Short-horizon market efficiency, order imbalance, and speculative trading: Evidence from the Chinese stock market

Preliminary version (do not quote)

Abstract

This paper uses a two-stage regression approach and tick data from 2012 to investigate the factors that affect the short-horizon market efficiency of the Chinese stock market. The findings show that market efficiency is significantly related to certain variables of individual stocks such as capitalization, turnover ratio, return volatility, trading volume, trading cost, and institutional trading. Furthermore, specific features of the Chinese stock market, such as prevalent speculative trading, cause these relations to differ from those in the U.S. stock market. However, speculative trading gradually loses its effect on market efficiency between 10 minutes and 20 minutes in the Chinese stock market.

JEL classification: G12; G14; G15.

Keywords: Order imbalance; Market efficiency; Speculative trading

Abbreviations:

SHSE: Shanghai Stock Exchange.

SZSE: Shenzhen Stock Exchange.

NYSE: New York Stock Exchange.

SME board: Small and Medium-sized Enterprise board.

SEHK: Hong Kong Stock Exchange.

1. Introduction

Since the contribution of Fama (1970), theoretical and empirical studies on market efficiency have attracted the attention of scholars and traders in the stock markets. Recently, based on the work of Chordia and Subrahmanyam (2004) and Chordia et al. (2005), the evaluation of the short-horizon market efficiency has become possible for researchers, among whom Chung and Hrazdil (2010a) find that short-horizon market efficiency in U.S. stock market is significantly correlated with certain company characteristics, such as market capitalization, trading volume, and liquidity, etc.; Visaltanachoti and Yang (2010) show that the short-horizon market efficiency of cross-listed stocks in the NYSE is significantly negatively related to the quality of their home country institutions. Current studies, however, mainly focus on American stock markets, and the effect of characteristics in other stock markets, especially the stock markets in developing countries, is largely unexplored.

In such a context, this study considers the Chinese stock market. While the significance of the Chinese stock market has increased over the past 25 years,[1] some special features of the Chinese stock market that are quite different from the American stock markets, such as the prevalent speculative trading[2], can have a significant influence on market efficiency[3]. Therefore, the following questions are of interest: (i) What are the factors that affect the short-horizon market efficiency of the Chinese stock market; and (ii) what are the effects of speculative trading on the factors that affect the short-horizon market efficiency?

Following Chordia et al. (2008) and Chung and Hrazdil (2010a, 2010b), this study adopts

[1] The Chinese stock market was formed in the early 1990s. By the end of 2014, the Shanghai Stock Exchange was ranked fourth in terms of global market capitalization, surpassing Euronext and the Hong Kong Stock Exchange. The Shanghai Stock Exchange and the Shenzhen Stock Exchange are ranked third and fourth, respectively, in terms of annual trading volume. Data source: WFE (World Federation of Exchanges) monthly report.

[2] Speculative trading may be defined as "the purchase (or sale) of goods with a view to resell (repurchase) at a later date" Kaldor, N., 1939. Speculation and economic stability. Review of Economic Studies 7, 1-27.

[3] In the context of this study, the market efficiency refers to the weak-form market efficiency Fama, E.F., 1970. Efficient Capital Markets: A Review of Theory and Empirical Work. Journal of Finance 25, 383-417.

a two-stage regression approach to analyze the short-horizon market efficiency in the Chinese stock market. First, the modified methodology of Chordia et al. (2008) (i.e., the regression of five-minute returns on lagged order imbalances and lagged returns) is used to estimate the degree of short-horizon market efficiency. Second, return predictability is analyzed at the firm level. The study then relates market efficiency to certain variables, such as average daily capitalization and average daily turnover ratio, to provide additional evidence about the ways in which these factors affect market efficiency. Furthermore, this study investigates how the prevalent speculative trading that is a specific market characteristic in the Chinese stock market influences the factors that affect market efficiency.

The empirical results suggest the following: (1) the short-horizon market efficiency of the Chinese stock market is positively related to certain variables of individual stocks, such as turnover ratio, return volatility, trading volume, and closing price, but is negatively correlated with market capitalization and the trading cost; (2) the dominance of speculative trading greatly enhances the market efficiency on the short-horizon; and (3) this effect gradually loses its power between 10 and 20 minutes, and the noise brought about by speculative trading eventually lowers the market efficiency on the long-horizon.

This study contributes to the literature in the following ways. First, while the factors affecting the market efficiency is comprehensively investigated in the developed markets, we still lack solid empirical evidences in the developing countries, where the researches are mainly concentrating on the effect of market microstructure change, such as market deregulation (Hung, 2009), split-share reform in China (Beltratti et al., 2016), etc., on market efficiency. A weak cross-correlation between market efficiency and trading volume is found in three emerging markets in Asia (Sukpitak and Hengpunya, 2016). The relation between trading cost and market efficiency is also confirmed in the Chinese stock market (Chen et al., 2009). This study first comprehensively investigates the factors affecting market efficiency in

the Chinese stock market to compliments the literature on market efficiency.

Second, since the characteristic of speculative trading in the Chinese stock market is largely confirmed and recognized (Mei et al., 2009), few studies are dedicated to investigate its effect on the market quality. Fong (2009) indicates that the superior performance of A-shares is more likely due to a return bias caused by speculation rather than risk compensation. Ding and Cheng (2011) find that the price bubble in the Hong Kong stock exchange in the period of the Hong Kong "through train scheme"[4] is caused by the speculative trading from mainland Chinese investors who were allowed to directly invest in Hong Kong market. This study fills this gap in the literature on speculative trading by investigating the effects of speculative trading, which is quite specific in the Chinese stock market, on market efficiency.

Third, it extends the findings of Chordia et al. (2008) by studying the short-horizon market efficiency of a stock market through the measure of order imbalance with high frequency data in a developing country. In the literature, studies generally focus on the U.S. stock market, and few are dedicated to other countries. Finally, all of the A stocks in the analysis are included to ensure a complete and thorough market efficiency study of the Chinese stock market.

This study corroborates the findings of Mei et al. (2009), which suggest that the Chinese stock market is characterized by prevalent speculative trading that is fostered by the joint effects of short-sales constraints and heterogeneous beliefs about stock prices. This study is also consistent with Wang (2010), who indicates that the informed investors' aggressive trading against the noise traders actually accelerates the speed of information integration into

[4] The "Share Investment Through-Train Scheme to Hong Kong" was announced on August 20th, 2007. Under the Scheme, mainland authority initially allowed individual mainland investors to directly purchase Hong Kong stocks. However, in a speech by Chinese Premier Minister on November 3rd, 2007, the scheme would have to be re-assessed because of the concern that excess fund flows could affect market stability. The scheme was not suspended, but in fact made no progress since then.

prices shortly after the arrival of new information.

The remainder of this paper is organized as follows. Section 2 provides a brief description of the Chinese stock market. Section 3 presents the theoretical considerations. Section 4 describes the data and the methods of analysis. Sections 5 and 6 explore the effect of speculative trading on the factors that affect market efficiency, and Section 7 provides concluding remarks.

2. Market structure in China

In early 1991, the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE) were formed and trading began. Since then, the two exchanges have expanded rapidly in terms of the number of listed securities and market value.

In China, stocks can be listed either on the SHSE or the SZSE but not both. Additionally, there are stringent listing requirements. The Chinese stock market is divided into three boards. The main board was created in 1991. It is the most important board and has the most stringent listing requirements. The Small and Medium-sized Enterprise (SME) board was created as a transitional board in 2004 and is regarded as midway between the main board and the ChiNext board. The latter was created in 2009 with relatively lower listing requirements. Both the SHSE and SZSE operate the main board, while the SZSE also runs the SME and the ChiNext boards.

Compared with the U.S. stock market, a specific feature of the Chinese stock market is the dominance of individual investors (Lee et al., 2010) who engage mainly in speculative trading (Mei et al., 2009; Wang et al., 2006). This characteristic of speculative trading is the result of strict short-sale constraints and the presence of less experienced individual investors who have heterogeneous beliefs about stock prices (Mei et al., 2009). Such investors are more concerned with short-term price fluctuations than long-term stock returns. The speculative trading that occurs is concentrated on stocks with high volatility and high price

levels. Therefore, it is ideal to investigate the effect of speculative trading on the stock market in China.

3. Theoretical considerations

3.1. The information flow effect of speculative trading

The Chinese stock market is dominated by individual investors (Lee et al., 2010) who engage mainly in speculative trading (Mei et al., 2009; Wang et al., 2006). Allen et al. (2007) highlight that the desire for quick gains combined with the absence of a strong legal framework in China has fostered a speculative attitude among investors. Consequently, they are more concerned with short-term price fluctuations than long-term stock returns. The speculative traders aim to obtain high profits by profiting the fluctuation of the price.

Wang (2010) extends the model proposed by Kyle (1985) to analyze trading dynamics by including noise trading. The results of the dynamic model show that although the noise imparted by noise trading eventually reduces the informativeness of prices over the long horizon, aggressive information trading by informed traders accelerates the integration of information into prices for the short horizon. Empirical evidence also suggests that greater noise trading resulting from more individual investor participation induces the informed trader to engage in more aggressive transactions and renders prices more informative (Ahn et al., 2014).

Speculative trading, which basically does not contain the information related to the value of the stock, is also characterized as noise trading. Different from the greater noise trader participation that induces more price noise verified by previous research (Ahn et al., 2014), speculative trading results in more active noise trading, which brings more noise into the price and provides more opportunities for informed trader to make profits. Therefore, as speculative trading becomes more prevalent, giving rise to a more active arbitraging by informed trader, the speed of the integration of new information into price accelerates. Thus,

in the Chinese stock market, speculative trading accelerates the integration of new information into prices and causes prompt price adjustments with regard to information flow, which increases market efficiency, at least for the short horizon after the arrival of new information (hereafter referred to as the information flow effect).

3.2. The information flow effect on various factors affecting market efficiency

The literature finds a positive relation between volatility and trading cost (Huang, 2004), which means that volatility is negatively related to market efficiency. Huang and Liu (2007) further argue that investors invest less in risky assets when they are risk averse, thereby reducing the benefit of more frequent information updates. Thus, information acquisition is less frequent for stocks with higher volatility. Ross (1989), however, finds that volatility is directly related to the rate of information flow in the market. Additionally, theoretical analysis and empirical evidence indicate that the price volatility is closely related to speculative trading (Hsin et al., 2003; Scheinkman and Xiong, 2003). Stock buying is considered a resale option because speculative investors assume a trading strategy of reselling the stock to a buyer who may pay a greater price in the future (Mei et al., 2009; Scheinkman and Xiong, 2003). As the stock price becomes more volatile, the resale option becomes more valuable. Therefore, stocks with high volatility attract speculative investors. The greater the volatility of the price is, the more attractive it is for investors to apply a speculative trading strategy. Because of the information flow effect of speculative trading in the Chinese stock market, the prices of stocks with higher volatility adjust to information flow more quickly, which increases market efficiency.

Visaltanachoti and Yang (2010) find a positive relation between price and market efficiency in the U.S. stock market. They argue that the market microstructure literature establishes a negative relation between price and trading costs represented by bid-ask spread (Stoll, 2003); however, the trading cost is not the only factor that relates the price to the

market efficiency. With speculative trading, price levels are elevated (Ding and Cheng, 2011; Harrison and Kreps, 1978; Scheinkman and Xiong, 2003). Elevated price levels mean a greater prevalence of speculative trading. This is because high price levels are the result of a series of speculative trading activities that usually push the price to rise. Moreover, high price levels are also a signal of concentrated speculative trading for the traders. The traders would expect the price to continue to increase because of the concentrated speculative trading. Consequently, high price levels also attract more speculative trading activities. Thus, the stocks with high prices adjust more promptly to information flow, which increases market efficiency. Additionally, we can expect that in a market with less prevalent speculative trading, the relation between the price level and the market efficiency is mainly determined by the trading cost. Furthermore, in a market with prevalent speculative trading activities, the relation between the price level and the market efficiency is determined not only by the trading cost but also by the information flow effect of speculative trading.

Larger companies are usually considered to have a better information environment and less information asymmetry. Thus, market capitalization is supposed to be positively related to market efficiency. However, because the Chinese stock market is characterized by prevalent speculative trading, the information flow effect of which improves market efficiency for small-capitalization stocks, market capitalization is negatively correlated with market efficiency. The literature finds that speculative trading is associated with higher trading volumes (Scheinkman and Xiong, 2003; Wang, 2010) and turnover ratios (Mei et al., 2009). Because of the information flow effect induced by speculative trading, the trading volume and turnover ratio are expected to be positively related to market efficiency.

Research (Chakravarty, 2001; Sias et al., 2006) shows that, on average, institutional investors are better informed and that their information is incorporated into security prices when they trade. More institutional trading means less noisy trading and greater market

efficiency.

4. Methods of analysis and data

4.1. Methods of analysis

Griffin et al. (2010) show that empirical efficiency measures necessarily rely on partial information sets. The careful choice of market efficiency measures is crucial for market efficiency research. The private information that provides investors the opportunity to earn greater returns (Cullen et al., 2010; Grossman and Stiglitz, 1980) is impounded in prices by the trading of informed investors and is reflected in excess buying or excess selling pressure (abnormal order flow). Therefore, order flow captures information that is not common knowledge. The imbalance in trading, which is a reflection of private information, will push prices to reflect this private information. The method proposed by Chordia and Subrahmanyam (2004) aims to measure the market efficiency by analyzing the relation between the stock return and the lagged order imbalance, which makes it an appropriate method for our research purpose.

This study computes order imbalance and stock return measures for all stocks.[5] Following Chordia et al. (2008), stock returns are computed over five-minute intervals using the bid-ask midpoints quoted at the end of the intervals. This study computes the order imbalance for each five-minute interval t. To assess the degree of short-horizon market efficiency, the following model is used:

$$Return_t = \alpha + \beta_1 OrderImbalance_{t-1} + \beta_2 Return_{t-1} + \varepsilon_t \qquad (1)$$

[5] Chordia, T., Subrahmanyam, A., 2004. Order imbalance and individual stock returns: Theory and evidence. Journal of Financial Economics 72, 485-518. These authors argue that "the concept of order imbalance over an interval makes sense only in a paradigm of an intermediated market, wherein market makers accommodate buying and selling pressures from the general public." The Chinese stock market is an electronic continuous auction market without market makers. Thus, the application of the order imbalance method in the Chinese stock market is doubtful; however, ibid. also indicate that "order imbalances can signal excessive investor interest in a stock, and if this interest is autocorrelated, then order imbalances could be related to future returns." Thus, the use of the order imbalance method is justified by this statement. Empirical findings verify the correlation between order imbalance and future stock returns Narayan, P.K., Narayan, S., Westerlund, J., 2015. Do order imbalances predict Chinese stock returns? New evidence from intraday data. Pacific-Basin Finance Journal 34, 136-151..

where $Return_t$ is the stock midpoint return over the five-minute interval t and $OrderImbalance_{t-1}$ is order imbalance over the five-minute interval $t-1$. This study's regression model is slightly different from that of Chordia et al. (2008). Because this study does not specifically investigate the liquidity effect on market efficiency, it follows Visaltanachoti and Yang (2010) and replaces the liquidity term of Chordia et al. (2008) with the $Return_{t-1}$, which is the lagged stock return over the five-minute interval $t-1$. This model considers the predictability of lagged order imbalance and lagged stock return. The t-statistic on the estimated coefficient for the lagged order imbalance variable β_1 and the *Adjusted* R^2 from the regression (1) are both measures of return predictability and can be used as proxies for short-horizon market efficiency.[6] This study uses the *Adjusted* R^2 as the primary measure of market efficiency throughout.

Eq. (1) is estimated for each firm on a daily basis at five-minute intervals. The *Adjusted* R^2 is collected from the estimation and used as the measure for short-horizon market efficiency. In a multiple regression framework, the ways in which market efficiency is associated with each variable are examined. Thus:

$$Efficiency_i = \alpha_i + \beta_1 Cap_i + \beta_2 Turnover_i + \beta_3 Volatility_i + \beta_4 Volume_i +$$
$$\beta_5 Price_i + \beta_6 Insholding_i + \beta_7 Effspread_i + \beta_8 SHSZ_i + \varepsilon_i \qquad (2)$$

where $i = 1,2,...,n, n$ is the total number of sample stocks. *Efficiency* is the short-horizon market efficiency measure estimated on a firm-by-firm basis over the sample period. The logit transformation to the *Efficiency* variable is applied because the *Adjusted* R^2 measure is bounded by zero and one. *Efficiency* is also rescaled by multiplying this variable by -1 so that, for ease of interpretation, higher values of *Efficiency* represent higher degrees of market

[6] More specifically, this method measures the speed of information integration into prices during the five minutes after new information arrives if the change in order imbalance and the stock return is considered as new information.

efficiency. *Cap* is the average daily total capitalization; *Turnover* is the average daily turnover ratio; *Volatility* is the average daily return volatility; *Volume* is the average daily trading volume; *Price* is the average daily closing price; and *Insholding* is the average quarterly institutional holding percentage of each stock and is the proxy for institutional trading. We obtain measures of effective spread (*Effspread*) to capture the effects of trading cost on the market efficiency. We measure the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint. Specifically, for stock i of transaction j, the measures are defined as:

$$Effspread_{i,j} = q_{i,j}(p_{i,j} - m_{i,j})/m_{i,j} \quad (3)$$

where $p_{i,j}$ is the transaction price, $m_{i,j}$ is the bid-ask midpoint prevailing for transaction j, and $q_{i,j}$ is the buy-sell indicator (with +1 for buys and −1 for sells). The *Effspread* is the volume-weighted average of $Effspread_{i,j}$.

SHSZ is assigned a value of one if the stock is listed on the SHSE and zero if the stock is listed on the SZSE to control for exchange difference. Based on our analysis above, we expect that *Turnover*, *Volatility*, *Volume*, and *Price* are positively related to market efficiency. *Cap* is negatively related to market efficiency. *Insholding* and *Effspread*, which are expected to have positive and negative relations with market efficiency, respectively, are included as control variables.

4.2. Data

This study obtains tick data from the Resset Financial Database from January 2 to December 31, 2012, because this year is characterized as a fairly smooth trading year without major changes to market structure and rapid index fluctuations. All A-share trading in the SHSE and the SZSE is examined. To be included in the sample, stocks have to meet the following criteria:

- They must have been normally traded in 2012;

• The IPO must have been before January 1, 2012; and

• They must have had at least 243 trading days in 2012.

If there are any stock splits, reverse splits, stock dividends, repurchases, or a secondary offering, the stock is deleted from the sample.

The final sample includes 1,693 stocks from both exchanges. Every transaction is assigned using the Lee and Ready (1991) trade assignment algorithm to estimate whether it is buyer-initiated or seller-initiated. Any quote less than five seconds prior to the trade is ignored, and the first quote at least five seconds prior to the trade is retained. A trade is classified as buyer-(seller-)initiated if it is closer to the ask (bid) price of the prevailing quote. If the trade is exactly at the midpoint of the quote, a "tick test" is used whereby the trade is classified as buyer-(seller-)initiated if the last price change prior to the trade is positive (negative).

To avoid contamination of the return serial correlations by bid-ask bounce, returns are computed from quote midpoints (Chordia et al., 2005). For each transaction during each day, the prevailing quote before the trade is used to compute a bid-ask midpoint. Returns are then computed from these midpoints.

Trades indicated as either buyer- or seller-initiated are used as indicators to calculate the imbalance measures in three ways. The first is based on the number of the trade (OIBNUM), the second on the share of the trade (OIBSHR), and the third based on the RMB value of the trade (OIBVAL). Following the work of Chung and Hrazdil (2012) and Visaltanachoti and Yang (2010), OIBNUM[7] for each stock is calculated for five-minute intervals.

5. Empirical analysis – basic results

5.1. Summary statistics

[7] OIBNUM is the estimated number of buyer-initiated trades minus seller-initiated trades divided by the total number of trades for the time interval.

Table 1 provides comparable descriptive statistics of the regression variables for the stocks of the entire sample. The data are obtained from the Wind financial database.

TABLE 1: Summary statistics

	Efficiency	Cap	Turnover	Volatility	Volume	Price	Insholding	Effspread
Sample	1,693	1,693	1,693	1,693	1,693	1,693	1,693	1,693
Mean	2.2742	10,931	1.0347	0.0243	56.17	11.78	38.90	0.0029
Median	2.2669	3,268	0.8507	0.0243	31.79	9.71	39.69	0.0027
SD	0.3029	55,652	0.7462	0.0050	89.16	9.80	24.39	0.0013
Min	1.2162	721	0.0089	0.0073	3.59	1.91	0.00	0.0006
1st quantile	2.1006	2,011	0.5264	0.0210	17.67	6.56	18.02	0.0022
3rd quantile	2.4482	6,501	1.3434	0.0275	59.70	14.19	57.76	0.0034
Max	3.5783	1,510,372	6.1196	0.0404	1,912.42	222.99	98.13	0.0118

Notes: The sample period covers the whole of 2012. The sample comprises 1,693 stocks from the Chinese stock market. *Efficiency* is defined in Section 4.2, *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint

The coefficient for market efficiency in the Chinese stock market is approximately 2.2742, the minimum is 1.2162, and the maximum is 3.5783. The *Cap* mean is 10,931.31 million yuan. The median is much smaller, however, which indicates the existence of stocks with extreme capitalization. The means of *Turnover*, *Volume*, and *Price* are higher than their medians; thus, some extreme values exist for these three variables.

Table 2 reports the Pearson and Spearman correlations among the tested variables.

TABLE 2: Correlation matrix

	Efficiency	Cap	Turnover	Volatility	Volume	Price	Insholding	Effspread
Efficiency	1	-0.1163*	0.1100*	0.3590*	0.1397*	0.3590*	0.0157	-0.4363*
Cap	0.0511	1	-0.1418*	-0.2398*	0.2721*	0.0747*	0.1982*	0.0004
Turnover	0.1053*	-0.4044*	1	0.6878*	0.1772*	-0.0405	-0.3105*	-0.1390*
Volatility	0.3180*	-0.2871*	0.7193*	1	0.0635*	0.1090*	-0.3085*	-0.1932*
Volume	0.1120*	0.6540*	0.3488*	0.2559*	1	0.2641*	0.1636*	-0.2429*
Price	0.5158*	0.0946*	0.0337	0.2208*	0.1196*	1	0.0955*	-0.4348*
Insholding	0.0279	0.4749*	-0.3618*	-0.2797*	0.1930*	-0.0129	1	-0.0482
Effspread	-0.3809*	-0.3544*	-0.1071*	-0.1256*	-0.4417*	-0.6963*	-0.0976*	1

Notes: This table shows the correlation matrix of the regression variables. The sample period covers the whole of 2012. Pearson (above diagonal) and Spearman (below diagonal) correlations that are significant at the 1% level are indicated by an asterisk.

Efficiency is significantly and positively correlated with *Turnover*, *Volatility*, *Volume*, and *Price* and negatively correlated with *Cap* and *Effspread*. Its relation with *Insholding* is not significant. Certain variables are significantly correlated. The positive correlation

between *Cap* and *Volume* indicates that stocks with more market capitalization always have higher trading volume. *Turnover* is positively and significantly correlated with *Volatility*, which implies that the more active the trading, the higher the volatility. *Price* is also highly negatively correlated with *Effspread*. To avoid the problem of multicollinearity, the regressions were run with different specifications and the stability of the results was tested in the multivariate regression section.

5.2. Multivariate regression

See Table 3 for the results of the multivariate regression in Eq. (2).

TABLE 3: Multivariate regression

	SHSE & SZSE					
	(1)	(2)	(3)	(4)	(5)	(6)
N	1,693	1,693	1,693	1,693	1,693	1,693
Intercept	1.8418***	2.3993***	1.8430***	1.9124***	1.8754***	1.5236***
	(39.5)	(80.05)	(39.49)	(41.41)	(42.3)	(36.29)
Cap	-.4415***	-.7299***	-.3835***	-.4115***	-.4212***	-.5049***
	(-3.77)	(-5.94)	(-3.39)	(-3.47)	(-3.61)	(-4.11)
Turnover	-.0938***	.0229**	-.0889***	-.1090***	-.0992***	-.0836***
	(-7.90)	(2.40)	(-7.65)	(-9.21)	(-8.51)	(-6.72)
Volatility	26.6491***		26.5448***	28.3602***	26.3779***	28.2497***
	(15.00)		(14.93)	(15.89)	(14.86)	(15.17)
Volume	.1527**	.1175		.2764***	.1721**	.2819***
	(1.96)	(1.41)		(3.58)	(2.21)	(3.46)
Price	5.0785***	6.5697***	5.3973***		5.1964***	8.6760***
	(7.01)	(8.61)	(7.64)		(7.19)	(12.3)
Insholding	.6412**	0.3634	.7000**	.7798***		.8628***
	(2.30)	(1.23)	(2.52)	(2.76)		(2.95)
Effspread	-72.3452***	-77.9137***	-73.6756***	-86.7071***	-73.0979***	
	(-13.25)	(-13.44)	(-13.59)	(-16.89)	(-13.39)	
SHSZ	0.015	-.0237*	0.0203	-0.003	.0228*	0.0097
	(1.09)	(-1.65)	(1.50)	(-0.22)	(1.71)	(0.67)
Adj R-square	0.3338	0.2452	0.3327	0.3147	0.3321	0.2648

Notes: *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint. *SHSZ* is a binary variable that is assigned a value of one if the stock is listed on the SHSE and zero if the stock is listed on the SZSE. The coefficient for *Cap* is multiplied by 10^6 and the coefficients for *Volume, Price,* and *Insholding* by 10^3. *, ** and *** denote the significance at the 10%, 5% and 1% levels, respectively.

The coefficient for *Volume* is highly significant and positive and remains significant and consistently strong across all specifications. The significantly positive coefficient for *Price* is

the result of speculative trading that elevates price levels. The information flow effect of speculative trading dominates the Chinese stock market, which enables information to be incorporated into prices more quickly for stocks of higher volatility as corroborated by the positive and significant coefficient for *Volatility*.

The coefficient for *Turnover* is negative and significant in models (1), (3), (4), (5), and (6). If *Volatility* is omitted from the specification, however, the coefficient for *Turnover* becomes positive and significant as hypothesized, which is the case in model (2). This is because of the high positive correlation between *Turnover* and *Volatility*.[8] *Turnover* is indeed positively correlated with market efficiency. This positive correlation is clearly demonstrated in Table 4.

TABLE 4: Market efficiency grouped by *Turnover*

	1st group	2nd group	3rd group	4th group	5th group	5th-1st
Turnover	2.31	2.29	2.29	2.28	2.19	-0.1179***

Notes: The sample is divided into five groups according to *Turnover* in decreasing order. The first group includes stocks with the highest 20% of the average daily turnover ratio, the second group includes stocks that represent the highest 20% to 40% of the average daily turnover ratio, and so on. The fifth group includes the 20% of stocks with the smallest average daily turnover ratio. The data are the arithmetic average of each group. *5th-1st* is the efficiency difference between the fifth group and the first group. *** denotes the two-tailed significance of the corresponding test statistics of the parametric paired t-test at the 1% level.

Market efficiency decreases together with average daily capitalization as indicated by the significantly negative coefficient for *Cap*. Although larger companies are considered to have a better information environment, the information flow effect of speculative trading that concentrates on small-capitalization stock dominates the Chinese stock market. Investors with speculative trading strategies pay more attention to small-capitalization stocks. The information flow effect of the speculative trading enables the process of information incorporation to occur more quickly.

The significant coefficient for *Insholding* implies the improvement of market efficiency through informed institutional trading. The significant coefficient of *Effspread* also indicates that the trading cost, which slows the information integration speed, lowers the market

[8] The coefficient of correlation is 0.7197 for Spearman and 0.6878 for Pearson.

efficiency.

Some of this study's findings differ from the results of the studies for the U.S. stock market (Chung and Hrazdil, 2012; Visaltanachoti and Yang, 2010). *Cap* is negatively correlated with market efficiency because the speculative trading that enhances information integration into price concentrates on small-capitalization stocks. Thus, the information flow effect of speculative trading is the dominant effect: the effects of the better information environment and less pronounced asymmetry of large-capitalization stocks verified in the U.S. stock market are overwhelmed. Although the relation between other variables and market efficiency is consistent with the findings for the U.S. stock market, the determinant factors differ. After controlling the trading cost represented by the effective bid-ask spread, the negative relation between *Price* and market efficiency in the Chinese stock market is still significant across all the specifications. This is evidence that the negative relation between *Price* and market efficiency is mainly determined by speculative trading that elevates the price levels instead of the trading cost effect found in studies of the U.S. stock market. Speculative trading that concentrates on high volatility stocks is also the main determinant of the relation between *Volatility* and market efficiency.

In the results of the multivariate regression, the decreasing level of $Adj.R^2$ when we drop *Volatility* in model (2) is much greater than the cases of other variables. It also indicates that market efficiency is more closely related to *Volatility* than the other factors and is evidence of the speculative trading feature of the Chinese stock market. The relation between *Price* and market efficiency is not as important as the one between *Volatility* and market efficiency. We further investigate its relation by separating our sample based on the level of speculative trading in Section 6.

6. Empirical analysis - the speculative trading effect on different factors

We investigate the factors affecting the market efficiency in the SHSE and the SZSE to

extensively analyze the effect of speculative trading in the Chinese stock market.

6.1. Summary statistics

Table 5 provides comparable descriptive statistics for the SHSE and the SZSE.

TABLE 5: Summary statistics

Panel A	**Efficiency**	**Cap**	**Turnover**	**Volatility**	**Volume**	**Price**	**Insholding**	**Effspread**
Sample	660	660	660	660	660	660	660	660
Mean	2.2356	20,251.35	1.0062	0.0230	79.1532	9.7598	47.6576	0.0031
Median	2.2322	4,912.96	0.8121	0.0233	43.2952	7.5604	48.4423	0.0027
SD	0.3300	87,672.25	0.8296	0.0053	122.1063	10.8303	21.9208	0.0014
Min	1.2401	989.68	0.0089	0.0073	5.7049	2.1667	0.0000	0.0006
1st quantile	2.0542	2,808.70	0.4702	0.0196	23.3904	5.5481	32.5332	0.0021
3rd quantile	2.4409	10,726.49	1.2768	0.0264	85.6567	11.4751	62.9700	0.0036
Max	3.5783	1,510,372.00	6.1196	0.0395	1,912.4220	222.9860	98.1298	0.0102
Panel B								
Sample	1,033	1,033	1,033	1,033	1,033	1,033	1,033	1,033
Mean	2.2989	4,976.59	1.0529	0.0252	41.4864	13.0661	33.3034	0.0029
Median	2.2817	2,719.52	0.8719	0.0249	26.6420	11.3684	30.2292	0.0027
SD	0.2816	8,866.45	0.6874	0.0046	54.3875	8.8440	24.2494	0.0011
Min	1.2162	720.71	0.0666	0.0107	3.5900	1.9060	0.0000	0.0008
1st quantile	2.1293	1,736.24	0.5558	0.0218	15.6085	7.7658	11.2640	0.0022
3rd quantile	2.4532	4,551.41	1.3814	0.0281	45.6293	15.6577	52.2239	0.0033
Max	3.4827	133,802.90	5.6300	0.0404	762.9169	133.7816	97.9256	0.0118
Panel C								
mean diff	.0633***	15274.76***	-.04672	-.0022***	37.6667***	-3.3063***	14.3541***	0.00020***

Notes: The sample period covers the whole of 2012. The sample comprises 660 stocks for the SHSE and 1,033 stocks for the SZSE. Panel A and panel B report the summary statistics of the variables for the stocks in the SHSE and the SZSE, respectively. *Efficiency* is defined in Section 4.2, *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint. Panel C presents the mean pairwise differences in the variables between the two exchanges. *** denotes two-tailed significance of the corresponding test statistics of the parametric paired t-test at the 1% level.

Cap is much higher for the SHSE than the SZSE. First, this is because traditional state-owned enterprises always choose to be listed on the SHSE. Second, the SZSE runs the ChiNext board where small-capitalization companies are listed. The market efficiency of the SZSE is superior to that of the SHSE and is statistically significant at the 1% level.

Table 6 reports the Pearson and Spearman correlations for the tested variables.

TABLE 6: Correlation matrix

Panel A	Efficiency	Cap	Turnover	Volatility	Volume	Price	Insholding	Effspread
Efficiency	1	-0.1772*	0.2231*	0.4782*	0.1836*	0.2597*	0.0439	-0.5107*
Cap	-0.0056	1	-0.1751*	-0.3040*	0.2396*	0.0873	0.2342*	0.013
Turnover	0.2722*	-0.5027*	1	0.6930*	0.1642*	0.0059	-0.3240*	-0.1629*
Volatility	0.4217*	-0.3249*	0.7670*	1	0.1021*	0.089	-0.2233*	-0.2361*
Volume	0.2031*	0.6294*	0.2748*	0.2713*	1	0.3735*	0.0901	-0.2712*
Price	0.5896*	0.2120*	0.1328*	0.2299*	0.3403*	1	0.1766*	-0.4042*
Insholding	0.0713	0.3973*	-0.4050*	-0.1975*	0.0943	0.2048*	1	-0.1069*
Effspread	-0.4783*	-0.3411*	-0.1282*	-0.1761*	-0.4839*	-0.8409*	-0.1640*	1
Panel B								
Efficiency	1	0.1752*	0.0031	0.2352*	0.1560*	0.4305*	0.0501	-0.3572*
Cap	0.1365*	1	-0.2033*	-0.1599*	0.7276*	0.4281*	0.3171*	-0.2196*
Turnover	-0.02	-0.3426*	1	0.7037*	0.2513*	-0.0954*	-0.3144*	-0.1117*
Volatility	0.2356*	-0.2068*	0.6937*	1	0.1492*	0.0642	-0.2915*	-0.1311*
Volume	0.0997*	0.6246*	0.4533*	0.3545*	1	0.2318*	0.1656*	-0.2801*
Price	0.4761*	0.2021*	-0.0654	0.1481*	0.1427*	1	0.1360*	-0.4550*
Insholding	0.0433	0.4452*	-0.3378*	-0.2864*	0.1541*	0.0097	1	-0.0503
Effspread	-0.3061*	-0.4138*	-0.0932*	-0.0855*	-0.4637*	-0.6292*	-0.0765	1

Notes: This table shows the correlation matrix for the regression variables. The sample period covers the whole of 2012. Panel A and panel B report the correlation matrix of the variables of stocks listed on the SHSE and the SZSE, respectively. Pearson (above diagonal) and Spearman (below diagonal) correlations significant at the 1% level are indicated by an asterisk.

With regard to the SHSE, *Efficiency* is significantly and positively correlated with *Turnover*, *Volatility*, *Volume*, and *Price*. It is significantly and negatively correlated with *Cap* and *Effspread*. Its relation with *Insholding* is not significant. With regard to the SZSE, the correlation between *Efficiency* and other variables is slightly different. A significantly positive correlation exists between *Efficiency* and *Cap*, *Volatility*, *Volume*, and *Price*, but its relation with *Turnover* and *Insholding* is unclear. It is significantly and negatively correlated with *Effspread*. Certain variables are significantly correlated. *Volume* is positively and significantly correlated with *Cap*, *Turnover*, and *Volatility*. *Turnover* is positively and significantly correlated with *Volatility*.

6.2. Multivariate regression

The following multivariate regressions are run for the SHSE and the SZSE that are different in terms of market efficiency.

$$Efficiency_i = \alpha_i + \beta_1 Cap_i + \beta_2 Turnover_i + \beta_3 Volatility_i + \beta_4 Volume_i +$$

$$\beta_5 Price_i + \beta_6 Insholding_i + \beta_7 Effspread_i + \varepsilon_i \quad (4)$$

The results reported in Tables 7 and 8 show that the SHSE and the SZSE demonstrate a slight difference in terms of the factors that affect market efficiency. With regard to the SHSE, the coefficients for different variables show the same characteristics as the results obtained for the entire sample in Section 5.2. The coefficients of *Price* are no longer significant, however, because in the SHSE where speculative trading is less prevalent, the information flow effect of speculative trading is not evident for the stocks with high price level. Because the price is negatively related to trading cost represented by bid-ask spread, when we control for the *Effspread*, the effect of *Price* on market efficiency is reduced.

TABLE 7: Multivariate regression for the SHSE

	SHSE							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N	660	660	660	660	660	660	660	660
Intercept	1.8092***	1.7803***	1.8827***	2.4262***	1.8160***	1.8195***	1.8605***	1.3596***
	(25.90)	(25.69)	(27.37)	(49.74)	(25.98)	(26.32)	(28.92)	(21.43)
Cap	-.3254***		-.3571***	-.6896***	-.2699**	-.3245***	-.2877**	-.3736****
	(-2.63)		(-2.85)	(-5.27)	(-2.25)	(-2.63)	(-2.36)	(-2.76)
Turnover	-.0754***	-.0780***		.0522***	-.0703***	-.0771***	-.0834***	-.0682***
	(-4.40)	(-4.54)		(3.65)	(-4.15)	(-4.52)	(-5.01)	(-3.63)
Volatility	31.0666***	32.9020***	23.3309***		31.0050***	31.2770***	31.1379***	35.2795***
	(11.46)	(12.50)	(11.16)		(11.42)	(11.57)	(11.47)	(11.99)
Volume	.1668*	.1075	.1018	.1537		.1936**	.1724*	.2943***
	(1.82)	(1.21)	(1.11)	(1.54)		(2.22)	(1.88)	(2.96)
Price	1.0471	1.0271	1.5171	1.9785*	1.6084		1.2441	4.9072***
	(1.00)	(0.98)	(1.44)	(1.73)	(1.60)		(1.19)	(4.52)
Insholding	.9119*	.7000	1.4509***	.9912*	.9413*	.9614**		1.4915***
	(1.86)	(1.44)	(3.02)	(1.85)	(1.92)	(1.97)		(2.79)
Effspread	-88.4640***	-89.1513**	-87.2359***	-100.3816***	-90.1676***	-90.9314***	-89.9374***	
	(-11.50)	(-11.54)	(-11.19)	(-12.02)	(-11.79)	(-12.48)	(-11.73)	
Adj R-square	0.4243	0.4191	0.4082	0.3094	0.4223	0.4243	0.4221	0.3087

Notes: *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint. The coefficient for *Cap* is multiplied by 10^6 and the coefficients for *Volume, Price,* and *Insholding* by 10^3. *, ** and *** denote the significance at the 10%, 5% and 1% levels, respectively.

TABLE 8: Multivariate regression for the SZSE

	SZSE							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N	1,033	1,033	1,033	1,033	1,033	1,033	1,033	1,033
Intercept	1.8478***	1.8461***	1.9416***	2.2949***	1.8504***	1.9567***	1.8646***	1.6613***
	(31.02)	(30.99)	(32.96)	(58.19)	(31.03)	(32.38)	(32.95)	(31.60)
Cap	-2.1682		1.8370	--3.0598*	.3176	3.2927**	-2.0475	-3.3543**
	(-1.33)		(1.19)	(-1.80)	(0.32)	(2.10)	(-1.26)	(-2.03)
Turnover	-.1149***	-.1059***		-.0118	-.0994***	-.1263***	-.1173***	-.1108***
	(-6.45)	(-6.43)		(-0.79)	(-6.28)	(-6.86)	(-6.66)	(-6.12)
Volatility	22.5551***	22.7287***	13.5990***		22.5832***	26.5859***	22.3382***	22.4685***
	(9.70)	(9.79)	(7.15)		(9.70)	(11.25)	(9.66)	(9.49)
Volume	.4862*	.2143	-.2721	.5020*		.0039	.5033**	.7830***
	(1.90)	(1.40)	(-1.18)	(1.88)		(0.01)	(1.97)	(3.06)
Price	9.4342***	8.8972***	9.9339***	11.4697***	9.0004***		9.4563***	12.3317***
	(8.83)	(9.00)	(9.14)	(10.49)	(8.61)		(8.86)	(12.57)
Insholding	.3050	.2681	.6268*	-.0347	.3527	.3736		.3325
	(0.90)	(0.80)	(1.84)	(-0.10)	(1.04)	(1.07)		(0.97)
Effspread	-48.4870***	-49.6759***	-46.6672***	-48.0413***	-51.2079***	-78.0214***	-48.5773***	
	(-6.27)	(-6.47)	(-5.92)	(-5.95)	(-6.73)	(-10.79)	(-6.28)	
Adj R-square	0.2819	0.2813	0.2534	0.2167	0.2801	0.2280	0.2820	0.2551

Notes: *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint. The coefficient for *Cap* is multiplied by 10^6 and the coefficients for *Volume, Price,* and *Insholding* by 10^3. *, ** and *** denote the significance at the 10%, 5% and 1% levels, respectively.

With regard to the SZSE, the coefficients for *Volatility* and *Effspread* are highly significant across all specifications. In contrast to the results for the SHSE, the coefficient for *Price* is becoming positive and significant across all specifications. Speculative trading is more prevalent in the SZSE and the information flow effect becomes more evident for the stocks with high price levels, which makes the *Price* positively related to the market efficiency when *Effspread* is still included as control variable. The $Adj.R^2$ chute when *Price* is omitted in the model (6) is larger than when *Effspread* is omitted in the model (8). This is also clear evidence that the effect of price level on market efficiency becomes more evident in a market with more prevalent speculative trading.

The coefficients for *Cap* and *Turnover*, however, are not as significant as the coefficients for the same variables with regard to the SHSE. There is only a marginal effect on market

efficiency.

We further verify our results by using the data of stocks traded in the ChiNext board. In the ChiNext board, the stocks of rapidly developing companies are traded and speculative trading is considered to be more prevalent. Table 9 reports the summary statistics.

TABLE 9: Summary statistics for ChiNext

	Efficiency	**Cap**	**Turnover**	**Volatility**	**Volume**	**Price**	**Insholding**	**Effspread**
Sample	246	246	246	246	246	246	246	246
Mean	2.3622	2516	1.1575	0.0271	26.6507	15.8747	23.6590	0.0029
Median	2.3260	1890	0.9511	0.0271	19.3766	13.8056	18.7964	0.0027
SD	0.2572	1984	0.7452	0.0047	20.7082	7.6212	19.6701	0.0010
Min	1.5770	739	0.2066	0.0155	3.5900	5.8364	0.0000	0.0014
1st quantile	2.1883	1319	0.6271	0.0235	12.6821	11.2230	6.8079	0.0024
3rd quantile	2.5172	3012	1.4828	0.0305	33.9261	18.0609	36.9343	0.0033
Max	3.3361	16492	5.2592	0.0396	113.0127	61.6277	93.5234	0.0118

Notes: The sample period covers the whole of 2012. The sample comprises 246 stocks for the ChiNext board. It reports the summary statistics of variables for the stocks in the ChiNext board. *Efficiency* is defined in Section 4.2, *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint.

Although the *Cap*, *Turnover*, and *Volume* of stocks in the ChiNext board are lower than the stocks in the main board, the *Volatility* and *Price* of the stocks in the ChiNext board are higher than the stocks in the main board, which indicates more prevalent speculative trading in the ChiNext board. *Efficiency* in the ChiNext board is higher and significantly different than that in the main board.[9] The results of multivariate regression in Eq. (4) for the ChiNext board are reported in Table 10.

[9] The result is provided in Section 6.3.

TABLE 10: Multivariate regression for ChiNext

	ChiNext							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N	246	246	246	246	246	246	246	246
Intercept	1.8685***	1.8334***	1.8945***	2.2826***	1.8399***	1.9197***	1.8684***	1.7246***
	(14.58)	(15.11)	(14.61)	(25.67)	(14.60)	(14.53)	(14.61)	(15.26)
Cap	-12.7554		11.1977	-19.3050	.7406	3.9248	-12.9590	-8.0924
	(-0.85)		(0.89)	(-1.25)	(0.08)	(0.26)	(-0.89)	(-0.54)
Turnover	-.1330***	-.1105***		-.0303	-.0925***	-.1662***	-.1328***	-.0095**
	(-2.85)	(-2.86)		(-0.72)	(-2.86)	(-3.48)	(-2.86)	(-2.55)
Volatility	21.3308***	21.7535***	14.2769***		21.4356***	26.1273***	21.2985***	20.7076***
	(4.35)	(4.46)	(3.32)		(4.37)	(5.28)	(4.38)	(4.19)
Volume	1.9554	.9100	-1.3863	2.0813		2.3210	1.9620	2.2020
	(1.20)	(0.85)	(-1.21)	(1.23)		(1.38)	(1.21)	(1.34)
Price	10.2683***	9.7347***	11.3984***	12.6452***	10.4192***		10.2624***	11.1940***
	(4.29)	(4.21)	(4.75)	(5.23)	(4.35)		(4.30)	(4.70)
Insholding	-.0486	-.2104	.1593	.3491	-.0063	.0963		-.0799
	(-0.06)	(-0.26)	(0.19)	(0.41)	(-0.14)	(0.11)		(-0.10)
Effspread	-38.7467**	-36.8110**	-32.7796*	-34.7384**	-40.0680**	-50.7615***	-38.7630**	
	(-2.31)	(-2.22)	(-1.94)	(-2.00)	(-2.39)	(-2.96)	(-2.32)	
Adj R-square	0.2272	0.2281	0.2043	0.1693	0.2258	0.1710	0.2304	0.2132

Notes: *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint. The coefficient for *Cap* is multiplied by 10^6 and the coefficients for *Volume, Price,* and *Insholding* by 10^3. *, ** and *** denote the significance at the 10%, 5% and 1% levels, respectively.

The coefficients for *Turnover*, *Volume*, and *Cap* all become insignificant. The coefficients for *Volatility*, *Price*, and *Effspread* are still significant. The importance of affecting the market efficiency for *Effspread* is decreasing, however, which is evidenced by the comparatively less significant coefficients in various specifications and by the less $Adj.R^2$ chuting in model (8). *Volatility* and *Price* remain the two most important factors affecting the market efficiency, as the investors with a more speculative investing attitude choose the stocks mostly based on the stock price volatility that enhances the value of this "resale option" and on the stock price level that indicates a more intensive speculative trading. The results provide further evidence that the prevalent speculative trading is a main force that impacts the factors affecting market efficiency in the Chinese stock market.

6.3. Short-horizon versus long-horizon efficiency

In this section, we investigate the information flow effect of speculative trading on the market efficiency at different time intervals. The information flow effect is supposed to affect the market efficiency over the short-horizon. Over the long-horizon, this effect should become less important in affecting the market efficiency. Therefore, we obtain the market efficiency measure at different time intervals (10 m to 30 m) and rerun Eq. (2). The results are shown in Table 11.

TABLE 11: Multivariate regression at different time intervals

	SHSE & SZSE				
	5 m	10 m	15 m	20 m	30 m
N	1,693	1,693	1,693	1,693	1,693
Intercept	1.8418***	2.3090***	2.7611***	2.9610***	2.8575***
	(39.5)	(33.26)	(34.19)	(33.52)	(28.49)
Cap	-.4415***	-.7381***	-.7460***	-.7956***	-.8193***
	(-3.77)	(-4.24)	(-3.68)	(-3.54)	(-3.25)
Turnover	-.0938***	-.0767***	-.0232	.0273	.0032
	(-7.90)	(-4.34)	(-1.13)	(1.21)	(0.12)
Volatility	26.6491***	19.9788***	10.3108***	2.0846	3.8397
	(15.00)	(7.55)	(3.35)	(0.62)	(1.00)
Volume	.1527**	1.0468***	.7906***	.6020***	.6325***
	(1.96)	(8.99)	(5.84)	(4.06)	(3.76)
Price	5.0785***	2.9212***	-3.2040**	-5.7088***	-8.1130***
	(7.01)	(2.71)	(-2.56)	(-4.16)	(-5.21)
Insholding	.6412**	1.0295**	.2977	.0812	.8391
	(2.30)	(2.48)	(0.62)	(0.15)	(1.40)
Effspread	-72.3452***	-103.9346***	-105.4973***	-85.4434***	-54.5230***
	(-13.25)	(-12.79)	(-11.16)	(-8.26)	(-4.64)
SHSZ	0.015	-.0160	.0125	.0786***	.0932***
	(1.09)	(-0.78)	(0.52)	(3.01)	(3.15)
Adj R-square	0.3338	0.2567	0.1281	0.0758	0.0458

Notes: *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint. *SHSZ* is a binary variable that is assigned a value of one if the stock is listed on the SHSE and zero if the stock is listed on the SZSE. The coefficient for *Cap* is multiplied by 10^6 and the coefficients for *Volume, Price,* and *Insholding* by 10^3. *, ** and *** denote the significance at the 10%, 5% and 1% levels, respectively.

Table 11 shows that the explanatory power of the dependent variables decreases with the time interval. The $Adj.R^2$ decreases sharply, and the coefficient of the intercept increases. On the other hand, the coefficients of the dependent variables become less significant as the time interval increases. The coefficients for *Turnover* and *Insholding* become insignificant at

15 or 20 minute intervals. The coefficient of *Volume* remains significant, but becomes smaller with the time interval. The coefficient for *Volatility* becomes insignificant for the long-horizon at 20-m and 30-m intervals. The information flow effect of speculative trading is only valid for the short-horizon; therefore, the coefficient of *Volatility* is no longer significant at 20-m and 30-m intervals as the information flow effect of speculative trading is decreasing in the long-horizon. The coefficient of *Price* is significant and positive at 5 m and 10 m, and it becomes significant and negative at 15-m, 20-m, and 30-m intervals. The information flow effect of speculative trading, which is valid at the short-horizon, makes the coefficients of *Price* positively significant at 5-m and 10-m intervals. Because this effect is decreasing in the long-horizon, however, the coefficients of *Price* become negatively significant at 15-m, 20-m, and 30-m intervals because the noise brought by the speculative trading overwhelms the information flow effect in long-horizon, which decreases the market efficiency for stocks with higher prices. An interesting finding is that the coefficients of *Cap* become negatively larger with the time intervals. It seems that apart from speculative trading, other factors exist that make the market capitalization negatively related to the market efficiency.

The information flow effect of speculative trading is further demonstrated in Table 12.

TABLE 12: Comparison of the average market efficiency for different time intervals

	N	5 m	10 m	15 m	20 m	30 m
Av. Eff. SHSE (1)	660	2.2356	2.5013	2.6939	2.8328	2.8691
Av. Eff. SZSE (2)	1,033	2.2989	2.5456	2.6909	2.7462	2.7452
Diff. (1) vs (2)		-.0633***	-.0443**	.0030	.0866***	.1239***
Av. Eff. not ChiNext (3)	1,447	2.2593	2.5106	2.6851	2.8002	2.8273
Av. Eff. ChiNext (4)	246	2.3622	2.6327	2.7329	2.6610	2.5943
Diff. (3) vs (4)		-.1029***	-.1220***	.0478	.1392***	.2330***

Notes: *Av.Eff.SHSE* is the average of the market efficiency coefficient for the stocks in SHSE. *Av.Eff.SZSE* is the average of the market efficiency coefficient for the stocks in SZSE. *Av.Eff.not ChiNext* is the average of the market efficiency coefficient for the stocks that are not in ChiNext. *Av.Eff.ChiNext* is the average of the market efficiency coefficient for the stocks in ChiNext. *Diff. (1) vs (2)* is the difference in the average market efficiency coefficient between *Av.Eff.SHSE* and *Av.Eff.SZSE*. *Diff. (3) vs (4)* is the difference in the average market efficiency coefficient between *Av.Eff.not ChiNext* and *Av.Eff.ChiNext*. *, **, and *** denote two-tailed significance of the corresponding test statistics of the parametric paired t-test at the 10%, 5%, and 1% levels, respectively.

As the information flow effect of speculative trading is decreasing with the time interval, the market efficiency advantage of the markets with more prevalent speculative trading is

also reduced. At the 15-m interval, the information flow effect is completely disappearing. This is consistent with our results in Table 11 (the coefficients of *Volatility* become insignificant at intervals longer than 15 m; the coefficients of *Price* change signs for intervals from 15 m to 30 m). This result further shows that the information flow effect of speculative trading in the Chinese stock market is only valid in the short-horizon. It gradually loses its effect on market efficiency and is overwhelmed by the noise from the speculative trading between 10 minutes and 20 minutes.

6.4. State-owned company concerns

The results indicate that smaller firms are priced more efficiently because the speculative trading that enhances information integration into price is concentrated on small-capitalization stocks. Thus, the information flow effect of speculative trading is the dominant effect. This is opposite of the effect in the U.S., where large Cap firms with a better information environment and less pronounced asymmetry are priced more efficiently. Traditional state-owned companies always choose to be listed on the SHSE, so it may not be that larger cap companies are less efficient, but rather that state-owned companies are less efficient. Therefore, we run the multivariate regressions in Eq. (2) by excluding state-owned companies. The results are shown in Table 13.

TABLE 13: Multivariate regression without state-owned companies

	SHSE & SZSE								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
N	1,077	1,077	1,077	1,077	1,077	1,077	1,077	1,077	1,077
Intercept	1.8206***	1.8071***	1.9445***	2.2669***	1.8415***	1.9535***	1.8328***	1.6414***	2.2799***
	(30.22)	(29.90)	(33.16)	(57.10)	(30.21)	(32.56)	(31.49)	(31.13)	(56.90)
Cap	-.8751***		-.7559***	-1.1832***	-.3158	-.7844***	-.8675***	-1.0799***	-.6457***
	(-3.51)		(-2.98)	(-4.60)	(-1.37)	(-3.05)	(-3.48)	(-4.31)	(-2.72)
Turnover	-.1032***	-.0994***		.0057	-.0829***	-.1300***	-.1050***	-.0968***	.0121
	(-6.80)	(-6.53)		(-0.49)	(-5.55	(-8.49)	(-7.00)	(-6.30)	(1.07)
Volatility	22.1463***	23.1971***	11.5770***		21.7900***	25.7955***	21.9829***	22.1635***	
	(9.56)	(10.05)	(6.61)		(9.29)	(10.99)	(9.53)	(9.43)	
Volume	.6976***	.5182***	.4907***	.6641***		.7697***	.7099***	.8436***	
	(5.54)	(4.48)	(3.93)	(5.06)		(5.93)	(5.68)	(6.73)	
Price	9.7588***	9.5819***	11.4221***	11.8463***	10.1978***		9.8784***	12.7795***	12.2326***
	(8.39)	(8.21)	(9.84)	(9.96)	(8.67)		(8.57)	(12.08)	(10.19)
Insholding	.2717	.2248	.6333*	-.0256	.5109	.6519*		.2837	.2069
	(0.79)	(0.65)	(1.82)	(-0.07)	(1.47)	(1.84)		(0.81)	(0.57)
Effspread	-44.0195***	-47.7168***	-40.3477***	-44.1102***	-52.2429***	-71.9741***	-44.0544***		-51.9430***
	(-5.86)	(-6.38)	(-5.28)	(-5.64)	(-7.00)	(-10.36)	(-5.87)		(-6.70)
SHSZ	.0394**	.0375*	.0194	.0051	.0632***	.0069	.0423**	.0364*	.0283
	(2.02)	(1.91)	(0.99)	(0.26)	(3.27)	(0.35)	(2.20)	(1.83)	(1.44)
Adj R-square	0.2919	0.2844	0.2619	0.2319	0.2722	0.2458	0.2921	0.2698	0.2142

Notes: *Cap* is the average daily total capitalization in millions of yuan, *Turnover* is the average daily turnover ratio expressed as a percentage, *Volatility* is the average daily return volatility, *Volume* is the average daily trading volume in millions of yuan, *Price* is the average daily closing price, *Insholding* is the average quarterly institutional holding expressed as a percentage, and *Effspread* is the volume-weighted average of the difference between the bid-ask midpoint and the actual transaction price divided by the bid-ask midpoint. *SHSZ* is a binary variable that is assigned a value of one if the stock is listed on the SHSE and zero if the stock is listed on the SZSE. The coefficient for *Cap* is multiplied by 10^6 and the coefficients for *Volume, Price,* and *Insholding* by 10^3. *, ** and *** denote the significance at the 10%, 5% and 1% levels, respectively.

The results are comparatively the same as the results for state-owned enterprises. Therefore, the state-owned characteristic does not affect the fact that the short-horizon market efficiency decreases with the market capitalization.

7. Summary and conclusions

Based on the measure of short-horizon market efficiency proposed by Chordia et al. (2008), this study represents the first comprehensive investigation of the relation between different factors and market efficiency in the Chinese stock market, a stock market that is characterized by prevalent speculative trading. This study finds that return volatility and closing price are positively correlated with market efficiency. Such a finding is stable across the two Chinese stock exchanges and is consistent with Chung and Hrazdil (2012) and

Visaltanachoti and Yang (2010). Their effect on market efficiency is increasing as the speculative trading becomes more dominant in the stock market. Capitalization, trading volume, and turnover ratio are three other factors that affect market efficiency. Furthermore, the short-horizon market efficiency of the SZSE is slightly better than that of the SHSE. Compared with the U.S. stock market, the features of speculative trading greatly influence market efficiency in the Chinese stock market. The information flow effect of speculative trading enhances the market efficiency in the short-horizon. This effect is more evident in the market with more prevalent speculative trading. This effect, however, is not valid in the long-horizon. The empirical evidence shows that it gradually loses its effect on market efficiency between 10 minutes and 20 minutes in the Chinese stock market. The feature of noise trading for speculative trading eventually lowers the market efficiency in the long-horizon.

This study has important implications for investors, listed companies, regulators, and stock exchanges. It answers questions concerning the factors that affect stock market efficiency in China. This is significant for portfolio construction by investors and arbitrageurs. The findings are also significant for regulators. This study provides insight into the Chinese stock market and provides regulators with a solid basis from which to develop market policies and evaluate their effect. One limitation of the study, however, is that the traditional measures of fundamental value, such as the P/E ratio, P/D ratio, and 'Fed model,' are not applicable in the Chinese stock market because of the lack of transparency in the Chinese accounting system. This makes it difficult to differentiate between prices that are elevated because of an increase in fundamental value versus an increase due to speculative trading; however, this difficulty also makes the price itself an appropriate variable in our method because the investors with a speculative attitude apply their trading strategies based on the price level while they cannot determine a precise fundamental value of the stock. Another

limitation of the study is that the method of measuring the short-horizon market efficiency is focused on the information integration speed of private information. Therefore, the short-horizon market efficiency based on public information is beyond the scope of this paper. Moreover, this fact also makes it difficult to use the traditional market efficiency measures, such as the variance ratio measure, for a robustness check because they are based on the whole information set, including both private and public information. Future research could investigate the short-horizon market efficiency for market-wide public information. Additionally, this study could be generalized to other stock markets in developing countries.

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