnover	0.02%	0.00%	0.01%
Quote Spread	-6.91%***	2.02%***	-8.93%***
Panel B: Subsequent Open			
Return (5min)	0.00%	0.01%	0.00%
Return (day)	-2.46%**	-0.20%	-2.25%**
Trade Execution (no. trades)	0.00	-0.01	0.01
Share Turnover	0.00%	0.00%	0.00%
Quote Spread	-0.27%	0.24%	-0.51%

5. Results

Table 4 reports mean estimates of trading characteristics for manipulated stocks at the close of trading on the day of manipulation (last 5 minutes) and at the open of trading on the subsequent day (first 5 minutes). In unreported results, we find that 91% (18%) of orders for manipulated (non-manipulated) stocks are received in the final 5 minutes of the manipulation day suggesting that this abnormal trading behavior is designed to influence the closing process. This evidence justifies the use of a real-time interval of five minutes of the end of the trading day to perform our analysis as opposed to using a transaction-time interval. We uncover statistically significant excess returns at the close on the day of manipulation of 11.48%, providing evidence of significant price ramping for these low-liquidity securities. We see in Table 4 that trade execution is positive and statistically significant for the manipulated firms relative to control firms suggesting the possibility that some of the price movement is due to trades rather than quotes. However, the magnitude of this term (0.88) is not sufficient to explain the large price movements observed suggesting that the price movements are more likely driven by quotes than trades. Our results interestingly show that the effects associated with this manipulation have a permanent price effect. Returns to manipulated firms are 11.48% (on average) on the day of manipulation and -2.46% (on average) the following day, an insufficient reversal to correct the price movement on the day of manipulation. We also find that quoted spreads are significantly narrowed for manipulated firms, reducing by 6.91% on average on the day of manipulation.[6]

To better understand how exchange institutional features and market microstructure contribute to the price manipulation, we present quote characteristics for both the Manipulated and Treatment groups during the manipulation period in Table 5. The results in Panel A show both bid returns and the frequency of quote updates are significantly higher for the manipulation sample relative to both the clean period and control stocks. Bid returns in the final few minutes of trade rise by an average of 10.28%, which has the effect of moving benchmark prices upwards by a similar value. Such an effect is not observed for the control group of stocks and is specific to manipulated firms. Quote returns on the offer side of the order book (Panel B) display no significant change during the manipulation period. The significant increase in quoting on the bid side of the order book, combined with the reduction in quoted depth is consistent with the quote-based nature of the manipulation - large manipulative bids would be potentially costly if executed. As such, and given the illiquid nature of the assets, manipulators enter relatively small bid orders in order to affect the benchmark price.

We finally resolve to address whether the price manipulation unwinds following the integrity breaches. Hanson and Oprea (2009) argue that manipulation should not have a discernible effect on prices, except during the period of manipulation, arguing that the market will correct such temporary price distortions. Aggarwal and Wu (2006) suggest that stock prices should decline after the manipulation ends, though their empirical findings show that prices fail to revert fully to their pre-manipulation levels one-year after the manipulation. Fig. 1 shows the average return behavior for the manipulated stocks for a period of 120 trading days following the manipulation. The cumulative abnormal return rises to 80% in the six months post-manipulation and is both economically and statistically significant.

The failure of prices to revert following manipulation is not necessarily an inefficiency. Pereiro (2001) and Imisiker and Tas (2013) both find that smaller firms which are tightly held are more susceptible to manipulation due to the lack of available stock to short sell. If manipulated stocks lack available shares to short-sell (perhaps due to ownership concentration by the manipulator themselves) successive closing price manipulations may sustain higher prices post-manipulation, facilitating further inflated personal borrowing opportunities.

[6] All results are robust to the use of median values of trading characteristics.

Table 5

Impact of quote-based manipulation on bid (ask) behavior This table reports the effect of manipulation on order-based characteristics by isolating the effects of this end-of-day manipulation from unrelated day-end phenomena using a difference-in-difference method. Treatment are the difference in manipulated stocks observed on the days in which the manipulation is reported to occur and a clean period of 30 trading days, ending 15 days prior to the first instance of a reported manipulation. Control is calculated in an identical manner from PSM-matched (non-manipulated) firms. Panel A reports on the returns (quote), quote frequency (no. of prevailing market orders), and market depth (order size relative to shares outstanding) from the bid-side of the order-book. Panel B calculates the same metrics based on the offer-side of the order book. Results are reported for the day of manipulation (m) for a period of five-minutes prior to the close and on the subsequent day (s) during the first five minutes of trade. Differences between the treatment and control groups are reported in the last column and levels of significance at the 10%, 5% and 1% levels are indicated by *, **, and ***, respectively.

Panel A: Bid	Manipulated $(Y^M_{i,t1} - Y^M_{i,t0})$	Control $(Y^C_{i,t1} - Y^C_{i,t0})$	Difference
Return (m)	10.28%***	-0.21%	10.49%***
Return (s)	-0.24%	-0.08%	-0.16%
No. Quotes (m)	0.90***	-0.04	0.94***
No. Quotes (s)	0.09	-0.07	0.16
Depth (m)	-1.16%***	0.90%***	-2.07%***
Depth (s)	0.42%	-0.50%*	0.92%*
Panel B: Ask			
Close Return (m)	0.04%	0.16%	-0.12%
Open Return (s)	0.07%	0.02%	0.05%
No. Quotes (m)	0.07**	0.02	0.05
No. Quotes (s)	0.01	-0.07*	0.08
Depth (m)	-0.62%***	0.86%***	-1.47%***
Depth (s)	-0.06%	-0.91%**	0.86%**

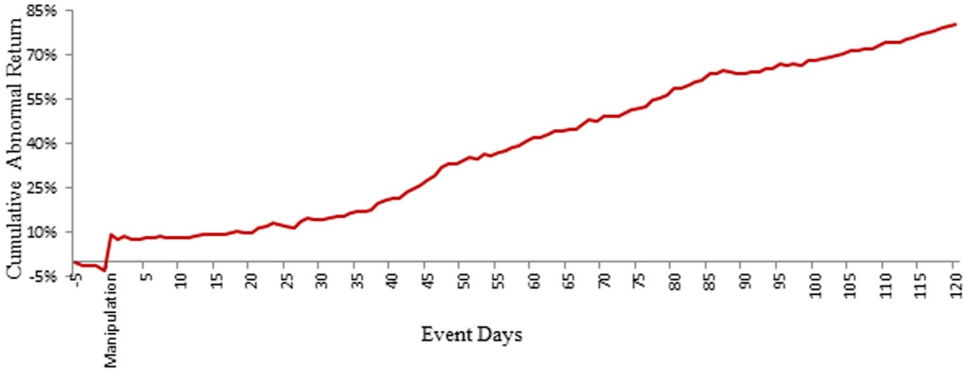

Fig. 1. Cumulative Abnormal Return Post Manipulation This figure shows the cumulative stock return post manipulation averaged across all stock-days in our manipulation sample. The return is constructed using closing prices.

6. Conclusion

Based on a sample of 123 prosecuted cases of closing price manipulation, we document the existence of a form of quote-based manipulation executed on the HKEx. Manipulators are able to influence closing prices by placing artificially high bids, which are not intended to be executed. This form of manipulation is distinct from standard marking the close practices which generate both buying and selling activity. We show that institutional rules facilitate breaches of market integrity and that illiquid securities are targeted by these practices. Interestingly, we show that prices do not revert to their pre-manipulation values following the market abuse period, likely due to the high ownership concentration in these securities and the lack of available options to short-sell these securities.

CRediT authorship contribution statement

Ching Chau: Conceptualization, Formal analysis, Software, Validation, Writing - original draft. **Angelo Aspris:** Formal analysis, Software, Validation, Writing - original draft, Supervision. **Sean Foley:** Conceptualization, Formal analysis, Software, Validation, Writing - original draft. **Hamish Malloch:** Methodology, Writing - review & editing.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.frl.2020.101556

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