



An empirical analysis of the Shanghai and Shenzhen limit order books[☆]



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ABSTRACT

This paper investigates the market microstructure of the Shanghai and Shenzhen Stock Exchanges. The two major Chinese stock markets are pure order-driven trading mechanisms without market makers, and we analyze empirically both limit order books. We begin our empirical modeling using the vector autoregressive model of Hasbrouck and extend the model to incorporate other information in the limit order book. We also study the market impact on A shares, B shares and H shares, and analyze how the market impact of stocks varies cross sectionally with market capitalization, tick frequencies, and turnover. Furthermore, we find that market impact is increasing in trade size. Order imbalances predict the next day's returns, with small order imbalances having a negative effect.

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1. Introduction

There are two stock exchanges in mainland China. The Shanghai Stock Exchange was founded on November 26, 1990 and trading began on December 19, 1990. The Shenzhen Stock Exchange started stock trading on December 1, 1990. After the first year of trading, the market capitalization, including all shares in Shanghai Stock Exchange and Shenzhen Stock Exchange, was only about 3 billion Renminbi (RMB). Shanghai had only eight listings, and had a daily average turnover of only 18 million RMB.

Since these modest beginnings, both markets have seen impressive growth which we describe in Table 1. By December 2007, Shanghai Stock Exchange's market capitalization ranked sixth worldwide and Shenzhen ranked 20th. Their combined market capitalization of \$4,479 billion USD was the second largest globally after the United States. At year-end 2011, there are more than 2,000 listings on the two markets, and combined daily average trading volume is nearly \$26 billion.

After peaking in 2007–8, the markets have fallen by more than half and only partially recovered. The Shanghai Stock Exchange Composite Index, which once reached 6,092 in October 2007, retreated to 2,086 at the end of the third quarter of 2012. The Shenzhen Composite Index closed at 853.826, after peaking at 1,576.501 on January 15, 2008.

The trading mechanism of the stock market in mainland China, summarized in Table 2, is similar to that of the Hong Kong or Tokyo Stock Exchanges. Both Shanghai and Shenzhen run a pure order-driven

trading mechanism on electronic systems without official market makers. Trading is conducted from Monday to Friday, except holidays. For each trading day, there is a morning session and afternoon session. The morning session includes one pre-trading auction 9:15–9:25 AM and one continuous trading period 9:30–11:30 AM. The afternoon session includes only one continuous trading period 13:00–15:00. Only limit orders and market orders are allowed in both exchanges and orders are filled following price, time and size priority. The limit of price change for each trading day is $\pm 10\%$ of the previous closing price, beyond which, trading will be halted for the rest of the day. The quantity of stock purchased must be in round lots of 100 while there is no requirement on the quantity of sales.

There are three types of shares in the market: A shares that are denominated in Renminbi, H shares that are denominated in Hong Kong Dollar (HKD) and B shares that are dominated by U.S. Dollar (USD). H shares are only traded in Shenzhen Stock Exchange while B shares are only traded in Shanghai Stock Exchange. A shares are traded in both exchanges. Domestic investors can trade all 3 types of shares while the foreign investors only have access to B shares and H shares. The minimum tick sizes for A shares, B shares and H shares are 0.01RMB, 0.001USD and 0.01HKD, respectively.

There is a limited literature about the microstructure of the Chinese stock market, but only a few papers analyze intra-day limit order book information. Xu (2000) discussed the trading mechanism of Chinese stock market but the paper's quantitative study focused on stocks' daily returns. As to limit order book, Shenoy and Zhang (2007) studied the relationship between daily order imbalance from limit order book and daily stock returns. Bailey et al. (2009) separated the order imbalance from individual, institutional and proprietary investors and investigated the various influences of different traders. Liu and Maheu (2012) estimate intra-daily durations for three randomly selected A and B share stocks.

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Table 1

Market statistics for Shanghai and Shenzhen.

The data are from the World Federation of Exchanges (<http://www.world-exchanges.org/statistics>). Market capitalization and daily average trading volume are in millions of US dollar (USD mn).

	Dec. 2007	Dec. 2011
Market cap. (USD mn):	4,479	4,027
Shanghai	3,694	2,357
Shenzhen	785	1,054
Daily avg. trading volume (USD mn):	25,506	25,934
Shanghai	16,816	14,606
Shenzhen	8,690	11,328
Number of listings	1,530	2,242
Shanghai	860	931
Shenzhen	670	1,411

The vector autoregressive (VAR) model of Hasbrouck (1991) presents a basic structure of the dynamic interaction between security trades and quote processes on a limit order book. Dufour and Engle (2000) use the Hasbrouck model to explore the informational role of time durations between transactions. Chan et al. (2002) analyze empirically the information content of stock and option net trade volume in the specification of a VAR model.

Two papers utilize the baseline Hasbrouck model on Chinese equities. Meng et al. (2007) find lags in the impounding of private information, particularly in smaller stocks. Zhou et al. (2011) analyze the intra-day dependence between returns and trades of Chinese equities and warrants using a VAR model.

This paper extends Hasbrouck's model by analyzing the market impact of limit order book information in Chinese stock markets. We then examine the cross-sectional influences on market impact. Stocks with larger market capitalization, less frequent quote updates, and higher turnover have a larger market impact.

The last portion of the manuscript analyzes the information in trade size. There is an extensive literature on U.S. equities that finds "stealth trading" by institutions. Barclay et al. (1993) report that

medium size trades are the most informative. Cai et al. (2006) find that block trades are the most informative in China. We examine the market impact from different trade sizes and find that market impact increases with trade size. Small order imbalances also have a persistent negative effect on returns.

The manuscript is organized as follows. Section 2 introduces the data and basic statistics. Section 3 specifies the baseline Hasbrouck model and reports the market impact of trades on stock prices. In Section 4, we extend the model to incorporate other information on limit order book and assess the market impact of one buy order in our limit order book model. Section 5 studies the relationship between market impacts and microstructure characteristics. Section 6 pays particular attention to small and block order market impacts and the effect of order imbalances on returns. Section 7 concludes.

2. Data

We obtained the China Securities Market Trade and Quote Research Database, a database of Chinese securities analogous to the New York Stock Exchange TAQ database. We have limit order book information on 1,652 Chinese stocks for the month of June 2007, including all A shares, B shares and H shares traded on Shanghai Stock Exchange and Shenzhen Stock Exchange during the sample period. In this limit order book, we have trade-driven data with 5 bids and 5 asks with quantities, with updates no faster than every second. The trades are not combined with each other even if they happened on the same price at the same time. The data set identifies whether the trade was buyer or seller initiated. We report summary statistics on the three share classes in Table 3.

A shares' median price in our data set is 12.26 RMB, while the median prices of B shares and H shares are 0.998 USD (about 6.78 RMB) and 6.65 HKD (about 5.86 RMB), respectively. As to market cap, the median market cap of A share is 1,964 RMB (mn), higher than that of B shares, 201 USD (mn) or about 1,367 RMB (mn), and that of H shares, 999 HKD (mn), or about 879 RMB (mn). A shares have much higher turnover

Table 2

Comparison of microstructures.

Characteristic	Shanghai/Shenzhen	NYSE	NASDAQ	Tokyo	Hong Kong
Market type	Order-driven	Hybrid	Hybrid	Order-driven	Order-driven
Floor trading	No	Yes	No	No	No
Market makers	No	Yes	Yes	No	Yes
Open hours	09:30–11:30 13:00–15:00	9:30–16:00	9:30–16:00	09:00–11:00 12:30–15:00	10:00–12:30 12:30–14:30 14:30–16:00
Pre-trading period or opening session	09:15–09:25	04:00–09:30	07:00–09:30	No	9:30–10:00
After hours trading	No	16:00–20:00	16:00–20:00	No	16:00–16:10
Market order	Yes	Yes	Yes	Yes	No
Limit order	Yes	Yes	Yes	Yes	Yes
Stop limit order	No	Yes	Yes	No	No
Fill-or-kill order	No	Yes	Yes	No	Yes
Call auction used?	Yes	Yes	No*	Yes	Yes
At market opening?	Yes	Yes	No*	Yes	Yes
At market closing?	No	No	No	Yes	No
Call auction design	Price/Time	Price/Time	N/A	Price/No time priority	Order type/Price/Time
Intraday trading mechanism	Continuous auction	Continuous auction	Continuous auction	Continuous auction	Continuous auction
Priority	Price/Time/Size	Price/Time	Price/Time/Size or Price/Size/Time or Price/Time/Access Fee	Price/Time	Price/Time
Tick size	A shares: 0.01RMB B shares: 0.001USD H shares: 0.01HKD	0.01 USD	0.01 USD	JPY: ≤2k: 1 2k–3k: 5 3k–30k: 10 30k–50k: 50 50k–500k: 100 500k – 1M: 1k 1M – 20M: 10k 20M – 30M: 50k > 30M: 100k	HKD: ≤0.25: 0.001 0.25–0.5: 0.005 0.5–2: 0.01 2–5: 0.025 5–30: 0.05 30–50: 0.1 50–100: 0.25 100–200: 0.5 200–1k: 1 1k–9995: 2.5

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