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Information asymmetry, price discovery, and the Chinese B-share discount puzzle ☆

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ABSTRACT

This paper addresses the information asymmetry between Chinese local A-share and foreign B-share markets and its impact on the B-share discount puzzle, contingent upon Chinese stock market liberalization reforms in 2001 and 2002. In contrast with the widespread notion that domestic investors are better informed than foreign investors, this study shows that foreign investors actually possess more value-relevant, firm-specific information in emerging markets, where information transparency and investor protection rights are relatively weak. As such, the observed B-share discount is not compensation for the informational disadvantage of foreign investors but, rather, the result of a downward price correction (toward the fundamental values) once more firm-specific information is capitalized by sophisticated foreign investors in the B-share market. The price correction effect is significant even after controlling for several alternative explanations. Further investigation suggests a mitigated degree of information asymmetry and B-share discount upon market liberalization.

1. Introduction

As capital markets become more and more globally integrated, the issue of information asymmetry in international equity markets is becoming increasingly crucial. Despite general agreement on the presence of information asymmetry, the issue of whether or not domestic investors are better informed than foreign investors remains controversial, especially in emerging contexts. Some researchers argue that domestic

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investors are better informed because they have linguistic, cultural, and regulatory advantages (e.g., Brennan and Cao, 1997; Chakravarty et al., 1998; Chan et al., 2008), whereas others point out that foreign investors have an informational advantage in emerging markets because they are more experienced and subject to less information censorship (e.g., Chui and Kwok, 1998; Grinblatt and Keloharju, 2000).

In the context of China, one major contribution of the information asymmetry analysis is that it points to a possible explanation for the Chinese B-share discount puzzle. Prior to Chinese stock market liberalization reforms,[2] Chinese firms could issue two classes of stocks, identical in all aspects except for their ownership restrictions: A shares, which could only be held and traded by Chinese domestic investors, and B shares, which could only be held and traded by foreign investors. As a result, the Chinese stock market is divided into two separate markets: the local A-share and foreign B-share markets. In segmented markets where companies issue restricted shares that are only available to domestic investors and unrestricted shares that can be held and traded by foreign investors, unrestricted shares are traded uniformly at a premium relative to their restricted counterparts (e.g., Bailey et al., 1999). In China, however, unrestricted B shares are traded at a large discount, a fact that is often referred to as the "Chinese B-share discount puzzle" (Bailey et al., 1999; Bailey and Jagtiani, 1994; Chan et al., 2008; Yang and Lau, 2005). This sharp contrast has attracted a substantial body of research, among which the most influential is the uninformed foreign investor hypothesis. The idea is that due to language barriers, different accounting standards, and weak access to local information, foreign investors often have less information than domestic investors, and, hence, require a higher premium (stock price discount) in the B-share market (e.g., Chakravarty et al., 1998; Chan et al., 2008). A major deficiency of this argument stems from its generalizability to emerging markets.

In an environment with limited investor protection, ineffective legal enforcement, and ill-functioning accounting–auditing systems, the presumption that domestic investors are in possession of sufficient value-relevant information is unwarranted. In fact, Chinese investors are found to be speculators who trade on rumors rather than informed investors who trade on fundamentals (e.g., Ma, 1996; Mei et al., 2003), and the price movements of Chinese stocks are found to be highly synchronous with the movements of the market rather than reflecting firm-specific information (e.g., Chan and Hameed, 2006; Morck et al., 2000). The fact that Chinese domestic A shares are not informative *per se* has been a large factor in questioning the uninformed foreign investor interpretation of the B-share discount puzzle. Moreover, many recent studies indicate that foreign investors tend to be more informed than domestic investors in emerging markets where the institutional environment is weak (e.g., Chui and Kwok, 1998; Yang, 2003).

The ongoing debate over the issue of whether or not domestic investors are better informed than foreign investors in emerging markets gives rise to the first motivation of this study. Using a panel sample of Chinese firms that issue both local A and foreign B shares, we find that foreign investors are actually more informed than domestic investors in an emerging market such as China. Built upon this "informed foreign investor" hypothesis, the study also offers an alternative explanation for the B-share discount puzzle. As empirical evidence indicates, with informed foreign investors and inherent stock misvaluation, the observed Chinese B-share discount is not compensation for the informational disadvantage of foreign investors but, rather, the result of a downward price correction (toward the fundamental values) once more firm-specific information is capitalized by sophisticated foreign investors in the B-share market. Moreover, while the impact of market liberalization on the evolution of the Chinese stock market has stimulated a growing body of research, the focus is primarily on the first liberalization reform, i.e., the opening of the foreign B-share market to Chinese domestic investors on February 19, 2001. The second reform, i.e., the opening of the domestic A-share market to qualified foreign institutional investors (QFII) on November 5, 2002, is largely ignored. For instance, Karolyi et al. (2009) define the pre-liberalization period as February 1, 2001–February 19, 2001, and the post-liberalization period as February 28, 2001–April 1, 2001; Chan et al. (2007) define the pre-liberalization period as January 10, 2000–February 19, 2001, and the post-liberalization period as February 20, 2001–November 8, 2001; and Karolyi and Li (2003) define the pre-liberalization period as January 1, 1999–February 19, 2001, and the post-liberalization period as February 20, 2001–December 31, 2001. Evidence on the post-liberalization period

[2] The opening of the foreign B-share market to Chinese domestic investors on February 19, 2001 and the opening of the domestic A-share market to qualified foreign institutional investors (QFII) on November 5, 2002.

generated from these studies may capture nothing but abnormal fluctuations between the two regulatory reforms. Hence, unlike previous studies that focus exclusively on the opening of the foreign B-share market to domestic investors (e.g., Chan et al., 2007; Karolyi, et al., 2009; Karolyi and Li, 2003), this study addresses the more fundamental question of whether, and to what extent, the Chinese market liberalization reforms—that is, the opening of the foreign B-share market to Chinese domestic investors on February 19, 2001 and the opening of the domestic A-share market to QFII on November 5, 2002—influenced the patterns of information asymmetry and the B-share discount.

This study contributes to the literature in several dimensions. First, it challenges the prevailing view that domestic investors are better informed than foreign investors and extends our understanding of how unique institutional environments can shape the information context in a particular country. Founded upon the informed foreign investor hypothesis, this study also points to another possible explanation of the Chinese foreign share discount puzzle. In particular, the B-share discount can be explained as a result of a downward price correction (toward the fundamental values) once more firm-specific information is capitalized by sophisticated foreign investors in the B-share market. Empirical evidence indicates that the price correction effect is significant even after controlling for other alternative explanations. Second, this study provides additional clarity in the development of information asymmetry measures. In particular, we find that the literature is populated by a multitude of measures, many of which are rather ambiguous, resulting in conflicting results regarding the direction of information asymmetry. For instance, Chakravarty et al. (1998) find that domestic investors are better informed based on (1) the return sensitivity of B shares to their A-share counterparts (i.e., $Cov_{A,B}/\sigma_A^2$), arguing that higher sensitivity indicates less information asymmetry because B-share investors could obtain more information from A-share prices; (2) the sample variance of B-share returns, where high volatility suggests more information asymmetry because the prediction of B-share prices is more difficult; and (3) the number of company citations in the Wall Street Journal index. While these proxies have some explaining power concerning the degree of information asymmetry, it is not clear whether domestic or foreign investors are better informed. Moreover, Chan et al. (2007) find that local A shares dominate the price discovery process based primarily on Hasbrouck's (1995) information shares approach. Note, however, that a necessary condition for Hasbrouck's (1995) model to work is costless arbitrage. Given that the A and B shares are not perfectly exchangeable and that short selling is legally forbidden in China, this approach cannot be effectively utilized in analyzing the informativeness of Chinese stocks. Because unwarranted quantifications of inputs inevitably result in misleading results, more robust and consistent measures of information asymmetry have to be developed and utilized. The present paper also bridges this gap. Finally, while the issues of information asymmetry and the Chinese foreign share discount puzzle have stimulated a considerable amount of quality research, there is limited evidence on the impact of market liberalization on the dynamics of information environment, and the second liberalization reform (i.e., the opening of the domestic A-share market) is largely ignored in the extant literature. Using a balanced panel, which spans from October 1997 to September 2007, this study effectively examines the impact of market liberalization on the evolution of information environment and the process of price discovery.

The remainder of this paper is organized as follows: Section 2 briefly discusses the development of the hypotheses; Section 3 describes the data and model specifications; Section 4 reports the empirical results, followed by concluding remarks in Section 5.

2. Hypothesis development

2.1. Information asymmetry

Despite the growing importance of the issue of information asymmetry in international equity markets, the question of whether domestic investors are better informed than foreign investors remains controversial, especially in emerging contexts. In the literature, it is widely believed that foreign investors have an informational disadvantage relative to domestic investors due to the former's lack of linguistic, cultural, and regulatory knowledge and weak access to local information (e.g., Brennan and Cao, 1997; Chakravarty et al., 1998; Chan et al., 2008). In support of the uninformed foreign investor hypothesis, Chan et al. (2008) point out that foreign investors tend to face more severe information asymmetry in an emerging market such as

China, where firms often hide material changes in their business conditions, corporate managers freely manipulate firm-specific information, and insider trading is widespread. This is the very case facing the Chinese stock market. However, this argument ignores the fact that Chinese domestic investors are likely to face the same situation. With limited investor protection, ineffective legal enforcement, and ill-functioning information infrastructure, domestic investors may not necessarily be more informed than foreign investors. In China, investors are frequently regarded as speculators who trade on rumors rather than informed investors who trade on fundamentals (e.g., Ma, 1996; Mei et al., 2003), and the price movements of individual stocks are found to be highly synchronous with the movements of the market rather than reflecting firm-level information (e.g., Chan and Hameed, 2006; Morck et al., 2000). The fact that Chinese local A shares are not informative *per se* plays a major role in questioning the uninformed foreign investor interpretation of the B-share discount puzzle.

In this study, we expect foreign investors to be better informed than domestic investors. We justify this argument on three grounds. First, the disclosure requirement is stricter for firms with foreign B-share listings. In China, firms that issue shares to both domestic and foreign investors are required to prepare their financial statements based on both the Chinese Generally Accepted Accounting Principles (GAAP) and the International Accounting Standards (IAS), whereas firms that issue shares exclusively to domestic investors are subject solely to the Chinese GAAP. The higher financial reporting standard in the B-share market will, to a large extent, mitigate information asymmetry between corporate insiders and outsiders. Second, the B-share market is more regulated and subject to less information censorship. The increased investor protection and enhanced information transparency in the B-share market will undoubtedly facilitate timely information transmission, and hence, promote informed trading. Third, foreign investors participating in the B-share market are often more experienced and sophisticated than Chinese domestic investors in collecting, processing, and analyzing value-relevant corporate information.

In the literature, a popular way to address the direction of information asymmetry is to investigate the lead–lag relation between the two markets (e.g., Chan and Hameed, 2006; Chui and Kwok, 1998; Lo and MacKinlay, 1990; Yang, 2003). In a perfect market with no information asymmetry, all available information should be incorporated into stock prices instantaneously. However, if some investors have an informational advantage relative to others, then a large portion of information will be impounded into stock prices by uninformed investors with a lag after observing the action of informed investors. Consistent with this argument, Lo and MacKinlay (1990) find that past returns of large firms lead current returns of small firms. Badrinath et al. (1995) find that returns on stocks with high institutional ownership lead returns on stocks with low institutional ownership. Brennan et al. (1993) and Chan and Hameed (2006) find that returns of firms with high analyst coverage lead those of firms with low analyst coverage. These empirical findings point to a single story: There is a significant lead–lag relation between informed and uninformed parties, where uninformed parties tend to follow informed parties in their decision making processes.

Following the literature, we use the vector autoregression (VAR) methodology to investigate the lead–lag relationship between local A and foreign B shares. In the context of this study, the informed foreign investor hypothesis implies that information will tend to flow from foreign to domestic investors and that the price movements in the B-share market will lead those in the A-share market. Based on the above discussion, the following hypothesis is developed:

H1a. *Foreign investors are better informed in an emerging market such as China, and the movements in the B-share market lead those in the A-share market.*

While the VAR model provides a direct measure of the lead–lag relationship, some caveats should be noted. First, the VAR approach only tells us the direction of information flow; it does not tell us the contribution of each factor to the process of price discovery. Moreover, observing a dominant price discovery role in one market does not necessarily mean that investors trading in that market are better informed. It is not clear how well-informed the investors are, nor how value-relevant are the stock prices. In addition, given that the VAR model provides a multidimensional, simultaneous analysis of exogenous variables, the inclusion of a large number of control variables is often technically impossible. Therefore, while previous studies attempt to draw inferences by relying heavily on the VAR approach (e.g., Yang, 2003), in the context of this study it is utilized mainly for exploratory purposes.

Intuitively, a more direct way to address the direction of information asymmetry is to compare the price informativeness between the two classes of assets. The idea is that if domestic (foreign) investors are better informed, then A-share (B-share) prices should be more informative compared to their B-share (A-share) counterparts.

Drawing on state-of-the-art finance literature (e.g., Chan and Hameed, 2006; Morck et al., 2000; Roll, 1988), this study uses price synchronicity to measure stock price informativeness. This stream of research is developed upon a hypothesized decomposition of information in stock pricing. As Roll (1988) points out, the extent to which stocks move together depends on the relative amounts of firm-level and market-level information incorporated into stock prices. The idea is that if asset prices can be considered as a function of both firm-specific and market-wide information, then in an environment with significant impediments to informed trading, investors will have to rely more on market-wide information, resulting in a higher degree of stock co-movement. In contrast, the price movements will tend to be less synchronous in a more transparent environment that encourages informed trading. Empirically, a growing body of literature consistently provides support for this information-based interpretation of price synchronicity. For example, Morck et al. (2000) find that stock prices move together more in emerging markets, where reliable firm-specific information is either technically unavailable or prohibitively expensive. Durnev et al. (2003) indicate that the relationship between current returns and future earnings is stronger for firms and industries with low price synchronicity. Durnev et al. (2004) document a positive association between the economic efficiency of corporate investment and the magnitude of firm-specific variation in stock returns. Jin and Myers (2006) find that stock price synchronicity decreases with the level of information transparency. Gul et al. (2010) note that foreign ownership and auditor quality are inversely associated with synchronicity and that the amount of firm-level information reflected in stock prices is lower for firms with high synchronicity. Overall, these empirical findings suggest that higher firm-specific return variation (as a fraction of total variation) indicates more informative stock pricing.

In the context of this study, the informed foreign investor hypothesis implies that foreign B-share prices should be more informative (less synchronous) compared to their A-share counterparts. Therefore, the following hypothesis is developed:

H1b. *Foreign investors are better informed in an emerging market such as China, and foreign B-share prices are more informative than local A-share prices.*

2.2. The B-share discount puzzle

In segmented markets where companies issue restricted shares that are only available to domestic investors and unrestricted shares that can be held and traded by foreign investors, unrestricted shares are traded uniformly at a premium relative to their restricted counterparts (e.g., Bailey et al., 1999; Bailey and Jagtiani, 1994; Domowitz et al., 1997; Hietala, 1989; Stulz and Wasserfallen, 1995). In China, however, unrestricted B shares are traded at a large discount (e.g., Bailey et al., 1999; Bailey and Jagtiani, 1994; Chan et al., 2008; Yang and Lau, 2005). This difference is considered a “puzzle” because, in theory, given that foreign investors can diversify away a large portion of risk associated with Chinese B shares through non-Chinese stocks, the required return should be lower for foreign B shares than for local A shares, resulting in a B-share premium rather than a discount.

The sharp contrast between the Chinese and other capital markets has attracted a substantial body of research. Nevertheless, empirical evidence to date has been inconclusive in interpreting the causes of the discount. Overall, frequently documented hypotheses can be roughly classified into four streams.

The first stream of research relies on the theory of supply and demand. As Bailey and Jagtiani (1994) and Fernald and Rogers (2002) point out, it is the lack of alternatives to low-yielding bank accounts in China that drives domestic savings into the A-share market and pushes A-share prices up, beyond parity. In addition, Sun and Tong (2000) argue that the existence of the Hong Kong H-share market provides a good substitute for the B-share market, which grants higher demand elasticity to the B shares. Both effects tend to inflate the A-share prices and deflate the B-share prices. The major criticism concerning this hypothesis stems from its failure to explain the cross-sectional variation in A-share premiums (Chan et al., 2008).

The second line of research attributes the price differential between the two classes of stocks to the speculative behavior of Chinese investors. Because Chinese security markets are extraordinarily risky, domestic investors tend to be highly risk tolerant and speculative, diverting A-share prices from a rational level (e.g., Ma, 1996; Mei et al., 2003). While Mei et al. (2003) find that the A-share turnover rate, which proxies for the amount of speculative trading, explains some of the cross-sectional variation in A-share premiums, a large portion of the variation remains unexplained.

The third school of research considers the Chinese foreign share discount as a result of B shares' lack of liquidity and high trading costs (e.g., Chen et al., 2001; Chen and Xiong, 2001). That is, B shares are priced lower to compensate for their lower liquidity and higher transaction costs. This hypothesis, however, cannot explain why other capital markets with similar ownership restrictions do not experience the same pattern of foreign share discount.

The last and most prevalent body of research is built upon the information asymmetry hypothesis developed by Brennan and Cao (1997). The idea is that due to language barriers, different accounting standards, and weak access to local information, foreign investors often have less information than domestic investors, and, hence, require a higher premium (stock price discount) in the B-share market (e.g., Chakravarty et al., 1998; Chan et al., 2008). The major challenge facing this hypothesis is the question of whether domestic investors are in possession of sufficient value-relevant information in weak information environments.

If foreign investors do not have an informational disadvantage, as is proposed in this study, then the question becomes whether the analysis of information asymmetry still contributes to our understanding of the B-share discount puzzle. To better illustrate this point, it is important to understand two idiosyncrasies associated with the Chinese stock market. First, Chinese domestic shares are universally overvalued relative to their fundamentals (e.g., Bailey and Jagtiani, 1994; Fernald and Rogers, 2002; Ma, 1996; Mei et al., 2003). It is argued that both the excess funds in the A-share market and the highly speculative behavior of Chinese investors contribute largely to the deviation of stock prices from a rational level. Second, the movements of stock prices are highly synchronous with the movements of the market rather than reflecting firm-specific information in China (e.g., Chan and Hameed, 2006; Morck et al., 2000). This phenomenon can be well explained by the information-based interpretation of price synchronicity. If we consider asset prices as a function of both firm-specific and market-wide information, then investors will have to rely more on market-level information in an environment where credible firm-level information is either technically unavailable or prohibitively costly, resulting in more synchronous price movements.

Because the B-share market is associated with a higher level of regulatory and disclosure standards, less information censorship, and more sophisticated investor base, one should expect foreign B-share investors to be more efficient in collecting and processing value-relevant information than local A-share investors. Consequently, more firm-specific information should be capitalized into B-share prices, resulting in more accurate or less overvalued B-share pricing. Therefore, in a world with informed foreign investors and inherent stock overvaluation, the so-called B-share discount can be interpreted as a result of a downward price correction (toward the fundamental values) once more firm-specific information is incorporated into stock pricing. If this is the case, then one should observe a positive relation between the magnitude of the B-share discount and the capitalization of firm-specific information (as measured by price synchronicity).

Based on the above discussions, the following hypothesis is derived:

H2. *The B-share discount can be attributed largely to the price correction effect, and the more informative the stock prices, the larger the discount.*

2.3. Impact of market liberalization

Observing the information asymmetry between foreign and domestic investors, however, is not the end of the story in today's increasingly integrated world. A more interesting and important question to address is whether and to what extent the market liberalization reforms—that is, the opening of the foreign B-share market in 2001 and the opening of the domestic A-share market in 2002—affect the patterns of information asymmetry and the B-share discount. It is important to note that the process of market liberalization defined in this study is different from previous studies, which focus exclusively on

the opening of the foreign B-share market to domestic investors (e.g., Chan et al., 2007; Karolyi, et al., 2009; Karolyi and Li, 2003).

While it is unlikely for the processes of market liberalization to entirely eradicate the difference between the two markets, mitigated information asymmetry and reduced price disparity are expected. First, given that the disclosure and regulatory requirements across the two markets have been increasingly standardized since the regulatory reforms, the information asymmetry between local A-share and foreign B-share markets should be less prominent. Second, the capabilities of investors to collect and process value-relevant, firm-specific information should be less divergent after market integration, since the investor base is more or less the same across the two markets. Therefore, one hypothesizes the following:

H3. *Both information asymmetry and price disparity between the two markets are mitigated upon the regulatory reforms of market liberalization.*

3. Data and methodology

3.1. The B-share discount

This study examines the price dispersion between the local A and foreign B shares that are issued by the same companies (hereafter termed the twin-share portfolios). Given that not all Chinese publicly listed firms issue shares to both domestic and foreign investors, this study focuses only on firms that issue both A and B shares. Using balanced panel data, we further require the sample firms to be continuously listed on either the Shanghai Stock Exchange (SSE) or the Shenzhen Stock Exchange (SZSE) for at least 10 years at the time of estimation. After eliminating firms with insufficient histories or missing values on related variables, companies with incomparable sizes, enterprises in financial industries, and those with foreign listings other than B-share listings, we are left with 53 firms. The final sample, therefore, consists of 53 firms (26 SSE-listed and 27 SZSE-listed), each with a continuous dual-listing history during the sample period from October 1997 to September 2007.

In this study, both firm-level data and stock market figures are compiled from the China Stock Market and Accounting Research Database (CSMAR). To facilitate a more rigorous analysis, daily data series is utilized, where the trading day closing price is used in calculating continuously compounded returns. To control for the impact of market liberalization, we further divide the sample into three sub-periods: the pre-market-liberalization period, the post post-market-liberalization period, and the period of market restructuring. The sub-periods are truncated by the two regulatory reforms, i.e., the opening of the foreign B-share market to Chinese domestic investors on February 19, 2001 and the opening of the domestic A-share market to QFII on November 5, 2002. The time frame is illustrated in Fig. 1.

Table 1 presents the price differential between the local A and foreign B shares issued by the same companies, sorted by exchange listing (SSE or SZSE) and time period of estimation (i.e., the pre-market-liberalization period, the post-market-liberalization period, and the market restructuring period). Consistent with previous studies that document a significant B-share discount, Table 1 indicates that the currency-adjusted B-share prices are significantly lower, on average, than the corresponding A-share

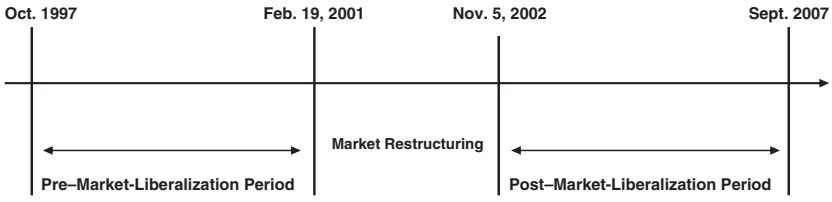

Fig. 1. Estimation time frame. This figure illustrates the time frame of estimation. As indicated, the two regulatory reforms (i.e., the opening of the foreign B-share market to Chinese domestic investors on February 19, 2001 and the opening of the local A-share market to qualified foreign institutional investors on November 5, 2002) have divided the sample into three sub-periods: the pre-market-liberalization period, the post-market-liberalization period, and the period of market restructuring.

Table 1
Price differential between A and B shares. This table reports the price differential between the local A and foreign B shares that are issued by the same companies, sorted by exchange listing (SSE or SZSE) and time period of estimation (i.e., the pre-market-liberalization period, the post-market-liberalization period, and the market restructuring period). The final sample consists of 53 firms (26 SSE-listed firms and 27 SZSE-listed firms), each with a continuous dual-listing history over the entire sample period. Standard deviations are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

	A-share portfolio	B-share portfolio	Price differential
Panel A. SSE-listed firms (26 firms)			
The pre-market-liberalization period	11.988	2.133	9.855***
	(2.06)	(0.78)	
The period of market restructuring	14.119	7.086	7.033***
	(1.99)	(1.32)	
The post-market-liberalization period	7.449	3.650	3.799***
	(2.19)	(0.99)	
Panel B. SZSE-listed firms (27 firms)			
The pre-market-liberalization period	11.649	2.711	8.938***
	(1.98)	(0.64)	
The period of market restructuring	12.228	6.409	5.819***
	(1.65)	(1.52)	
The post-market-liberalization period	7.317	4.392	2.925***
	(1.81)	(0.84)	

prices. In line with hypothesis H3, which predicts a mitigated level of price disparity upon market integration, the price differential shrinks dramatically during the post–market-liberalization period. The mean difference declines from 9.86 to 3.80 on the SSE and falls from 8.94 to 2.93 on the SZSE.

Figs. 2 and 3 confirm this pattern graphically. It is clear that there is a significant price differential or B-share discount over the sample period from October 1997 to September 2007, and that the divergence becomes less evident after the completion of market liberalization reforms in 2002.

3.2. The lead–lag relation

Given the empirical complexity in investigating information related issues, this study uses two approaches to measure information asymmetry between domestic and foreign investors: the lead–lag relation and the price informativeness.

Following the literature, we use the VAR model to investigate the lead–lag relation between foreign and domestic investors. For a more robust analysis, firms listed on the SSE and the SZSE are considered separately. Hence, the regulatory segmentation of the local A-share and foreign B-share markets, together with the two exchange choices, has divided the Chinese stock market into four segmented markets: the Shanghai A-, Shanghai B-, Shenzhen A-, and Shenzhen B-share markets. In order to obtain a more complete picture, the four portfolios (i.e., SSE-listed A and B twin-share portfolios and SZSE-listed A and B twin-share portfolios) are considered simultaneously in an integrated VAR system. Borrowing the idea from the capital asset pricing model (CAPM), corresponding market returns are also included in the simultaneous equations as additional exogenous variables. Specifically, the following VAR system is estimated:

$$\begin{bmatrix} \mathrm{SHA}_t \\ \mathrm{SHB}_t \\ \mathrm{SZA}_t \\ \mathrm{SZB}_t \end{bmatrix} = A_0 + \sum_{k=1}^{K} A_k \begin{bmatrix} \mathrm{SHA}_{t-k} \\ \mathrm{SHB}_{t-k} \\ \mathrm{SZA}_{t-k} \\ \mathrm{SZB}_{t-k} \end{bmatrix} + \sum_{l=1}^{L} B_l \begin{bmatrix} \mathrm{SHAI}_{t-l} \\ \mathrm{SHBI}_{t-l} \\ \mathrm{SZAI}_{t-l} \\ \mathrm{SZBI}_{t-l} \end{bmatrix} + \begin{bmatrix} \varepsilon_{\mathrm{SHA},t} \\ \varepsilon_{\mathrm{SHB},t} \\ \varepsilon_{\mathrm{SZA},t} \\ \varepsilon_{\mathrm{SZB},t} \end{bmatrix} \quad (1)$$

where SHA_t and SHB_t are the SSE-listed twin-share portfolio returns at time t, and SZA_t and SZB_t are the SZSE-listed twin-share portfolio returns at time t. Note that the final sample consists of 26 SSE-listed firms and 27 SZSE-listed firms, each of which has a continuous A- and B-share dual-listing history over the entire sample period. The variables SHAI_t, SHBI_t, SZAI_t, and SZBI_t are the corresponding market returns at time t. Here, A_0 is a 4×1 column vector, A_k and B_l are both 4×4 matrices of coefficients, k is the number of

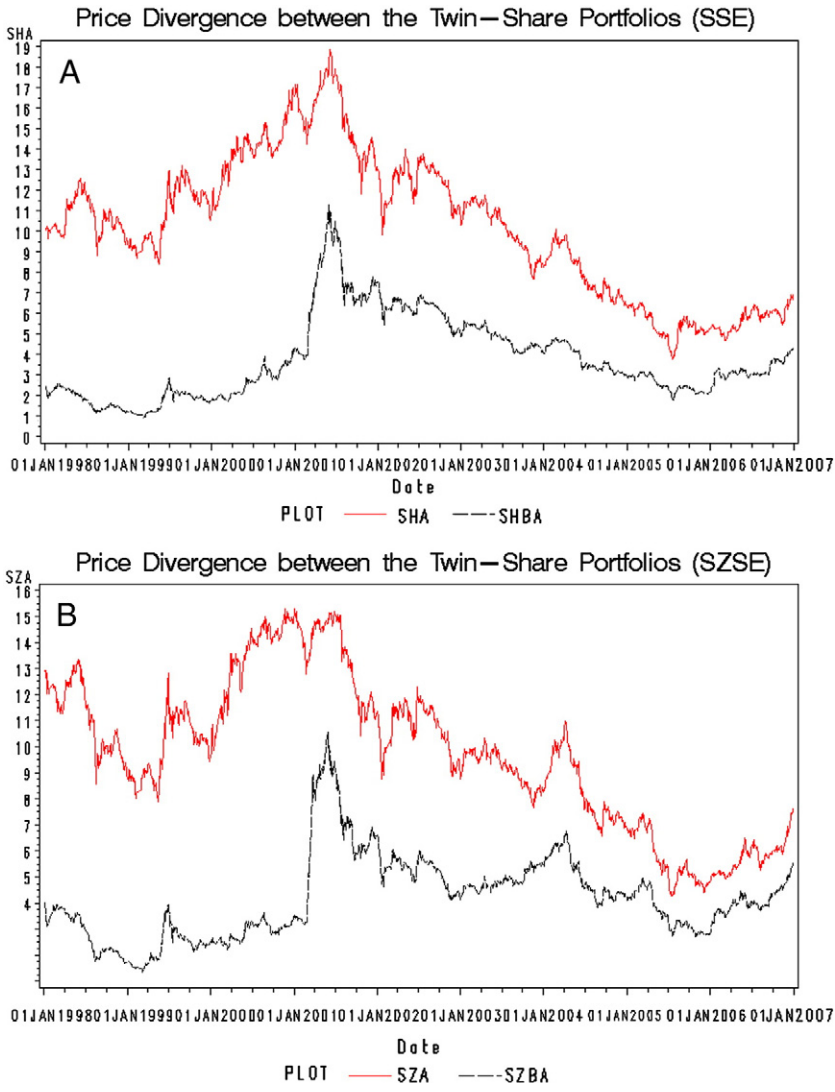

Fig. 2. Price divergence between the twin-share portfolios. These figures plot the price differential between the local A and foreign B shares that are issued by the same companies over the sample period from October 1997 to September 2007. The estimation period spans the two regulatory reforms (i.e., the opening of the foreign B-share market to Chinese domestic investors on February 19, 2001 and the opening of the local A-share market to qualified foreign institutional investors on November 5, 2002).

lagged endogenous variables, and l is the number of lagged exogenous variables. The i,jth component of A_k measures the direct impact that an innovation on the jth market would have on the ith market in k period.

Table 2 reports the correlation matrix of the twin-share portfolios with one another and with the four market indices. As Table 2 indicates, the correlation coefficients between the A and B twin-share portfolios are highly significant (0.60 for SSE-listed firms and 0.63 for SZSE-listed firms), indicating a high degree of contemporaneous interdependence between the A and B shares that are issued by the same companies. In other words, a large portion of innovations in one market will be shared by the other on the same calendar day. Moreover, the correlation coefficients between individual portfolios and market indices are all significant (ranging from 0.55 to 0.98), implying that the movements of individual stocks are highly synchronous with the movements of the market.

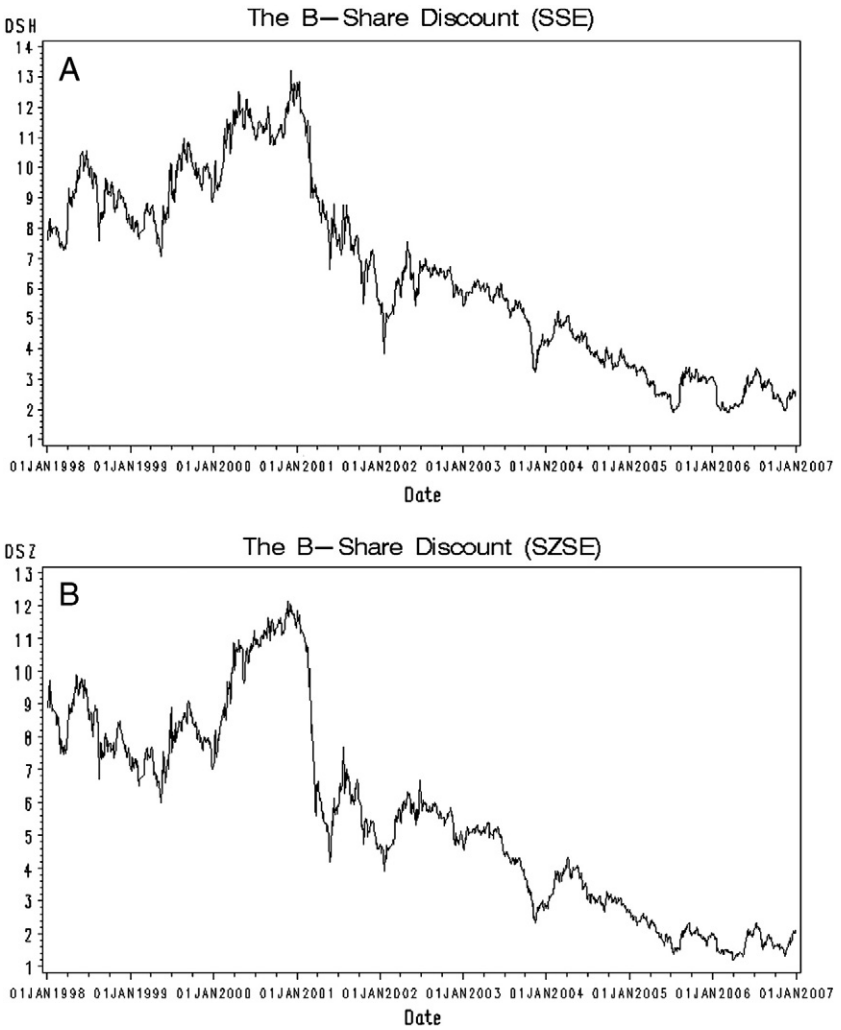

Fig. 3. The B-share discount. These figures plot the B-share discount over the sample period from October 1997 to September 2007. The estimation period spans the two regulatory reforms (i.e., the opening of the foreign B-share market to Chinese domestic investors on February 19, 2001 and the opening of the local A-share market to qualified foreign institutional investors on November 5, 2002).

In addition to the integrated VAR system, firms that are listed on the SSE and the SZSE are further investigated separately. In particular, the following simultaneous equation systems are estimated:

$$\begin{bmatrix} \mathrm{SHA}_t \\ \mathrm{SHB}_t \end{bmatrix} = A_0 + \sum_{k=1}^{K} A_k \begin{bmatrix} \mathrm{SHA}_{t-k} \\ \mathrm{SHB}_{t-k} \end{bmatrix} + \sum_{l=1}^{L} B_l \begin{bmatrix} \mathrm{SHAI}_{t-l} \\ \mathrm{SHBI}_{t-l} \end{bmatrix} + \begin{bmatrix} \varepsilon_{\mathrm{SHA},t} \\ \varepsilon_{\mathrm{SHB},t} \end{bmatrix} \tag{2}$$

$$\begin{bmatrix} \mathrm{SZA}_t \\ \mathrm{SZB}_t \end{bmatrix} = A_0 + \sum_{k=1}^{K} A_k \begin{bmatrix} \mathrm{SZA}_{t-k} \\ \mathrm{SZB}_{t-k} \end{bmatrix} + \sum_{l=1}^{L} B_l \begin{bmatrix} \mathrm{SZAI}_{t-l} \\ \mathrm{SZBI}_{t-l} \end{bmatrix} + \begin{bmatrix} \varepsilon_{\mathrm{SZA},t} \\ \varepsilon_{\mathrm{SZB},t} \end{bmatrix} \tag{3}$$

where A_0 is a 2×1 column vector, A_k and B_l are both 2×2 matrices of coefficients, and all the other variables are defined as in Eq. (1).

Table 2
Correlation matrix. This table reports the Pearson correlation coefficients of the A and B twin-share portfolios with each other and with the four market indices (i.e., the Shanghai A-, Shanghai B-, Shenzhen A-, and Shenzhen B-share markets), where the null hypothesis is of no correlation.

Panel A. SSE-listed firms						
	SHA	SHB	SHAI	SHBI	SZAI	SZBI
SHA		0.5970	0.8581	0.5726	0.8788	0.5489
		<.0001	<.0001	<.0001	<.0001	<.0001
SHB	0.5970		0.5884	0.9819	0.5921	0.8030
	<.0001		<.0001	<.0001	<.0001	<.0001
Panel B. SZSE-listed firms						
	SZA	SZB	SHAI	SHBI	SZAI	SZBI
SZA		0.6275	0.8836	0.5502	0.9287	0.5884
		<.0001	<.0001	<.0001	<.0001	<.0001
SZB	0.6275		0.6010	0.8074	0.6109	0.9704
	<.0001		<.0001	<.0001	<.0001	<.0001

The order of VAR is determined by comparing the information criteria among model specifications with lag lengths ranging from 1 to 20 (i.e., from one day to one month). For a more precise specification, the Akaike information criterion (AIC) and the Schwarz Bayesian criterion (SBC) are considered jointly in this study. The statistics of the information criteria for model specifications with 1, 2, 3, 4, 5, 10, and 20 lags are reported in Table 3.

According to Table 3, the VAR with 1 lag seems to be the most appropriate identification for all three model specifications, suggesting that a large portion of innovations in one market are transmitted to another within two calendar days. Therefore, the order of VAR is chosen to be 1 throughout the study.

3.3. Stock price informativeness

In line with the literature (e.g., Chan and Hameed, 2006; Morck et al., 2000; Roll, 1988), this study uses the *R*-squared value from the regression of the CAPM to measure the departure of firm-specific stock movements from the market. Note that in the literature, many studies include industry returns in the regression (see, for example, Durnev et al., 2004; Gul et al., 2010; Roll, 1988). It is argued, however, that in studies that focus on emerging markets, the inclusion of industry returns in the regression as an additional independent variable might be problematic, because of the difficulties in disentangling the industry effect from the market and the fact that some industries are dominated by a few firms (e.g., Chan and Hameed, 2006). This study follows Chan and Hameed's approach.[3] In particular, the following model is estimated:

$$\left(R_{it}-R_t^{\mathrm{F}}\right)=\alpha+\beta\left(R_t^{\mathrm{M}}-R_t^{\mathrm{F}}\right)+\varepsilon_{it} \tag{4}$$

where R_{it} is the stock return for each individual firm at time t, that is, $R_{it}=\log\left(\frac{P_{it}}{P_{it-1}}\right)\times 100$; R_t^{M} is the corresponding market return at time t, that is, $R_t^{\mathrm{M}}=\log\left(\frac{P_t^{\mathrm{M}}}{P_{t-1}^{\mathrm{M}}}\right)\times 100$; R_t^F is the risk-free rate (China's monthly yield of the three-month household deposit interest rate) at time t; and β is the covariance of the market return with the portfolio return divided by the variance of the market return. The *R*-squared values from Eq. (4) are then used to measure the departure of firm-specific movements from the market. Specifically,

$$R^2=1-\frac{\sum\hat{\varepsilon}_t^2}{\sum\left[y_t-\overline{y}\right]^2} \tag{5}$$

[3] A similar measure is used by Doukas et al. (2011).

Table 3
Information criteria for different model specifications. This table reports the information criteria statistics for different model specifications with lag lengths ranging from 1 to 20 (i.e., from one day to one month). To obtain a more precise specification, the Akaike information criterion (AIC) and the Schwarz Bayesian criterion (SBC) are considered jointly in identifying the order of VAR.

	Order 1	Order 2	Order 3	Order 4	Order 5	Order 10	Order 20
Model specification 1							
AIC	−3.4465	−3.4325	−3.4463	−3.4281	−3.4025	−3.3068	−3.2769
SBC	−3.2737	−3.1059	−2.9658	−2.7937	−2.6141	−1.7464	−0.1646
Model specification 2							
AIC	0.1827	0.1834	0.1855	0.1927	0.2012	0.2196	0.1758
SBC	0.2307	0.2698	0.3104	0.3561	0.4031	0.6145	0.9587
Model specification 3							
AIC	−0.2549	−0.2540	−0.2578	−0.2565	−0.2490	−0.2193	−0.1950
SBC	−0.2069	−0.1675	−0.1329	−0.0931	−0.0470	0.1756	0.5879

This study uses panel regression to control for potential survivorship bias and omitted-variables problems. According to the Hausman specification test, the one-way random effects model is utilized. This means that, in general, the residual consists of two parts, that is, $\varepsilon_{it} = u_i + v_{it}$. For a more precise estimation, the error components model and generalized least squares (GLS) estimation are also applied. The standard errors in the regressions account for serial correlations and heteroskedasticity.

3.4. Multivariate regressions

To achieve a more direct assessment of the price correction effect, a series of multivariate regressions are conducted. In the regressions, the level of B-share discount is regressed on price informativeness, as well as a number of control variables that have been documented to have nontrivial influences on stock valuation or the B-share discount. To be consistent with the literature (e.g., Chakravarty et al., 1998; Chen et al., 2001; Karolyi, et al., 2009), the dependent variable, B-share discount, is computed as the difference between the closing A-share price and B-share price on a currency-adjusted basis divided by A-share price, i.e., $\mathrm{DIS} = (P_A - P_B)/P_A$. Specifically, the following model is estimated:

$$\begin{aligned}\mathrm{DIS}_{it} = {} & \lambda_0 + \lambda_1\left(\frac{\mathrm{INFO_B}}{\mathrm{INFO_A}}\right)_{it} + \lambda_2\left(\frac{\mathrm{SO_B}}{\mathrm{SO_{A+B}}}\right)_{it} + \lambda_3\left(\frac{\mathrm{VOL_B}}{\mathrm{VOL_{A+B}}}\right)_{it} + \lambda_4\left(\frac{\sigma_A}{\sigma_B}\right)_{it} + \lambda_5 \mathrm{GO}_{it} + \lambda_6 \mathrm{MOM}_{it} \\ & + \lambda_7 \mathrm{SIZE}_{it} + \lambda_8 \mathrm{BM}_{it} + \lambda_9 \mathrm{ROA}_{it} + \lambda_{10} \mathrm{LEV}_{it} + \lambda_{11} \mathrm{DEXCH}_{it} + \lambda_{12} \mathrm{DPOST}_{it} + \varepsilon_{it}\end{aligned} \tag{6}$$

where $\mathrm{INFO_B/INFO_A}$ is the relative price informativeness. Here, price informativeness measure is the inverse of price synchronicity, i.e., $\mathrm{INFO_A} = 1/\mathrm{SYNCH_A}$ and $\mathrm{INFO_B} = 1/\mathrm{SYNCH_B}$. Intuitively, the lower the price synchronicity, the more informative the stock prices are. Following the literature (e.g., Chan and Hameed, 2006; Durnev et al., 2004; Morck et al., 2000), we measure price synchronicity as $\mathrm{SYNCH_A} = \mathrm{Log}\left(\frac{R_A^2}{1-R_A^2}\right)$ and $\mathrm{SYNCH_B} = \mathrm{Log}\left(\frac{R_B^2}{1-R_B^2}\right)$. Logistic transformation is utilized because the *R*-squared value is undesirable for regression purposes (it is bounded between 0 and 1). In addition, the transformed variable possesses some useful features. That is, $\mathrm{SYNCH} = \mathrm{Log}\left(\frac{R^2}{1-R^2}\right) = \mathrm{Log}\left(\frac{\sigma_m^2}{\sigma_\varepsilon^2}\right) = \mathrm{Log}(\sigma_m^2) - \mathrm{Log}(\sigma_\varepsilon^2)$. A higher value of SYNCH indicates a greater power of market-wide variation, σ_m^2, relative to firm-specific variation, σ_ε^2, in explaining stock performance. Therefore, if the price correction hypothesis is valid, then we should observe a significant positive relationship between relative price informativeness and the B-share discount.

Here $\mathrm{SO_B/SO_{A+B}}$ is the ratio of B shares outstanding to total shares outstanding. It is argued that the excessive demand in the A-share market (or relatively low demand in the B-share market) might have elevated the A-share prices beyond a rational level (e.g., Bailey and Jagtiani, 1994; Fernald and Rogers, 2002; Sun and Tong, 2000). In line with previous studies (e.g., Chen et al., 2001; Karolyi, et al., 2009), we

use the ratio of B shares outstanding to total shares outstanding as a proxy for relative demand conditions. If the differential demand hypothesis is valid, then the coefficient estimate on this term should be negative and significant. In equilibrium, however, the distinction between measures of supply and demand may not be very clear. If the number of shares outstanding is determined mainly by the supply of shares by firms rather than demand by investors, then we may observe a positive coefficient estimate.

Moreover, previous studies also attribute the price disparity to the B shares' lack of liquidity (e.g., Chen et al., 2001; Chen and Xiong, 2001). To be consistent with the literature (e.g., Chen et al., 2001; Karolyi, et al., 2009), we use the ratio of B-share trading volume to total trading volume,VOL_B/VOL_{A+B}, as a proxy for relative liquidity. If the differential liquidity hypothesis is valid, then the coefficient estimate on this term should be negative and significant.

In addition, Ma (1996) and Mei et al. (2003) argue that the speculative behavior of Chinese domestic investors plays an important role in explaining the observed B-share discount (or A-share premium). Following previous studies (e.g., Chen et al., 2001; Karolyi, et al., 2009), we use relative return volatility, σ_A/σ_B, to capture the speculative behavior of domestic versus foreign investors. If the differential risk hypothesis holds, then the coefficient estimate on the relative volatility term should be positive and significant.

Besides, recent studies find that government ownership (e.g., Hou and Lee, 2011; Karolyi, et al., 2009) and the momentum effect in the A-share market (Karolyi and Li, 2003) have a significant impact on the dynamics of B-share discount. Therefore, we further control for government ownership and the momentum effect, where government ownership, *GO*, is measured as the percentage of common shares owned by the state (e.g., Wang and Yung, 2011), and the momentum effect, *MOM*, is computed as the cumulative A-share returns over the preceding month (e.g., Karolyi and Li, 2003).

Additional control variables include firm size, *SIZE*, calculated as the natural log of total market capitalization of the firm; the book-to-market ratio, *BM*, measured as the difference between total assets and total liabilities, divided by the stock market capitalization of the firm; the return on assets ratio, ROA, computed as EBXI (i.e., earnings before extraordinary items and discontinued operations) divided by total assets; the leverage (debt-to-equity) ratio, LEV; an exchange dummy, DEXCH, where 1 stands for SSE-listed firms and 0 stands for SZSE-listed firms; and a post-liberalization dummy, DPOSTL, where 1 stands for post-liberalization period and 0 otherwise. The book-to-market ratio, return on assets ratio, and leverage ratio are included in the model to account for growth opportunities, profitability, and the impact of capital structure, respectively. To address potential industry effects, all regressions are conducted within each industry category.

The control variables are chosen based on previous studies, data availability, and the nature of this study. Both the correlation test and the VIF statistics suggest that the concern about multicollinearity among the independent variables does not appear to be warranted. Note that monthly data is utilized in multivariate regressions.

4. Empirical results

Table 4 reports the VAR estimates based on three different model specifications, where Panel A focuses on the pre-market-liberalization period and Panel B focuses on the post-market-liberalization period. Overall, the empirical results generated from different model specifications are highly consistent, suggesting that the models are well specified.

Panel A of Table 4 reports the regression results of the VAR systems during the pre-market-liberalization period. As columns 1–4 indicate, there is a significant dependence of A-share returns upon the past movements of their B-share counterparts prior to market liberalization, especially for the SSE-listed firms. Additionally, the past returns of Shenzhen B shares tend to have some predictive power on their own future returns. In terms of market returns, the Shenzhen B-share market appears to play a significant leading role in predicting individual stock returns (column 8 of Panel A). Overall, the results suggest that, under perfect market segmentation, the information tends to flow from foreign B-share market to domestic A-share market and that foreign investors are better informed than Chinese domestic investors (hypothesis H1a is supported). While Panel A documents significant Granger causality between the twin-share portfolios, an inconsistency has to be noted. The signs of some coefficient estimates are negative. Technically speaking, the signs of coefficient estimates in simultaneous equation systems are

Table 4
Lead–lag relation between A and B markets.
This table reports the VAR estimates based on the following different model specifications, where Panel A focuses on the pre-market-liberalization period and Panel B focuses on the post-market-liberalization period.

$$Model\ 1\ \begin{bmatrix} SHA_t \\ SHB_t \\ SZA_t \\ SZB_t \end{bmatrix} = A_0 + \sum_{k=1}^{K} A_k \begin{bmatrix} SHA_{t-k} \\ SHB_{t-k} \\ SZA_{t-k} \\ SZB_{t-k} \end{bmatrix} + \sum_{l=1}^{L} B_l \begin{bmatrix} SHAI_{t-l} \\ SHBI_{t-l} \\ SZAI_{t-l} \\ SZBI_{t-l} \end{bmatrix} + \begin{bmatrix} \varepsilon_{SHA,t} \\ \varepsilon_{SHB,t} \\ \varepsilon_{SZA,t} \\ \varepsilon_{SZB,t} \end{bmatrix}$$

$$Model\ 2 \begin{bmatrix} SHA_t \\ SHB_t \end{bmatrix} = A_0 + \sum_{k=1}^{K} A_k \begin{bmatrix} SHA_{t-k} \\ SHB_{t-k} \end{bmatrix} + \sum_{l=1}^{L} B_l \begin{bmatrix} SHAI_{t-l} \\ SHBI_{t-l} \end{bmatrix} + \begin{bmatrix} \varepsilon_{SHA,t} \\ \varepsilon_{SHB,t} \end{bmatrix}$$

$$Model\ 3 \begin{bmatrix} SZA_t \\ SZB_t \end{bmatrix} = A_0 + \sum_{k=1}^{K} A_k \begin{bmatrix} SZA_{t-k} \\ SZB_{t-k} \end{bmatrix} + \sum_{l=1}^{L} B_l \begin{bmatrix} SZAI_{t-l} \\ SZBI_{t-l} \end{bmatrix} + \begin{bmatrix} \varepsilon_{SZA,t} \\ \varepsilon_{SZB,t} \end{bmatrix}$$

where SHA_t and SHB_t SSE-listed twin-share portfolio returns at time t, and SZA_t and SZB_t are the SZSE-listed twin-share portfolio returns at time t. Note that the SSE-listed twin-share portfolios include 26 A- and B-share dual-listed firms, and the SZSE-listed twin-share portfolios include 27 A- and B-share dual-listed firms. The variables $SHAI_t$, $SHBI_t$, $SZAI_t$, and $SZBI_t$ are the corresponding market returns at time t. Here, A_0 is a 4×1 column vector in Model 1 and a 2×1 column vector in Models 2 and 3, A_k and B_l are 4×4 matrices of coefficients in Model 1 and 2×2 matrices of coefficients in Models 2 and 3. The parameter k is the number of lagged endogenous variables and l is the number of lagged exogenous variables. According to AIC and SBC criteria, a lag length of 1 is chosen for all three model specifications. The t-values are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Panel A. Pre-market-liberalization period (October 1, 1997–February 18, 2001)

	SHA (t−1)	SHB (t−1)	SZA (t−1)	SZB (t−1)	SHAI (t−1)	SHBI (t−1)	SZAI (t−1)	SZBI (t−1)
Model specification 1								
SHA	0.0147	−0.2034*			−0.0285	0.1553	0.0239	0.2551**
	(0.17)	(−1.82)			(−0.15)	(1.39)	(0.13)	(2.08)
SHB	0.0631	−0.0329			−0.5971*	0.0939	0.4281	0.1759
	(0.45)	(−0.18)			(−1.96)	(0.51)	(1.44)	(0.87)
SZA			0.0344	−0.1819	−0.1227	0.0012	0.0605	0.2299*
			(0.32)	(−1.40)	(−0.63)	(0.01)	(0.32)	(1.79)
SZB			0.0549	−0.3981**	−0.5709**	0.0554	0.3454	0.4943***
			(0.36)	(−2.17)	(−2.09)	(0.33)	(1.30)	(2.73)
Model specification 2								
SHA	−0.0031	−0.2060*			0.0462	0.2049*		
	(−0.04)	(−1.85)			(0.49)	(1.86)		
SHB	0.0075	−0.0386			−0.1099	0.1863		
	(0.05)	(−0.21)			(−0.71)	(1.03)		
Model Specification 3								
SZA			0.0503	−0.1996			−0.0518	0.2112*
			(0.48)	(−1.55)			(−0.44)	(1.67)
SZB			0.0382	−0.3873**			−0.1206	0.5395***
			(0.26)	(−2.12)			(−0.73)	(3.01)

Panel B. Post-market-liberalization period (November 6, 2002–September 30, 2007)

	SHA (t−1)	SHB (t−1)	SZA (t−1)	SZB (t−1)	SHAI (t−1)	SHBI (t−1)	SZAI (t−1)	SZBI (t−1)
Model specification 1								
SHA	0.1662**	−0.1043			−0.3084***	0.1645	0.2897**	−0.0786
	(2.44)	(−0.81)			(−3.01)	(1.26)	(2.08)	(−0.75)
SHB	0.0427	0.0270			−0.4037***	0.2520*	0.2060	−0.0154
	(0.57)	(0.19)			(−3.61)	(1.76)	(1.35)	(−0.14)
SZA			−0.0301	0.0142	−0.2094**	0.2035	0.1755	−0.0491
			(−0.33)	(0.13)	(−2.17)	(1.64)	(1.33)	(−0.50)
SZB			−0.1557	0.1010	−0.1902*	0.1672	0.1471	−0.0113
			(−1.59)	(0.90)	(−1.85)	(1.27)	(1.05)	(−0.11)
Model specification 2								
SHA	0.2285***	−0.1256			−0.1938***	0.1648		
	(4.12)	(−0.98)			(−2.93)	(1.30)		

(*continued on next page*)

Table 4 (*continued*)

Panel B. Post-market-liberalization period (November 6, 2002–September 30, 2007)								
	SHA (t−1)	SHB (t−1)	SZA (t−1)	SZB (t−1)	SHAI (t−1)	SHBI (t−1)	SZAI (t−1)	SZBI (t−1)
SHB	0.0396	0.0317			−0.3476***	0.2770**		
	(0.65)	(0.23)			(−4.81)	(2.00)		
Model specification 3								
SZA			−0.0326	0.0584			0.1189	−0.0670
			(−0.36)	(0.57)			(1.35)	(−0.70)
SZB			−0.1796*	0.1613			0.0904	−0.0144
			(−1.88)	(1.47)			(0.96)	(−0.14)

hard to interpret because of the multidimensional, simultaneous impacts among exogenous variables. Conceptually, a possible explanation of the observed negative coefficient estimates is that Chinese A-share investors tend to overreact initially to movements in the B-share market and self-correct the following day. We should note here that the contemporaneous impact is not reflected in the VAR systems but in the correlation matrix in Table 2.

Panel B of Table 4 reports the regression results of the VAR systems during the post–market-liberalization period. In line with hypothesis H3, which predicts a decreased level of information asymmetry upon market liberalization, we find no significant lead–lag relation between the A and B twin-share portfolios on either the SSE or the SZSE during this period (columns 1–4). Moreover, we find that the past returns of Shanghai A shares tend to lead their own stock movements and that Shanghai A-share index returns have a significant explanatory power for the price movements of individual stocks during the post-liberalization period. The results suggest that the Shanghai A-share market becomes more influential after market liberalization due to the active role played by foreign institutional investors. One possible explanation for the differential impact on Shanghai and Shenzhen markets is that the large-cap former state-owned enterprises primarily listed on the Shanghai exchange might have attracted more foreign institutional investors as opposed to the Shenzhen exchange, which features more small-cap, joint venture companies. Note that the signs of the coefficient estimates on the Shanghai A-share index are negative in all models. Again, the signs of coefficient estimates in VAR systems have little explanatory power due to the multidimensional, simultaneous impacts among exogenous variables. Intuitively, one possible interpretation is that investors tend to overreact initially to the movements on the A-share market, which is followed by a self-correction process. Overall, a close comparison between Panel A and Panel B indicates a reduced level of lead–lag interdependence between the two markets, suggesting that information asymmetry between foreign and domestic investors has been mitigated to a large extent since the structural segmentation was abrogated in China. In other words, investors in one market are now able to absorb information generated in the other market more quickly than before.

Fig. 4 plots the stock movements of the A and B twin-share portfolios over time. As can be seen, there is a significant interrelation between local A and foreign B shares that are issued by the same firms. The figures also indicate an increasing degree of contemporaneous cross-market synchronicity and a decreasing degree of lead–lag impact upon market liberalization. These findings suggest a reduced level of cross-market diversification benefits and improved market efficiency under increased market integration.

Table 5 reports the stock price synchronicity of the twin-share portfolios, sorted by exchange listing and time period of estimation. Following the literature (e.g., Chan and Hameed, 2006; Morck et al., 2000; Roll, 1988), we use the *R*-squared value from the regression of the CAPM to measure the departure of firm-specific stock movements from the market. Note that a high *R*-squared value in such a regression indicates a high degree of stock price synchronicity, suggesting that the market return (as opposed to firm-specific information) explains a large portion of variation in individual stock movements. Recall that hypothesis H1b predicts that foreign B shares are more informative (less synchronous) than their A share counterparts. This implies that the *R*-squared value should be lower among B shares than A shares, i.e., $R_B^2 < R_A^2$.

According to columns 1 and 2 of Table 5, the *R*-squared values are much lower among foreign B shares than among local A shares prior to market liberalization reforms (0.14 relative to 0.30 for SSE-listed firms, and 0.12 relative to 0.34 for SZSE-listed firms), suggesting that foreign B shares are more informative than

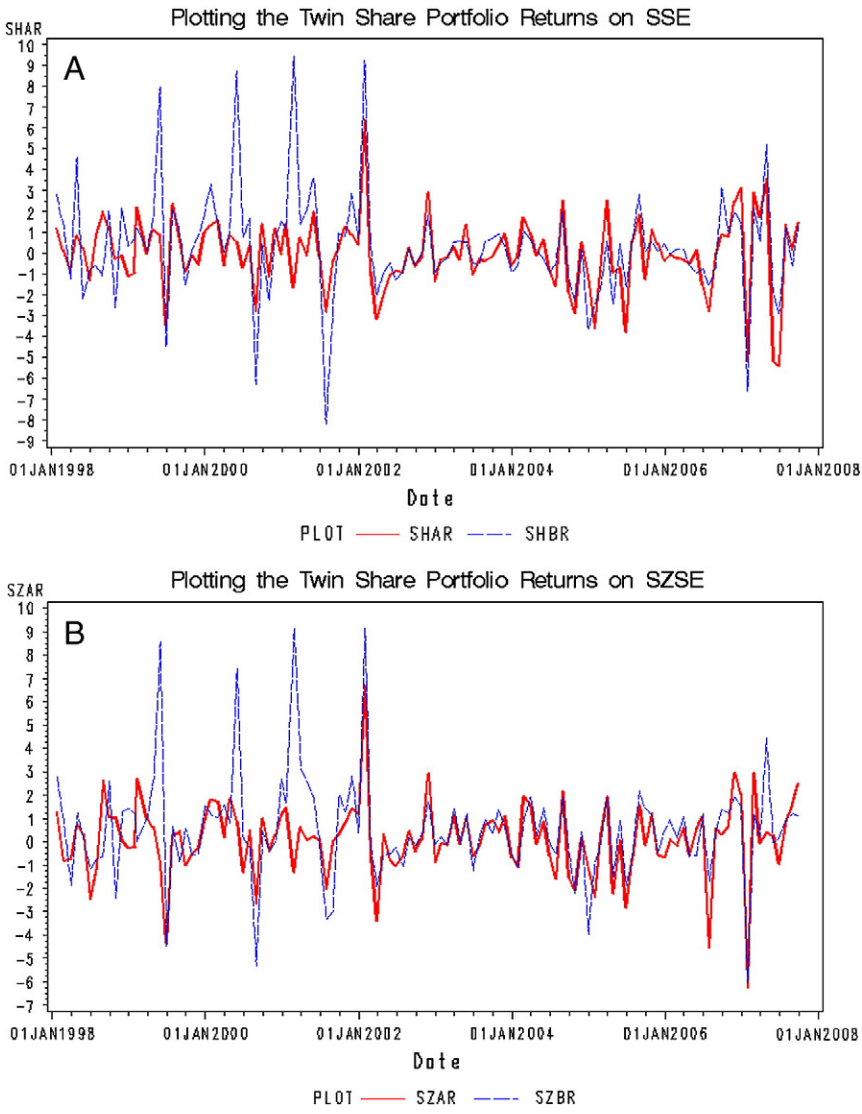

Fig. 4. The twin-share portfolio returns. These figures plot the stock returns of the twin-share portfolios over the sample period from October 1997 to September 2007. The estimation period spans the two regulatory reforms (i.e., the opening of the foreign B-share market to Chinese domestic investors on February 19, 2001 and the opening of the local A-share market to qualified foreign institutional investors on November 5, 2002).

their A-share counterparts under perfect market segmentation. In addition, hypothesis H2 predicts a positive relation between the magnitude of the B-share discount and the capitalization of firm-specific information. As Table 1 shows, the price disparity between the two classes of stocks declines dramatically after the regulatory reforms (decreases from 9.86 to 3.80 for SSE-listed firms and drops from 8.94 to 2.93 for SZSE-listed firms). In the meantime, the divergence in price synchronicity also shrinks substantially upon the completion of liberalization reforms (the mean difference of the *R*-squared values declines from 0.16 to 0.05 for SSE-listed firms and drops from 0.22 to 0.001 for SZSE-listed firms).

Consistent with hypothesis H3, which predicts a mitigated degree of information asymmetry across the two markets, we find a clear convergence in regression *R*-squared values between the two classes of

Table 5
Price informativeness of A and B shares. This table reports the stock price synchronicity of the twin-share portfolios over the sample period from October 1997 to September 2007. For a more rigorous analysis, the regression is conducted contingent upon the choice of exchange listings (SSE or SZSE) and the two regulatory reforms (i.e., the opening of the foreign B-share market to Chinese domestic investors in 2001 and the opening of the local A-share market to qualified foreign institutional investors in 2002). Following the literature, the price synchronicity is measured by the R-squared value from the capital asset pricing model, i.e., $(R_{it}-R_t^F)=\alpha+\beta(R_t^M-R_t^F)+\varepsilon_{it}$, where $R_{it}$is the individual stock return at time t,R_t^M is the corresponding market return at time t, and $R_t^F$is the risk-free rate at time t. The t-values are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Panel A. SSE-listed firms (26 firms)

	Pre-market-liberalization		Market restructuring period		Post-market-liberalization	
	A-share portfolio	B-share portfolio	A-share portfolio	B-share portfolio	A-share portfolio	B-share portfolio
α Estimate	0.046	−0.129*	0.294*	0.401*	−0.107*	−0.101*
	(1.50)	(−2.76)	(10.41)	(10.43)	(−4.38)	(−4.88)
β Estimate	1.021*	0.932*	1.151*	1.127*	1.008*	0.994*
	(92.1)	(55.7)	(99.7)	(71.6)	(87.3)	(101.2)
R-squared	0.304	0.137	0.482	0.324	0.225	0.281

Panel B. SZSE-listed firms (27 firms)

	Pre-market-liberalization		Market restructuring period		Post-market-liberalization	
	A-share portfolio	B-share portfolio	A-share portfolio	B-share portfolio	A-share portfolio	B-share portfolio
α Estimate	0.018	−0.509***	0.136***	0.533***	0.071***	−0.022
	(0.64)	(−11.66)	(5.18)	(13.30)	(3.05)	(−1.02)
β Estimate	1.023***	0.810***	1.070***	1.191***	1.083***	1.003***
	(100.8)	(52.7)	(102.5)	(74.8)	(100.9)	(101.2)
R-squared	0.335	0.121	0.486	0.335	0.273	0.274

shares upon market liberalization. This is due to both a dramatic decline in price synchronicity among local A shares (the *R*-squared value decreases from 0.30 to 0.23 for SSE-listed firms and falls from 0.34 to 0.27 for SZSE-listed firms) and an increased co-movement among foreign B shares (the *R*-squared value increases from 0.14 to 0.28 for SSE-listed firms and rises from 0.12 to 0.27 for SZSE-listed firms). The reduced price synchronicity among local A shares indicates an increased information transparency after the opening of the local A-share market to foreign investors. The increased price synchronicity among B shares can be well explained within our uninformed domestic investor framework. The idea is that if Chinese investors are accustomed to trading on market-level information, then more market-wide (less firm-specific) information should be incorporated into B-share prices once Chinese investors are allowed to trade in the B-share market, regardless of whether credible firm-level information is available or not.

Table 6 presents the regression results from multivariate regressions, where columns 1–2 focus on the full sample period, columns 3–4 report results for the pre-liberalization period, and columns 5–6 report results for the post-liberalization period. Consistent with the price correction hypothesis, the coefficient estimate on relative price informativeness,$INFO_B/INFO_A$, is positive and significant across all model specifications. As can be seen, both the significance level and the positive sign of the coefficient estimate on relative price informativeness remain unchanged after controlling for differential demand conditions, liquidity, level of risk, government ownership, and the momentum effect. In conjunction with the results in Tables 4 and 5, the evidence leads to conclude that the price correction effect explains a large portion of the B-share discount. This result is robust even after controlling for other alternative explanations.

In terms of control variables, we find that firm size, book-to-market ratio, return on assets all have a negative impact on the B-share discount, suggesting that larger firms, firms with better growth opportunities, and more profitable firms tend to experience less foreign share discount. In addition, we find that SSE-listed firms tend to face larger B-share discount than SZSE-listed firms. Consistent with hypothesis *H3*, the coefficient estimate on the post-liberalization dummy is negative and significant, indicating a mitigated degree of B-share discount upon market liberalization. In line with the differential demand hypothesis, the coefficient estimate on relative shares outstanding, SO_B/SO_{A+B}, is positive and significant in all models, suggesting that the relatively high demand in the A-share market plays a nontrivial role in interpreting the B-share discount, and that the number of shares outstanding is

Table 6
Multivariate regressions. This table reports the results from multivariate regressions. The dependent variable, B-share discount, is computed as the difference between the closing A-share price and currency-adjusted B-share price divided by A-share price, i.e., $DIS = (P_A - P_B)/P_A$. The independent variables include relative price informativeness, $INFO_B/INFO_A$, relative shares outstanding, SO_B/SO_{A+B}, relative trading volume, VOL_B/VOL_{A+B}, relative volatility, σ_A/σ_B, government ownership, *GO*, the momentum factor, *MOM*, firm size, *SIZE*, the book-to-market ratio, *BM*, the return on assets ratio, *ROA*, the leverage (debt-to-equity) ratio, *LEV*, an exchange dummy, *DEXCH*, and a post-liberalization dummy, *DPOSTL*. To address potential industry effects, all regressions are conducted within each industry category. The *t*-values are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

	Full sample period (Oct. 1997–Sept. 2007)		Pre-market liberalization (Oct. 1997–Jan. 2001)		Post-market liberalization (Dec. 2002–Sept. 2007)	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Intercept	1.687***	1.257***	1.412***	1.275***	1.388***	1.064***
	(34.79)	(27.67)	(32.65)	(29.91)	(30.07)	(22.99)
INFOA/INFOB	0.045***	0.027***	0.023***	0.016***	0.051***	0.030***
	(14.83)	(9.60)	(9.98)	(7.01)	(15.22)	(9.48)
SOB/SO(A + B)		0.460***		0.139***		0.342***
		(30.06)		(11.15)		(18.89)
VOLB/ VOL(A + B)		−0.273***		−0.046***		−0.036***
		(−27.24)		(−5.34)		(−2.60)
σA/σB		0.019		−0.028		0.074**
		(0.76)		(−1.43)		(2.57)
GO		0.068***		0.047***		0.097***
		(7.72)		(6.57)		(9.42)
MOM		0.001***		0.0002		0.0004**
		(5.05)		(1.63)		(2.25)
SIZE	−0.067***	−0.052***	−0.039***	−0.035***	−0.062***	−0.057***
	(−21.53)	(−17.94)	(−14.10)	(−12.29)	(−20.35)	(−20.22)
BM	−0.0002***	−0.0001***	−0.0001***	−0.00005***	−0.0002***	−0.0002***
	(−13.39)	(−9.70)	(−7.10)	(−3.19)	(−20.37)	(−14.51)
ROA	−0.211***	−0.193***	−0.271***	−0.237***	−0.092***	−0.081***
	(−7.26)	(−7.10)	(−9.98)	(−9.08)	(−3.00)	(−2.71)
LEV	0.0002	−0.0002	0.0029***	0.0022**	0.0004**	0.0001
	(0.89)	(−0.81)	(2.75)	(2.10)	(2.17)	(0.83)
DEXCH	0.047***	0.008	0.041***	0.026***	0.085***	0.022***
	(10.13)	(1.54)	(12.02)	(6.13)	(16.18)	(3.55)
DPOSTL	−0.198***	−0.210***				
	(−40.49)	(−47.96)				
R-squared	0.391	0.523	0.385	0.474	0.353	0.464

determined mainly by supply of shares by firms in China. Consistent with the findings of Chen et al. (2001) and Chen and Xiong (2001), the coefficient estimate on relative trading volume, VOL_B/VOL_{A+B}, is negative and significant in all models, suggesting that the B-share discount can be attributed largely to the lack of liquidity in the B-share market. While the coefficient estimates on both relative volatility, σ_A/σ_B, and the momentum factor, MOM, have expected positive signs, they are significant only during the post-liberalization period, suggesting that the excess risk and the momentum effect in the A-share market are more likely to affect the B-share discount in a more integrated capital market world. Moreover, we find a positive relationship between government ownership and the B-share discount, suggesting that foreign investors tend to discount firms with high government ownership concentration.

5. Concluding remarks

This study addresses the information asymmetry between the Chinese local A-share and foreign B-share markets and its impact on the B-share discount puzzle, contingent upon the regulatory reforms of Chinese stock market liberalization in 2001 and 2002. In contrast with the widespread belief that domestic investors are better informed than foreign investors, B-share investors are found to be more efficient in collecting and processing value-relevant, firm-specific information in an emerging environment such as China, where information transparency and investor protection are relatively weak. In particular, we find that under perfect market segmentation, the information tends to flow from foreign to domestic investors

and that foreign B shares are generally more informative than their A-share counterparts. As such, the observed B-share discount is not compensation for the informational disadvantage of foreign investors but, rather, the result of a downward price correction (toward the fundamental values) once more firm-specific information is capitalized by sophisticated foreign B-share investors. Moreover, the empirical evidence indicates that the price correction effect is significant even after controlling for other alternative explanations. Further investigation suggests a mitigated degree of information asymmetry and B-share discount upon market liberalization.

Despite the interesting findings, some caveats should be noted. While this study offers an alternative explanation for the Chinese B-share discount puzzle, we do not try to rule out other possible interpretations documented in the literature. Rather, our empirical findings are fairly consistent with the differential demand hypothesis (e.g., Bailey and Jagtiani, 1994; Fernald and Rogers, 2002; Sun and Tong, 2000), the liquidity hypothesis (e.g., Chen et al., 2001; Chen and Xiong, 2001), and the government ownership hypothesis (e.g., Hou and Lee, 2011; Karolyi, et al., 2009), suggesting that the relatively high demand in the A-share market, the B-share's lack of liquidity, and political risk play a nontrivial role in explaining the B-share discount puzzle. In addition, we find supportive evidence for the speculative behavior hypothesis (e.g., Ma, 1996; Mei et al., 2003) and the momentum hypothesis (e.g., Karolyi and Li, 2003) during the post-liberalization period, implying that excess risk and the momentum effect in the A-share market are more likely to be behind the B-share discount in a more integrated market.

Overall, this study offers several new insights into the literature. First, it challenges the prevailing view that domestic investors are better informed than foreign investors. While an earlier study by Yang (2003) has largely questioned the informed domestic investor hypothesis in China, this study goes beyond Yang (2003) and indicates that the results are robust using different information asymmetry measures even after controlling for other factors. Second, this study provides additional clarity in the development of information asymmetry measures. In particular, we find that the conflicting results that have been plaguing the literature are mainly a result of various information asymmetry measures utilized by different researchers. Because unwarranted quantifications of inputs inevitably result in misleading results, more robust and consistent measures of information asymmetry have to be developed and utilized. Our study introduces a more direct and robust measure, i.e., the price informativeness. Finally, while the issues of information asymmetry and the Chinese foreign share discount puzzle have stimulated considerable research interest, there is limited evidence on the impact of market liberalization on the dynamics of information environment, and the second liberalization reform (i.e., the opening of the domestic A-share market) is largely ignored in the extant literature. The present paper also bridges this gap.

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