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Are foreign IPOs really foreign? Price efficiency and information asymmetry of Chinese foreign IPOs

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ABSTRACT

We investigate the informational risk and price efficiency of Chinese firms undertaking a foreign IPO on the Hong Kong stock exchange between 1996 and 2012. Specifically, using intraday tick data, we examine the spreads, asymmetric information component of the bid-ask spread, autocorrelations of intraday returns, variance ratios and return predictability of the order flow for foreign IPO firms. We contrast these measures against those of comparable IPO firms on both the Chinese stock exchanges and the Hong Kong stock exchange matched based on the year of IPO, industry and firm size. We find that while the foreign IPO firms largely operate in China, they are generally perceived as having a similar level of information asymmetry and price efficiency as Hong Kong IPO firms. In contrast, IPOs on the Chinese exchanges have much higher proportions of information asymmetry in their spreads and lower price efficiency than foreign IPO firms. Our findings are generally robust to the use of the Heckman two-stage procedure that controls for potential self-selection bias. Our results provide further evidence that it is the location of trading that is important for pricing of firms rather than the location of their business.

1. Introduction

Financial markets have become increasing integrated over the past few decades, giving firms access to a greater pool of capital outside their own geographic borders. As a result, firms going public for the first time can choose to list their shares: on their home stock market, simultaneously on their home and a foreign market, or finally on a foreign market. The latter option, known as a foreign IPO, is an interesting and relatively new trend in capital raising (Bruner et al., 2004). For example, Samsonite International, founded in Canada and headquartered in Luxembourg, raised US$ 1.25 billion through its Hong Kong initial public offering in 2011. Caglio et al. (2013), studying a comprehensive sample of 17,808 IPOs from 90 countries between 1995 and 2007, report that while foreign IPOs make up only 6% of their initial public offering sample, they represent approximately 25% of total IPO proceeds, close to half a trillion US dollars.

Foreign IPOs represent a curious situation for investors and firms alike. Specifically, these are foreign domiciled firms, and in most cases are primarily subject to the economic conditions and corporate norms within their home country, which have chosen to bind themselves to the listing and disclosure rules of a foreign market. The uncertain nature of IPO firms, which generally possess limited public historical records, is compounded for foreign IPOs as investors are likely to be less familiar with these companies' local operations, and so investors face serious challenges in evaluating the prospects of these firms. Generally, there are two possible outcomes from an investor's perspective: the foreign IPO firm will be considered to retain the informational and economic risks of its home market or alternatively the decision to bind the firm to foreign rules acts as a strong signal of reduced information risk in the company and so investors will treat the foreign IPOs more like domestic IPOs (Seigel, 2005).

In this paper, using a sample of foreign IPOs of Chinese companies on the Hong Kong stock exchange, we investigate whether the choice of listing location has any impact on trading behavior, risk and the information environment for foreign IPO firms compared to those firms that list their shares for the first time solely in either their home market (Chinese A Shares) or the host market (Hong Kong).

China provides an interesting case to explore given its substantial economic growth and the need of local firms to raise equity capital. In the past two decades, an increasing number of Chinese firms have opted to raise capital in overseas markets, either through a domestic IPO and subsequent cross-listing or a foreign

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initial public offering, the preferred method of international capital raising. For example, Zhang and King (2010) report that in their sample of Chinese firms going abroad between 1993 and 2005, there were only 33 Chinese firms that listed first in China and then listed in the US using American Depository Receipts versus 218 foreign IPOs in the US, Singapore and Hong Kong. We study foreign IPOs on the Hong Kong stock exchange as this is the most popular choice for Chinese firms seeking to list abroad due to geographical preferences, the cost of offering and the lack of language barriers (Yang and Lau, 2006).

Our study contributes to the literature related to the choice of listing location, trading activities and incorporation of information into stock prices. Froot and Dabora (1999) demonstrate that the location of trading has an impact on pricing. They document that for the Siamese twin companies, whose charter fixes the division of cash flows to each of the two companies, their relative prices are more correlated with the stock market index of the country where they are actively traded. Lau and McInish (2003) further report that individual firm's trading volume is closely related to the market where these stocks are traded, and firms that switch their primary listing locations can expect the trading characteristics of their shares to become more similar to those of the new market. Chan et al. (2003) study the case of the Hong Kong based Jardine company and find that the share price of this company, after delisting from Hong Kong and moving its trading to Singapore, correlate less (more) with the Hong Kong (Singapore) market, despite the fact that their main business location remains in Hong Kong. While these studies provide evidence that the location of trade matters for the incorporation of information and pricing of stocks of companies when firm change their location of trading, the question remains whether the same is true for foreign IPOs. Specifically, these firms have no listing history and, in the case of Chinese IPOs, are listing their shares in a more advanced stock market, namely Hong Kong.

We explore how the choice of listing location by Chinese firms affects their trading, risk and information environment. In these respects, our paper differs markedly from the existing studies in the field of foreign IPOs (e.g., Blass and Yafeh, 2001; Bruner et al., 2004; Valero et al., 2009; Huang and Song, 2005 and Zhang and King, 2010). Specifically, we investigate how our sample of foreign IPOs is perceived by investors in the foreign market and whether they are treated differently from comparable IPO firms that list for the first time in either Hong Kong or China. Of particular interest is to observe whether such a Chinese firm is treated as being of greater risk than a purely Hong Kong firm as a result of coming from a less well regulated and highly protected country. We use high frequency transaction data, and compare and contrast the transaction costs and the asymmetric information component of the bid-ask spread of foreign IPOs. We also test the weak-form efficiency (referred hereafter as informational efficiency) of foreign IPO firms using common methodologies such as the autocorrelation of intraday returns, variance ratio tests and the Chordia et al. (2002) measure of return predictability from order flow. To deal with potential self-selection issues that are endemic in the cross-listing and foreign IPO literature, we employ matched samples of comparable IPOs in Hong Kong and China based on the year of the IPO industry, size, price and book to market, to find the closest possible match.[1] Additionally, we also employ the Heckman treatment model as a robustness check.

Our empirical findings indicate that the Chinese foreign IPO firms have similar levels of information asymmetry compared to the sample of Hong Kong based firms. We also observe that the Chinese foreign IPO firms have very similar levels of informational efficiency. Putting these findings together, we can assert, from an informational point of view, investors in the Hong Kong market treat Chinese firms listed for the first time in Hong Kong as if the latter was their home market. In contrast, foreign IPO firms have consistently lower information asymmetry and better information efficiency than comparable matched Chinese IPO firms. Our findings provide strong evidence that the location of trading matters for Chinese foreign IPOs. On the whole, our empirical evidence may provide some support to the legal bonding hypothesis, whereby firms list in countries with stronger investor protection laws as a way of convincing investors that they are well governed and run (Stulz, 1999; Pagano et al., 2002). Binding themselves under the stricter legal regime is a costly signal that these firms are committed to having better disclosure and governance than their home market peers. Our findings are largely consistent with those observed in a recent study by Cetorelli and Peristiani (2010) who report that cross-listing in a prestigious market enhances a firm's visibility, strengthens corporate governance, and lowers informational frictions.

The remainder of this paper is organized as follows. The methodology and data are discussed in Sections 2 and 3, respectively. The empirical results are reported and discussed in Section 4. We conclude this paper in Section 5.

2. Methodology

We first investigate how the choice of listing location by Chinese foreign IPO firms affects their trading, perceived risk and information using univariate analysis of the transaction costs, the asymmetric information component of the bid-ask spread, and the informational efficiency of the pricing. Next, we conduct multivariate regressions, employing measures of various firm level characteristics to control for other possible explanations for the potential differences observed.

2.1. Transaction costs and information asymmetry

To examine the transaction costs and the level of information asymmetry within the firms, we examine four spread based measures. We first examine two simple measures of total spread, the average percentage spread, defined as the difference between ask and bid prices divided by the midpoint of the spreads and the average effective spread, defined as:

$$ES = 2 * \left| \frac{p_t - m_t}{p_t} \right| \tag{1}$$

where p_t is the traded price and m_t is the midpoint of the prevailing bid and ask spreads at the time of the trade. The primary difference between the percentage and effective spreads is that the effective spread allows for trades to occur at prices either inside or outside of the quoted bid and ask prices. In both cases, we compute the percentage and effective spreads at the time each trade occurs and then compute the average over the entire 12 month sample period following their IPO listing.

Many of the microstructure models of spreads (such as Glosten and Milgrom, 1985 and Huang and Stoll, 1994) view spreads as composed of the compensation for various risks faced by liquidity providers, specifically inventory holding and order processing costs and information asymmetry. As a result, transaction cost based measures do not allow us to directly observe the impact of the information environment on the spreads. To isolate the impact of information asymmetry, we employ two spread decomposition

[1] While we have gone to considerable effort to find the closest possible matched firms, as we show later, there are some significant differences between our foreign IPO sample and the samples of Hong Kong and Chinese domestic IPOs. Therefore, our results need to be interpreted with some caution.

models, specifically the Lin et al. (1995) and Madhavan et al. (1997) models. The cost of information asymmetry, a measure of the quality of the information environment, represents the compensation that market makers price into the spread for the cost of trading against a better informed counterparty, or put differently the risk of unpriced information.

Specifically, the models argue that informed trades can be identified by the impact that they have on prices. The arrival of new information, via the order flow, will change the markets view of the fundamental value of the company. The subsequent change in the midpoint results in a permanent change in the price as the market adjusts to the impact of the new information. Order processing costs and inventory costs by contrast are expected to result in only temporary price changes. Specifically, specialists will revise their quotes following a trade to balance their position and ensure their costs are covered. In essence, this means they set quotes so as to encourage a trade reversal, where a buy is then followed by a sell or vice versa. By contrast, new information results in order persistence, where buys are followed by buys or sells by sells.

The Lin et al. (1995) model argues that the response of the midpoint to a trade at the bid or ask will reflect the degree of information asymmetry, i.e.

$$\Delta m_{t+1} = \lambda z_t + e_{t+1}, \tag{2}$$

where Δm_{t+1} is the change in the log of the quoted midpoint at time t, $z_t = p_t - m_t$, p_t is the log of the trade price at time t, and λ is the information asymmetry component of the spread expressed as a percentage. We estimate λ over the sample period using all trades that occur during the normal trading hours of the market. To deal with stale quotes and news arrival during market closing hours, we exclude the first trade of each trading day when we estimate the spread decomposition models.

Madhavan et al. (1997) by contrast dynamically relate the order flow to transaction price returns to determine the information asymmetry component of the spread. Specifically, Madhavan et al. (1997) model transaction price returns over the sample period as

$$p_t - p_{t-1} = \theta(x_t - \rho x_{t-1}) + \phi(x_t - x_{t-1}) + u_t, \tag{3}$$

θ is the per share cost of information asymmetry, ϕ is the per share compensation for inventory holding and order processing costs, ρ is the first-order autocorrelation of the trade direction and u_t captures the impact of price discreteness and new public market-wide information releases. x_t is a trade indicator that equals 1 for buyer initiated trades, -1 for seller initiated trades. As tick history data does not identify the direction of the trade, we construct the trade indicator variable based on the Lee and Ready (1991) algorithm where transactions that occur at prices above (below) the midpoint of the quotes are classed as buyer-initiated (seller-initiated). To control for the fact that the error term in Eq. (3) is likely to be non-normal (e.g. due to price discreteness), we estimate the model using GMM as per Madhavan et al. (1997).

In this model the arrival of an informed trade in a given direction causes the market to adjust the fundamental value by θ. When more informed traders are present, or their expected profits are higher, θ will be larger. We use the proportion of information asymmetry in the spread to make the value relative and therefore comparable regardless of the price level or spread size. This proportion is computed as $\theta/(\theta + \phi)$ for each company.

2.2. Information efficiency

One advantage of a more developed market, such as Hong Kong, is that it is likely to be more informationally efficient. An informationally efficient market is one that impounds available information into prices quickly and accurately.[2] This allows for better resource allocation decisions and reduces the ability of sophisticated investors to exploit price inefficiencies making the firm more attractive for investors. We test for the relative weak form price efficiency, that is the speed with which the information content of past price changes is impounded into prices, between the foreign IPO firms and the Chinese and Hong Kong samples using the autocorrelation, the variance ratio of intra-day returns (Lo and Mackinlay, 1988) and a measure of return predictability from order flow (Chordia et al., 2002). These measures examine informational efficiency by exploring deviations from the requirement that weak form efficient prices should follow a random walk and not be predictable based on past information. The degree to which returns deviate from these requirements indicates the level of inefficiency in prices. Informational efficiency metrics based on intra-day time frequencies correlate highly with low-frequency measures and are not correlated with measures of liquidity (Rosch et al., 2013), making them valid proxies. Additionally, high frequency data has been shown to have higher statistical power and greater precision compared to tests that use daily data (Comerton-Forde and Putniņš, 2015). One caution that has been raised regarding the use of autocorrelation based measures comes from Griffin et al. (2012) who find that variance ratios compared between developed and emerging markets indicated similar levels of efficiency, or in some cases that emerging markets were more efficient than developed markets. They argue that the power of weak-form efficiency tests as a measure of information efficiency may be limited.

The first measure we explore, auto-correlation of intra-day returns, argues that if there is auto-correlation in quoted midpoints, either positive or negative, then returns deviate from the random walk and therefore have short-run predictability. We use the prevailing quoted midpoint at the end of each interval to calculate the midpoint returns, excluding the first trade of the day. We estimate first-order return autocorrelations for each stock day for a particular company such that:

$$Autocorrelation_k = Corr(r_{k,t}, r_{k,t-1})$$

where k represents different intraday intervals, specifically 60 s intervals and $r_{k,t}$ is the midpoint returns at time t.[3] We then take the absolute value of the autocorrelation and average over stock days in the sample period for each company. Larger values, or greater predictability in returns, indicate less efficient prices.

Variance ratio's measure deviation from a random walk. If returns follow a random walk then the variance of its returns is simply a linear function of the time frequency over which the measurement is conducted, or put differently the variance of returns measured at 60 s intervals should be 6 times greater than the variance of returns measured at 10 s intervals (Lo and MacKinlay, 1988). We estimate the variance ratio as:

$$Variance\ Ratio_{kl} = \left| \frac{\sigma^2_{kl}}{k * \sigma^2_l} - 1 \right|$$

where σ^2_{kl} and σ^2_l are the variances of l-sec and k-sec quoted midpoint returns for a stock day for a particular firm. We examine the 10 and 60 s return combination.[4] Again, a larger variance ratio indicates less informational efficiency within the market.

[2] While several papers have investigated the efficiency of the Hong Kong and Chinese markets as whole (among others, see Charles and Darne (2009), Lim and Luo (2012), Mobarek and Fiorante (2014)), we are interested in examining and comparing the price efficiency of our IPO samples.

[3] We also consider two additional intervals, 10 and 300 s. However, as the results are substantively similar we only report the 60 s interval.

[4] We also consider the 60 and 300 s return combination. However, as the results are substantively similar we only report the 10, 60 s combination.

Chordia et al. (2002) argue that order imbalance plays a role in determining returns. Specifically, they suggest that there is positive autocorrelation in trade imbalances driven by institutional traders splitting large orders. This autocorrelation in the order flow in turn is positively correlated with subsequent price movements due to price pressures caused by imbalances in the order flow. This measure therefore gives rise to another test of weak form market efficiency, in that the stronger the predictive power of lagged trade imbalances, the less efficient the market is. We follow Chordia et al. (2008), who apply this methodology in an intra-day setting, to calculate the return predictability from order flow. Specifically, for each 1 min interval throughout the trading day, we calculate the trade imbalance, defined as the dollar value of buyer-initiated trades less seller-initiated trades.[5] We sign the trades using the Lee and Ready (1991) algorithm. We also calculate the return of the quoted spread based on the midpoint of the spreads based on the prevailing quotes at 1 min intervals. We then regress the lagged trade imbalances against the returns over the entire 6-month sample period, excluding overnight returns from the calculation. The measure of price efficiency in this case is the R^2 value of the regression.

In addition to simple univariate differences employing *t*-tests and Wilcoxon Signed Rank tests between foreign IPO firms and the two matched samples, Hong Kong firms and Chinese firms, we also conduct multivariate regressions. We use measures of various firm level characteristics to control for other possible explanations for the potential differences observed. In particular, we control for firm size, measured as the natural log of the total assets of the firm at the financial year end of the year prior to the IPO. We employ the log of the price to control for price discreteness, which can affect intra-day measures as it dictates the influence of the spread. We define price as the log of the price at the end of the calendar year that the firm was listed. Trades per day, defined as the natural log of the number of trades over the sample period divided by the number of days with observed trades, is employed as a measure of the liquidity of the firm. We also include year and industry dummies.

Table 1
Listings on the Hong Kong stock exchange by year and industry.

Year	All foreign IPOs	Sample – Hong Kong	Sample – China
Panel A: IPO firms by year			
1996	6	5	6
1997	15	13	14
1998	2	1	2
1999	3	3	3
2000	5	5	3
2001	5	4	5
2002	13	6	8
2003	14	9	12
2004	13	9	11
2005	11	5	5
2006	18	12	17
2007	9	2	9
2008	4	0	4
2009	4	1	4
2010	6	1	6
2011	3	1	3
2012	4	1	3
Total	135	78	115
Panel B: IPO listings by industry			
Oil and Gas	8	2	6
Basic Materials	19	12	18
Industrials	42	31	40
Consumer Goods	9	9	9
Health Care	10	2	8
Consumer Services	9	8	7
Telecommunications	1	0	0
Utilities	7	1	7
Financials	15	4	10
Technology	15	7	10
Total	135	78	115

Note: Samples were matched separately between all the Chinese foreign IPOs undertaken in Hong Kong between 1996 and 2012 and all the domestic IPOs that occurred on the Hong Kong and Chinese exchanges. Match IPOs were identified as occurring in the same year and in the same industry as the foreign IPO, where there was more than one match, the closest by total assets in the year prior to the IPO was identified. Industry classification is based on the ISCB level 1 industry classification.

3. Data

To examine Chinese firms which undertake an IPO onto the Hong Kong stock exchange, we hand collect a sample of companies listed in Hong Kong that are identified as Chinese firms but which are not listed on a Chinese stock exchange. Based on their international identification numbers (ISIN), we then match the foreign IPO firms with those firms available in the Thompson Reuters Tick History database, excluding any firm for which data is not available. As Tick History data is only available from 1996 onwards, we restrict our sample to firms that listed in Hong Kong after 1996 to the end of 2012. This results in an initial sample of 135 Chinese foreign IPOs listed in Hong Kong.

To test the consequences of the decision to first list in Hong Kong, we compare the informational measures computed for our foreign IPO firms against two samples: (1) Hong Kong IPO firms that listed on the Hong Kong stock exchange over the sample period, (2) Chinese IPO firms that listed on either the Shanghai or Shenzhen stock exchanges over the same period. We employ matched firms to ensure that, as much as possible, any observed differences are the result of the choice of location, and not due to selection biases driving from the decision to list abroad. Specifically, we construct our Hong Kong (Chinese) sample by finding the closest IPO in Hong Kong (China) for each foreign IPO sample firm. We conduct our matching by requiring that the IPO to occur within the same year and industry, based on the Level 1 Industry Classification Benchmark, and have the required data to estimate our dependent variables. If there is more than one potential matching domestic IPO for a foreign IPO, then we use the IPO with the closest firm size based on the value of total assets in the financial year before the IPO.[6] Where no matches occur, we exclude that foreign IPO firm from the Hong Kong (Chinese) sample. Based on this matching criteria, we have 80 foreign IPOs with a Hong Kong matched IPO firm and 120 foreign IPOs with a Chinese matched IPO firm.

We next collect data on every trade, including the price, volume, and bid and ask prices, for our sample firms and for all matched Hong Kong and Chinese IPO firms from Tick History.[7] We consider a 12 month period after the listing to ensure sufficient data for the intra-day models to be estimated accurately. To safeguard that we accurately estimate our measures, we further exclude any firms which have fewer than 5 trades per day over the sample period, this gives us final samples of 115 foreign IPOs when matched to Chinese IPO firms and 78 when matched with Hong Kong IPO firms. Additionally, to control for outliers in the datasets, we remove

[5] We additionally test 5 min intervals, as was employed in Chordia et al., 2008 and imbalance measured by number of trades. The results remain largely unchanged.

[6] In addition, we also tested our results using samples where we matched based on market capitalization at the calendar year end of the listing year, and additionally where we used Level 2 ICB classifications. The results remain broadly consistent irrespective of the matching procedure we employ. For the sake of brevity we have not included this analysis in the paper but it is available on request.

[7] For more detail on how we dealt with the data please refer to Appendix A.

Table 2
Summary statistics of trade based variables.

	Trades/Day	*Av Vol*	*Market Cap*	*Total Assets*	*Price*	*Sales Revenue*	*Net Income*	*Age*	*CAPEX*
Panel A: Hong Kong and foreign IPOs matched sample									
Foreign IPO firms									
Average	336	50484	5346	46800000	3.18	9582859	982302	2.73	166566
Median	135	46809	1592	2657047	2.01	390893	47886	1.00	26434
Std Dev	546	31489	10335	154000000	3.50	34900000	4086150	3.70	522555
Min	2	5141	24	0	0.12	0	−800373	0.00	0
Max	3595	163300	60645	923000000	22.25	223000000	25400000	21.00	4332200
Hong Kong IPO firms									
Average	99	75448	2378	1074320	13.56	2255012	195063	6.76	15992
Median	36	50678	670	390662	1.14	301535	31972	1.00	672
Std Dev	168	143850	7776	2198372	55.56	5406259	516731	12.02	45018
Min	3	10218	61	418	0.02	0	−461040	0.00	0
Max	898	1042200	55610	14400000	395.66	29500000	2754006	51.00	175488
Diff in average	237**	−24964	2968	45725680***	−10.38*	7327847**	787239*	−4.03***	150574***
Diff in median	99***	−3869	922	2266385***	0.87	89358	15914	0	25762***
Panel B: Chinese and foreign IPOs matched sample									
Foreign IPO firms									
Average	502	47334	12679	21,400,000	3.86	710411	67951	3.20	154365
Median	182	38502	2170	464482	2.28	45349	5673	2.00	30593
Std Dev	828	33191	48920	117000000	4.34	2930000	270590	4.45	312297
Min	5	5083	17	0	0.12	−3001	−58567	0.00	0
Max	4403	177160	401163	1010000000	27.55	26000000	2490000	22.00	1988500
Chinese IPO Firms									
Average	4103	3911	14133	2,620,000	7.05	486767	42610	4.56	40870
Median	534	2429	3072	117306	4.90	92822	8495	3.00	5543
Std Dev	11319	5200	33641	14000000	5.97	2150000	110414	5.30	100255
Min	37	521	398	12430	0.87	9282	850	0.00	0
Max	91385	28312	259300	136000000	31.35	215000	11041	15.00	669174
Diff in average	−3601***	43423***	−1454	18780000*	−3.19***	223644	25341	−1.36**	113495***
Diff in median	−352***	36073***	−902*	347176	−2.62***	−47473	−2822	−1	25050***

Note: Trades/Day is the cross-sectional average of the total number of trades over the 12 months following the IPO divided by the number of trading days. *Average volume* is the sum of trading volume over the 12 months following the IPO divided by the total number of trades. *Market Cap* is the market capitalization of the firm at the end of the calendar year of the listing year, *Total Assets*, *Sales Revenue* and *Net Income* are measured in the financial year prior to the IPO. *Price* is the price at the IPO date. *Age* is the difference between the firms incorporation year and its listing year. *CAPEX* is the value of capital expenditures in the year prior to the IPO. The Hong Kong (Chinese) matched sample is the 79 (117) foreign IPO firms that could be matched with Hong Kong IPOs based on the matching procedure and the resulting matched firms. *, **, *** denotes significance at 10%, 5% and 1%, respectively.

Table 3
Correlation matrix.

	% Spread	*Effective Spread*	*LSB*	*MRR*	*Auto*	*Var Ratio*	*CRS*	*Total Asset*	*Trades/Day*	*Price*
Eff Spread	0.9931***	1								
LSB	0.0914	0.063	1							
MRR	0.2899***	0.2537***	0.4704***	1						
Auto	−0.2968***	−0.2963***	0.0558	−0.147**	1					
Var Ratio	−0.0701	−0.069	0.1489	−0.1057***	−0.0331	1				
CRS	−0.0734	−0.0466	−0.2946***	−0.4399***	0.1218*	−0.1575	1			
TotalAsset	−0.1065	−0.1022	−0.1232	−0.1756**	0.103	0.0776	0.1673**	1		
Trades/Day	−0.2966***	−0.2733***	−0.243***	−0.3625***	0.0687	0.0915*	0.0354	0.2941***	1	
Price	−0.0075	−0.0075	−0.0377	0.058	0.0018	−0.0379	−0.0432	−0.0238	−0.0351	1

Note: Presents the correlation coefficients for the Hong Kong matched sample. All values were estimated over the 12 months following the IPO. *% Spread* is defined as the difference between the prevailing bid and ask prices divided by the quoted midpoint at the time of each trade, averaged over the entire 12 months period. *Eff Spread* is defined as two times the absolute difference between the trade price and the quoted midpoint divided by the quoted midpoint, averaged over the entire 12 months period. *LSB* is defined as the proportion of information asymmetry built into the spread based on the Lin et al. (1995) bid ask spread decomposition model. *MRR* is defined as the proportion of information asymmetry build into spreads based on the Madhavan et al. (1997) bid ask spread decomposition model. *Auto* is defined as the cross-sectional average of the first-order autocorrelation per trading day based on the quoted midpoints over 60 s intervals. *Var Ratio* is the defined as the cross-sectional average of the absolute value of the variance of the quoted midpoint returns 300 s divided by the variance of the quoted midpoint returns over 60 s intervals multiplied by 6 minus 1. *CRS* is the measure of return predictability of trade imbalance based on one minute intervals and the dollar value of trade imbalance. *Trades/Day* is the cross-sectional average of the total number of trades over the 12 months following the IPO divided by the number of trading days. *Total Asset* is the total asset in the financial year prior to the IPO, while *Price* is the price at the IPO date. *, **, *** denotes significance at 10%, 5% and 1%, respectively.

any trades or quotes with zero prices and any trade with a price or quoted midpoint ±10% different from the previous observation. On average this excludes less than 0.1% of the total number of trades.[8] Other firm level data for the Chinese sample firms are either collected from the companies' prospectus and annual reports or from the Wind Information Company. The information on Hong Kong firms are either collected from their prospectus and annual reports disclosed by the firms or from the Hong Kong stock exchange.

Panel A of Table 1 breaks down the samples employed in our study by the year and industry. The first column outlines the full sample of foreign IPOs. In general, we observe fewer than 6 foreign

[8] We also estimated the measures with both tighter and looser restrictions on the definition of an outlier, the results were not materially different.

Table 4
Summary statistics of the dependent variable for the Hong Kong sample.

	% Spread	Effective Spread	LSB	MRR	Auto	Var Ratio	CRS
Panel A: Hong Kong and foreign IPOs matched sample							
Foreign IPO firms							
Average	0.0152	0.0144	0.2423	0.2484	0.1201	0.1453	0.0073
Median	0.0096	0.0089	0.2478	0.2230	0.1028	0.0087	0.0041
Std Dev	0.0260	0.0253	0.1549	0.1838	0.1035	0.2248	0.0077
Min	0.0014	0.0017	0.0069	0.0041	0.0029	0.0027	0.0000
Max	0.2187	0.2133	0.8953	0.8301	0.4225	0.8701	0.0284
No. of		*Firms*	78				
Hong Kong IPO Firms							
Average	0.0180	0.0172	0.2386	0.2271	0.0999	0.2733	0.0046
Median	0.0149	0.0133	0.2540	0.1866	0.1007	0.1988	0.0031
Std Dev	0.0160	0.0156	0.1515	0.1397	0.0276	0.2016	0.0053
Min	0.0042	0.0043	0.0127	0.0258	0.0330	0.0228	0.0000
Max	0.1103	0.1213	0.9131	0.5448	0.1578	0.9318	0.0338
No. of		*Firms*	78				

	Means			Medians		
	Foreign	Hong Kong	Difference	Foreign	Hong Kong	Difference
Panel B: Hong Kong and foreign IPOs differences in means and medians						
% Spread	0.0152	0.0180	−0.0028	0.0096	0.0149	−0.005***
Effective Spread	0.0144	0.0172	−0.0028	0.0089	0.0133	−0.005***
LSB	0.2423	0.2386	0.0038	0.2478	0.2540	−0.0061
MRR	0.2484	0.2271	0.0213	0.2230	0.1866	0.0365
Auto 60	0.1201	0.0999	0.0202*	0.1028	0.1007	0.0021
Var Ratio	0.1453	0.2733	−0.128***	0.0087	0.1988	−0.190***
CRS	0.0073	0.0046	0.003***	0.0041	0.0031	0.0009

Note: Presents the summary statistics for the Hong Kong matched sample. All values were estimated over the 12 months following the IPO. *% Spread* is defined as the difference between the prevailing bid and ask prices divided by the quoted midpoint at the time of each trade, averaged over the entire 12 months period. *Eff Spread* is defined as two times the absolute difference between the trade price and the quoted midpoint divided by the quoted midpoint, averaged over the entire 12 months period. *LSB* is defined as the proportion of information asymmetry built into the spread based on the Lin et al. (1995) bid ask spread decomposition model. *MRR* is defined as the proportion of information asymmetry build into spreads based on the Madhavan et al. (1997) bid ask spread decomposition model. *Auto* is defined as the cross-sectional average of the first-order autocorrelation per trading day based on the quoted midpoints over 60 s intervals. *Var Ratio* is the defined as the cross-sectional average of the absolute value of the variance of the quoted midpoint returns 300 s divided by the variance of the quoted midpoint returns over 60 s intervals multiplied by 6 minus 1. *CRS* is the measure of return predictability of trade imbalance based on one minute intervals and the dollar value of trade imbalance. The significance of means is calculated using a *t*-test, the significance of medians is calculated using the Wilcoxon Rank Sum test. *, **, *** denotes significance at 10%, 5% and 1%, respectively.

IPOs per year, particularly in the periods between 1998–2001 and 2007–2012. Between 2002 and 2006 there is a marked upswing in the number of foreign IPOs. Overall there are 135 foreign IPOs within our sample period. Panel B of Table 1 provides an overview of sample firms based on their industries. We observe some industry clustering with Industrial (42), Basic Materials (19), Financial (15) and Technology (15) being the most common of our sample firms. As a result of the requirements that our matched IPOs must occur in the same year and within the same industry and that firms must have a certain minimum level of liquidity, we have 78 firms with matched Hong Kong IPOs. We capture most of the early IPOs prior to 2007, but fewer of the more recent IPOs due to fewer listings on the Hong Kong exchange in recent years. With respects to the industries, we capture all the consumer goods, and most of the industrials, consumer services and basic materials, but do not have a match for the one telecommunication foreign IPO and only capture a few of the financials, utilities and health care IPOs. In contrast, our China matched samples capture a much greater number of the foreign IPOs, 115 of the 135, resulting in a good coverage over both the years and the industries.

Table 2 presents summary statistics of our foreign IPO firms and their comparison with the samples of Hong Kong and Chinese matched IPOs. Panel A presents the sample of foreign IPOs and the Hong Kong IPO firms. We observe some differences between the two samples. Following the listing, foreign IPO firms, which are much larger than Hong Kong IPOs, are more actively traded, suggesting that these firms are significantly more liquid. However, over the first year after listing, there is no significant difference in average trading volume between the two samples. The foreign IPOs start out with significantly higher total assets, sales revenue and net income before their IPO. The Hong Kong IPO firms have a higher average price; however, this is mainly driven by a few outliers as shown by the higher maximum for the Hong Kong IPOs. Finally, we observe that the median age, measured as the difference between the incorporation year of the firm and the IPO year, is the same but the average age is much lower for the foreign IPOs. The foreign IPO firms also spend more on CAPEX. The values for age and capital expenditures suggest that the Hong Kong firms are older and could potentially be less growth orientated.

Panel B of Table 2 presents the sample of 115 Chinese IPO firms that best matched the foreign IPO firms. We observe some marked differences in the characteristics of the two samples. The foreign IPO firms listed in Hong Kong, while have less trading activity per day, have significantly greater trading volumes over the first year of listing, suggesting that over all they are more liquid. The average market capitalization of the two samples is comparable, though foreign IPO firms have slightly lower median market capitalizations, significant at the 10% level. The pre-IPO total assets of foreign IPOs is larger than their domestic peers but the median total asset values is not significantly different. The foreign IPO firms trade at lower prices and are on average younger, although the difference in the median is insignificant. Finally, the foreign IPO firms appear to be more growth orientated, being both younger and spending more on CAPEX than their Chinese peers. Table 2 generally reveals many of variables are skewed, as a result we use log transformation for many of these variables, including total assets, size, and trades per day.

While our matched samples represent our best efforts to create a reliable baseline against which to compare the impact of a foreign IPO, Table 2 does show that there remain some significant differences between the samples. As a result our matched sample is an imperfect measure for dealing with the endemic self-selection problem common to studies in this area. Our findings may still contain the impact of any selection biases.

Table 3 presents a correlation matrix of our dependent variables and the variables we include in the later multivariate analysis. We observe very strong correlation between percentage and effective spread, and a positive but weaker relationship between *LSB* and *MRR*, 0.47, both significance at 1%. The percentage and effective spreads are both positively related to *MRR*, and negatively related to *Auto*, while *MRR* is negatively related to the three informational efficiency measures and also to total assets, although the correlation is only −0.17. *CSR* is negatively related to the two decomposition measures, *LSB* and *MRR*, and marginally positively related to *Auto.* Trades per day has strong negative relationships with our information asymmetry measures, but weaker relationships with the price efficiency measures.

4. Results

We start our investigation by examining the level of information risk priced into the spreads of Chinese firms that list initially on the Hong Kong stock exchange. A key component of the spread

Table 5
Summary statistics of the dependent variable for the Chinese sample.

	% Spread	Effective Spread	LSB	MRR	Auto	Var Ratio	CRS
Panel A: Chinese and foreign IPOs matched sample							
Foreign IPO Firms							
Average	0.0136	0.0129	0.2445	0.2685	0.1116	0.1779	0.0059
Median	0.0089	0.0086	0.2323	0.2288	0.0930	0.0114	0.0027
Std Dev	0.0224	0.0217	0.1721	0.2015	0.0948	0.2564	0.0068
Min	0.0014	0.0016	0.0032	0.0027	0.0029	0.0027	0.0000
Max	0.2187	0.2133	0.8953	1.0192	0.4225	0.9722	0.0284
No of Firms	115						
Chinese IPO Firms							
Average	0.0016	0.0022	0.3548	0.3473	0.1409	0.2467	0.0120
Median	0.0015	0.0021	0.4499	0.3933	0.1269	0.2037	0.0105
Std Dev	0.0004	0.0007	0.2112	0.1773	0.0367	0.1459	0.0096
Min	0.0005	0.0010	0.0010	−0.0093	0.1040	0.0520	0.0000
Max	0.0029	0.0044	0.9936	0.6190	0.3148	0.9961	0.0539
No of Firms	115						

	Means			Medians		
	Foreign	Chinese	Difference	Foreign	Chinese	Difference
Panel B: Chinese and foreign IPOs differences in means and medians						
% Spread	0.0136	0.0016	0.0120***	0.0089	0.0015	0.0074***
Eff Spread	0.0129	0.0022	0.0107***	0.0086	0.0021	0.0065***
LSB	0.2445	0.3548	−0.1102***	0.2323	0.4499	−0.2176***
MRR	0.2685	0.3473	−0.0788***	0.2288	0.3933	−0.1645***
Auto	0.1116	0.1409	−0.0293***	0.0930	0.1269	−0.0338***
Var Ratio	0.1779	0.2467	−0.0688**	0.0114	0.2037	−0.1923***
CRS	0.0059	0.0120	−0.0062***	0.0284	0.0539	−0.0255***

Note: Presents the summary statistics for the Chinese matched sample. All values were estimated over the 12 months following the IPO. *% Spread* is defined as the difference between the prevailing bid and ask prices divided by the quoted midpoint at the time of each trade, averaged over the entire 12 months period. *Eff Spread* is defined as two times the absolute difference between the trade price and the quoted midpoint divided by the quoted midpoint, averaged over the entire 12 months period. *LSB* is defined as the proportion of information asymmetry built into the spread based on the Lin et al. (1995) bid ask spread decomposition model. *MRR* is defined as the proportion of information asymmetry build into spreads based on the Madhavan et al. (1997) bid ask spread decomposition model. *Auto* is defined as the cross-sectional average of the first-order autocorrelation per trading day based on the quoted midpoints over 60 s intervals. *Var Ratio* is the defined as the cross-sectional average of the absolute value of the variance of the quoted midpoint returns 300 s divided by the variance of the quoted midpoint returns over 60 s intervals multiplied by 6 minus 1. *CRS* is the measure of return predictability of trade imbalance based on one minute intervals and the dollar value of trade imbalance. The significance of means is calculated using a *t*-test, the significance of medians is calculated using the Wilcoxon Rank Sum test. *, **, *** denotes significance at 10%, 5% and 1%, respectively.

is the risk of trading against a better informed counterparty. Firms from markets with stricter information disclosure regimes should represent a lower risk to investors, and consequently have lower information asymmetry costs. The interesting issue for our sample of foreign IPO companies is that while they are listing into a market with tighter disclosure laws, they are domiciled in a country with weaker rules and enforcement of investor protection laws, and a less developed financial market. This may decrease the amount of information impounded into the price of foreign IPO firms, resulting in greater informational risk for these firms than their Hong Kong counterparts.

Table 4 presents the summary statistics of the transaction cost, information asymmetry (IA) and price efficiency measures we employ in this paper for the sample of foreign IPO firms matched with Hong Kong IPOs. Panel A presents the summary statistics for the two samples while Panel B presents the results for the tests of the statistical significance of the differences in both the means, using a *t*-test of the differences, and the medians, using a Wilcoxon Rank-Sum test. In Panel A we observe that the percentage spread and effective spreads both have lower medians than the averages, suggesting the presence of skewness in the variables. We also observe that the effective spreads are lower than the percentage spreads, suggesting that trades are on average being executed within the spreads. Both variables exhibit considerable variation, as seen from the range of minimum to maximum values. Our decomposed spread measures of the level of information asymmetry, *LSB* and *MRR*, give similar information asymmetry proportions of the spread (IA), around 25% for the foreign IPOs and 23% for the Hong Kong IPOs. However, we observe considerable variation in the level of information asymmetry ranging from firms with very little information asymmetry in the spreads to those whose spreads are predominantly IA costs. With regards to our price efficiency measures, *Auto* and *Var Ratio*, we observe the autocorrelation of our sample has a mean of 0.1201, and a median of 0.1028. There is however considerable variation between the largest and smallest values. The variance ratio is larger with a mean of 0.1453 and median of 0.0087 and a much greater variation. Boehmer and Kelley (2009) employ the same measures, albeit with different windows and find, for a sample of NYSE stocks between 1984 and 2004, autocorrelation of around 7%, and variance ratio figures of 0.37 for both the mean and the median. In comparison, our sample has similar levels of autocorrelation and a lower variance ratio. The return predictability of order imbalance, CRS, suggests that lagged trade imbalance explains less than 1% of returns. Overall, the results suggest that the prices in Hong Kong for the foreign IPO firms are reasonably efficient.

When we test for the differences in the means and medians, as reported in Panel B of Table 4, we observe that there is evidence to suggest that foreign IPO firms are viewed as being as risky, or in some cases less risky, than Hong Kong domestic IPOs. With regards to the means, we observe insignificant differences for the four information asymmetry measures, and mixed evidence for the price efficiency measures with *Auto* and *CRS* being higher for foreign IPOs, significant at the 10% and 1% levels respectively, suggesting more intraday autocorrelation. However, the variance ratio is significantly lower. When we consider the medians, we find that the percentage and effective spreads, and variance ratio are significantly lower for the foreign IPO firms. The lower spreads, given the lack of significant difference in the information asymmetry component, maybe driven by the greater trading activity in

Table 6
Matched sample regress analysis of information asymmetry measures.

	(1) *% Spread*	(2) *Effective Spread*	(3) *LSB*	(4) *MRR*	(5) *Auto*	(6) *Var Ratio*	(7) *CRS*
Panel A: Hong Kong matched sample							
Constant	0.0418***	0.0397***	−1.4351	1.4747	0.1607	0.4740*	0.0070
	(7.796)	(7.921)	(−1.366)	(1.497)	(1.520)	(1.775)	(0.005)
Hong Kong	0.0005	0.0007	−0.1353	−0.446***	−0.0191	0.1334***	−0.0009
	(0.505)	(0.718)	(−0.825)	(−3.246)	(−1.428)	(3.859)	(−1.270)
Total Assets	−0.0001	−0.0003	−0.0385	−0.0513	−0.0050	−0.0241*	0.0003
	(−0.457)	(−1.022)	(−0.754)	(−1.044)	(−1.041)	(−1.892)	(1.578)
Trades/Day	−0.0051***	−0.0042***	−0.196**	−0.488***	0.0155**	0.0440**	0.0019***
	(−7.792)	(−6.703)	(−2.423)	(−5.965)	(2.407)	(2.498)	(4.237)
Price	−0.0010***	−0.0011***	−0.0350	0.1746***	0.0023	−0.0157	−0.0007***
	(−2.752)	(−3.391)	(−0.546)	(4.180)	(0.618)	(−1.366)	(−2.812)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	156	156	156	156	156	156	156
R-squared	0.7464	0.7334	0.5244	0.5887	0.3046	0.4724	0.5540
Panel B: Chinese matched sample							
Constant	0.0253***	0.0229***	2.5305***	1.7563**	0.1897***	0.1197	−0.0074***
	(7.785)	(7.845)	(2.870)	(2.288)	(2.995)	(0.608)	(−1.115)
China	−0.0025**	−0.0019*	1.2095***	1.5564***	−0.0082	0.1237***	0.0044****
	(−2.275)	(−1.866)	(4.839)	(7.354)	(−0.521)	(3.034)	(2.696)
Total Assets	−0.0003	−0.0002	−0.0571	0.0040	−0.0030	0.0129	0.0003
	(−1.112)	(−1.031)	(−0.894)	(0.083)	(−0.761)	(1.157)	(0.71)
Trades/Day	−0.0027***	−0.0025***	−0.672***	−0.7421***	0.0132**	−0.0081	0.0025***
	(−3.953)	(−3.946)	(−7.059)	(−8.070)	(2.563)	(−0.693)	(4.323)
Price	−0.0031***	−0.0027***	0.3371***	0.1877*	0.0113*	−0.0299	−0.0024***
	(−4.821)	(−4.604)	(3.007)	(1.659)	(1.717)	(−1.628)	(−3.093)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	230	230	230	224	230	230	230
R-squared	0.6869	0.6708	0.5269	0.6452	0.2458	0.2755	0.3916

Note: Presents the summary statistics for the Chinese matched sample. All values were estimated over the 12 months following the IPO. *% Spread* is defined as the difference between the prevailing bid and ask prices divided by the quoted midpoint at the time of each trade, averaged over the entire 12 months period. *Eff Spread* is defined as two times the absolute difference between the trade price and the quoted midpoint divided by the quoted midpoint, averaged over the entire 12 months period. *LSB* is defined as the proportion of information asymmetry built into the spread based on the Lin et al. (1995) bid ask spread decomposition model. *MRR* is defined as the proportion of information asymmetry build into spreads based on the Madhavan et al. (1997) bid ask spread decomposition model. *Auto* is defined as the cross-sectional average of the first-order autocorrelation per trading day based on the quoted midpoints over 60 s intervals. *Var Ratio* is the defined as the cross-sectional average of the absolute value of the variance of the quoted midpoint returns 300 s divided by the variance of the quoted midpoint returns over 60 s intervals multiplied by 6 minus 1. *CRS* is the measure of return predictability of trade imbalance based on one minute intervals and the dollar value of trade imbalance. *Hong Kong (China)* represents a dummy variable that equals 1 if a firm is a local Hong Kong (Chinese) firms listed on their local market. *Total Asset* is the total asset in the financial year prior to the IPO. *Trades/Day* is the cross-sectional average of the total number of trades over the 12 months following the IPO divided by the number of trading days. *Price* is the price at the IPO date. The significance of means is calculated using a *t*-test, the significance of medians is calculated using the Wilcoxon Rank Sum test. *, **, *** denotes significance at 10%, 5% and 1%, respectively.

these measures suggesting lower liquidity costs. The lack of significance for the median differences for the *Auto* and *CRS* measures suggest that the significance observed for the means was driven by a small number of observations. Overall, the univariate results suggest that foreign IPO firms are not viewed as more risky than domestic IPOs, and less risky when we consider the variance ratio test.

Table 5 presents the same univariate analysis for the foreign IPOs matched with Chinese IPOs. As for the Chinese IPOs, we observe they have smaller effective spreads than percentage spreads, and lower median values for the spreads than for the averages. When test for the differences in the means and medians, presented in Panel B, we find some evidence to support the idea that a foreign IPO benefits a Chinese firm. Specifically, we observe strongly significant decreases in the two proportion of information asymmetry measures, *LSB* and *MRR*, along with the three price efficiency measures, *Auto*, *Var Ratio* and *CRS*. However, these results do raise some interesting questions. First, the percentage spread and the effective spread for the foreign IPOs are roughly ten times the size of the spreads for Chinese IPOs, which in Table 4 were shown to have median values significantly lower than the Hong Kong IPOs. While we would have expected that the spreads in China would be greater, we are not the first to report such a startling result. Chan et al. (2008) observes that domestic A-shares had an average relative quoted spread of 0.18%, while foreign B-shares had an average spread of 1.28% with similar values for the effective spread. The other interesting observation is that while the asymmetric information component of the spread is greater in China as a percentage, the actual dollar cost per share traded is likely to be smaller (roughly 0.2% for foreign IPOs vs 0.08% for Chinese IPOs).

Table 6 presents the results of the multivariate regressions for our information asymmetry measures against the firm level control variables. Panel A in this table provides the results where the regression is run between our sample of foreign IPO firms and Hong Kong IPO firms. The variable of interest, *Hong Kong*, is a dummy that equals 1 for the sample of Hong Kong matched IPO firms. The results provide even stronger support than the earlier reported univariate results. After controlling for firm level characteristics, specifically the log of total assets, trades per days and the price, we find no statistically significant difference between the sample of foreign IPOs and Hong Kong firms with two exceptions. The *Var Ratio* is lower for foreign IPO firms, suggesting they are more price efficient. Meanwhile, the *MRR* is larger, which suggests that the foreign IPO firms have a higher information asymmetry component in their spread. However, the *LSB* measure does not

Table 7
Heckman two-stage regression results for the Hong Kong sample.

	(1) *Probit*	(2) *% Spread*	(3) *Effective Spread*	(4) *LSB*	(5) *MRR*	(6) *Auto*	(7) *Var Ratio*	(8) *CRS*
Constant	−5.850**	0.0534***	0.0522***	−1.9745*	1.2098	0.1237	0.3904*	0.0074
	(−2.516)	(3.736)	(3.607)	(−1.810)	(1.176)	(1.260)	(1.792)	(1.40)
Hong Kong		−0.0021	−0.0020	−0.1687	−0.4405***	−0.0126	0.1227***	0.0006
		(−0.643)	(−0.598)	(−1.095)	(−3.283)	(−1.009)	(4.014)	(0.818)
Total Assets	0.4076***	0.0008*	0.0006	−0.0286	−0.0405	−0.0031	−0.0166*	0.0002
	(4.377)	(1.667)	(1.264)	(−0.577)	(−0.848)	(−0.789)	(−1.710)	(1.308)
Trades/ Day		−0.0092***	−0.0084***	−0.1311*	−0.4671***	0.0163***	0.0342**	0.0020***
		(−4.909)	(−4.482)	(−1.826)	(−6.292)	(2.861)	(2.510)	(4.3234)
Price		−0.0018**	−0.0020***	−0.0228	0.1547***	0.0027	−0.0017	−0.0008***
		(−2.439)	(−2.680)	(−0.339)	(3.206)	(0.686)	(−0.171)	(−3.038)
Inv Mills		0.0001	0.0001	−0.0108*	−0.0124***	0.0002	0.0032***	0.0000**
		(0.768)	(0.966)	(−1.754)	(−2.998)	(0.579)	(3.257)	(2.239)
Herfindahl	0.9888							
	(0.861)							
Leverage	−0.1311							
	(−0.299)							
Return on Assets	−0.0572							
	(−0.369)							
% Independent	−8.7914***							
	(−4.814)							
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	166	156	156	156	154	156	156	156
R-squared	0.3587	0.5275	0.4928	0.4869	0.5638	0.3289	0.4364	0.5613

Note: We employ a Heckman two-stage regression model. *% Spread* is defined as the difference between the bid and ask prices divided by the quoted midpoint. *Eff Spread* is defined as two times the absolute difference between the trade price and the quoted midpoint divided by the quoted midpoint. *LSB* is defined as the proportion of information asymmetry built into the spread based on the Lin et al. (1995) bid ask spread decomposition model. *MRR* is defined as the proportion of information asymmetry build into spreads based on the Madhavan et al. (1997) bid ask spread decomposition model. *Auto* is defined as the cross-sectional average of the first-order autocorrelation per trading day based on the quoted midpoints over 60 s intervals. *Var Ratio* is the defined as the cross-sectional average of the absolute value of the variance of the quoted midpoint returns 300 s divided by the variance of the quoted midpoint returns over 60 s intervals multiplied by 6 minus 1. *CRS* is the measure of return predictability of trade imbalance based on one minute intervals and the dollar value of trade imbalance. *Hong Kong (China)* represents a dummy variable that equals 1 if a firm is a local Hong Kong (Chinese) firms listed on their local market. *Total Asset* is the total asset in the financial year prior to the IPO. *Trades/Day* is the cross-sectional average of the total number of trades over the 12 months following the IPO divided by the number of trading days. *Price* is the price at the IPO date. *Herfindahl* is the sum of the squared market share based on sales for the firms industry based on 2 digit ICB industry classifications. *Leverage* is the firms debt as a percentage of total assets in the year prior to the IPO, *Return on Assets* is defined as net income divided by total assets in the year prior to the IPO while *% Independent* is the number of independent directors on the board of directors. *, **, *** denotes significance at 10%, 5% and 1%, respectively.

support the finding for the *MRR*, nor do the percentage and effective spreads which show no significant difference.

Of the control variables, we find that *Trades Per Day* has a significant negative relationship with the information asymmetry measures, suggesting more liquid stocks have less information asymmetry, and a positive relationship with the price efficiency measures, suggesting liquidity traders reduce price efficiency. This is consistent with previous findings in the literature that liquidity is negatively related to spreads and the level of information asymmetry (see, e.g., Hendershott et al., 2011). Price is also negatively associated with the two traded spread measures, which is not surprising as percentage spread is impacted by the price discreteness of a stock. Additionally, price has a positive relationship with *MRR* and a negative relationship with *CRS*. We finally find that the model specified does a good job of explaining our dependent variables, especially the spread and information asymmetry measures, which all have *R*-Squared values well above 50%.

Panel B of Table 6 presents the results of regressions coefficients where we test our sample of foreign IPO firms against the matched Chinese IPO firms. The results reported here are also strongly supportive of the earlier univariate findings. After controlling for firm level characteristics, we observe striking differences between the foreign IPO sample and the Chinese IPO sample in all cases, excluding *Auto*. The dummy variable for the sample of Chinese matched IPO firms is statistically significant. Chinese firms have significantly lower spreads, and higher IA and price efficiency measures. We also observe strong significance for *Trades Per Day* and *Price* variables, with the exception of the *Var Ratio*. As would be expected, we observe a negative relationship between trades per day and our measures indicating that there is lower transaction costs and less information risk in more actively traded firms. Both measures of spread have the expected negative relationship with price while they have positive relationships with the spread based IA measures, and a negative relationship with the other measures.

These results generally suggest that Chinese firms first listing on the Hong Kong stock exchange are not viewed as being informationally riskier than their Hong Kong counterparts, and are seen as considerably less risky than Chinese firms. Our findings provide some evidence of the legal and reputational bonding hypotheses, whereby firms list in countries with stronger investor protection laws as a way of convincing investors that they are well governed and managed. Binding themselves under the stricter legal regime is an expensive signal that the foreign IPO firms have better disclosure and governance than their home market peers. It may also be that the better developed financial market offers greater analysts coverage and access to more sophisticated investors who price more information into the firms share price.

4.1. Robustness analysis

One concern that has been highlighted in the literature on cross-listing is the self-selection bias inherent in the decision to cross-list offshore. It maybe that firms with lower information asymmetry or greater price efficiency are more likely to undertake a foreign IPO. If this is the case, our results reported so far, based on matched samples, could be biased as a result of characteristics that drove these firm to list abroad, rather than as a result of the actual foreign IPO firms. Numerous studies within the cross-listing literature have employed the Heckman (1979) two-stage model to control for such

Table 8
Heckman two-stage regression results for the Chinese sample.

	(1) *Probit*	(2) *% Spread*	(3) *Effective Spread*	(4) *LSB*	(5) *MRR*	(6) *Auto*	(7) *Var Ratio*	(8) *CRS*
Constant	−6.093***	0.0239***	0.0218***	2.4890***	1.7570**	0.1906***	0.1334	−0.0073
	(−4.02)	(4.133)	(3.837)	(2.846)	(2.284)	(3.010)	(0.680)	(−1.103)
China		0.0018	0.0025	1.1747***	1.4831***	−0.0118	0.1157***	0.0044***
		(0.468)	(0.656)	(4.701)	(6.821)	(−0.751)	(2.843)	(2.692)
Total Assets	0.3185***	0.0003	0.0004	−0.0606	−0.0046	−0.0033	0.0115	0.0003
	(4.039)	(0.486)	(0.540)	(−0.954)	(−0.092)	(−0.837)	(1.034)	(0.711)
Trades/Day		−0.0048***	−0.0045***	−0.6456***	−0.7073***	0.0145***	−0.0065	0.0025***
		(−2.766)	(−2.707)	(−7.052)	(−7.724)	(2.901)	(−0.576)	(4.308)
Price		−0.0055***	−0.0053***	0.3693***	0.2294**	0.0122*	−0.0292*	−0.0025***
		(−2.907)	(−2.827)	(3.375)	(2.006)	(1.936)	(−1.692)	(−3.0901)
Inv Mills		−0.0000**	−0.0000*	0.0048	−0.0009	−0.0003	−0.0013***	−0.0000
		(−1.991)	(−1.709)	(1.005)	(−0.472)	(−1.024)	(−3.282)	(−0.5396)
Herfindahl	−0.7042							
	(−0.438)							
Leverage	−1.8294**							
	(−2.506)							
Return on Assets	0.1202							
	(0.222)							
% Independent	10.473***							
	(6.675)							
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	236	236	236	236	230	236	236	236
R-squared	0.3124	0.4502	0.4296	0.5230	0.6367	0.2687	0.2814	0.3921

Note: We employ a Heckman two-stage regression model. *% Spread* is defined as the difference between the bid and ask prices divided by the quoted midpoint. *Eff Spread* is defined as two times the absolute difference between the trade price and the quoted midpoint divided by the quoted midpoint. *LSB* is defined as the proportion of information asymmetry built into the spread based on the Lin et al. (1995) bid ask spread decomposition model. *MRR* is defined as the proportion of information asymmetry build into spreads based on the Madhavan et al. (1997) bid ask spread decomposition model. *Auto* is defined as the cross-sectional average of the first-order autocorrelation per trading day based on the quoted midpoints over 60 s intervals. *Var Ratio* is the defined as the cross-sectional average of the absolute value of the variance of the quoted midpoint returns 300 s divided by the variance of the quoted midpoint returns over 60 s intervals multiplied by 6 minus 1. *CRS* is the measure of return predictability of trade imbalance based on one minute intervals and the dollar value of trade imbalance. *Hong Kong (China)* represents a dummy variable that equals 1 if a firm is a local Hong Kong (Chinese) firms listed on their local market. *Total Asset* is the total asset in the financial year prior to the IPO. *Trades/Day* is the cross-sectional average of the total number of trades over the 12 months following the IPO divided by the number of trading days. *Price* is the price at the IPO date. *Herfindahl* is the sum of the squared market share based on sales for the firms industry based on 2 digit ICB industry classifications. *Leverage* is the firms debt as a percentage of total assets in the year prior to the IPO, *Return on Assets* is defined as net income divided by total assets in the year prior to the IPO while *% Independent* is the number of independent directors on the board of directors. *, **, *** denotes significance at 10%, 5% and 1%, respectively.

a bias (see, e.g., Doidge et al., 2004; Baileya et al., 2006; Fernandes and Ferreira, 2008; Foucault and Frésard, 2012).

In the first stage of the Heckman model, we employ a probit regression to estimate the probability that a firm is likely to undertake a foreign IPO for the Chinese sample, and the probability that a firm is from a foreign market for the Hong Kong sample. We then use the estimate of the probit value to estimate the inverse mills ratio, which is then added to our main regression model as an additional variable. If there is a self-selection issue, we expect the inverse mills to be statistically significant. We construct the first stage regression based on Hung et al. (2011) who consider the cross-listing decision by Chinese firms.[9] However, as not all the variables employed in this model are appropriate in the context of Hong Kong firms, we modify the regression such that we can employ the same first stage model for both samples.

Our first stage estimates the probability of undertaking, or being, a foreign IPO as a function of the Herfindahl score for the firms industry, measured as the sum of the square of each firms market share based on sales revenue, as Hung et al. (2011) argue that firms in uncompetitive industries maybe more likely to undertake a foreign listing. In addition, Hung et al. (2011) includes the firms leverage ratio (measured as the book value of debt divided by the firms' total assets), firm size (measured as the firms total assets), the return on assets and the percentage of independent directors. All variables were measured in the year prior to the firms IPO.

Table 7 presents the results for the Heckman procedure for our Hong Kong matched sample. In the first stage, we find that larger firms and those with fewer independent directors are more likely to be foreign IPO firms. For the second stage, we include the inverse mills ratio into the same regression model employed in Table 6. The inverse mills ratio is significant for four of the models, the two spread decomposition models, the variance ratio and the return predictability of trade imbalance, suggesting that these models are impacted by self-selection issues. We find that once we control for self-selection biases, there is no real change in the results. We only observe significance for the *MRR* variable indicating that the proportion of asymmetric information in the spreads is larger for foreign IPOs based on this decomposition model. However, the *LSB* variable remains insignificant. The only other significant variable is the variance ratio which indicates foreign IPOs have lower variance ratios, supporting the earlier findings in Table 6.

Table 8 presents the results of the Heckman procedure for the Chinese matched sample. In the first stage, we see that, consistent with Table 7, larger firms are more likely to be a foreign IPO firm. However, in contrast with Table 7, a Chinese firm is more likely to take on an IPO in Hong Kong if it has more independent directors than comparable Chinese firms, and also if it has relatively less leverage. The results in the second stage are again largely unchanged with the exception of the percentage and effective spreads which become insignificant. Both of these measures have significant inverse mills ratios suggesting that there is an issue with self-selection for these models, likely driving the significance in Table 6. Of note, the spreads for the Chinese IPO firms are lower than for the foreign IPO firms, however, the results in Table 8

[9] One notable difference between Hung et al. (2011) and our study is that we use a Heckman two-stage sample selection model to calculate the inverse mills ratio which is then used in the second stage, while Hung et al., uses the predicted value of first-stage regression to control for the possibility of cross-listing in Hong Kong exchanges.

suggest that once we control for liquidity and self-selection biases there is no significant difference. Additionally, the inverse mills ratio is also significant for the variance ratio but for the other dependent variables self-selection does not appear to play a role.[10]

5. Conclusion

In this paper, we aim to investigate how investors perceive the information risk of a foreign IPO. Foreign IPO firms generally generate information and undertake their business within one country, and at the same time they are bound by the rules and laws of another. We explore this issue by examining Chinese firms that undertake their IPOs on the Hong Kong stock exchange between 1996 and 2012. Employing intraday tick data, we examine the asymmetric information component of the bid-ask spread, and also test the weak-form market efficiency of the foreign IPO firms. We find that while the foreign IPO firms are generally perceived as having similar information asymmetry to Hong Kong IPO firms, as well as having similar levels of price efficiency. In contrast, IPOs on the Chinese exchanges have much higher levels of priced information asymmetry and lower price efficiency compared to the foreign IPOS. From an informational point of view, investors in the Hong Kong market largely treat Chinese firms listed for the first time in Hong Kong as if Hong Kong was their home market. Our findings provide some evidence in line with the legal and reputation bonding arguments, which suggest listing in markets with stronger disclosure and listing rules can signal that a firm has lower information risk. Another implication of our results is that it is the location of share trading of a firm that matters to investors rather than the location of business.

However, we would like to caution the reader that while we have attempted to address the issue of self-selection bias in the decision to seek a foreign IPO using matched samples and the Heckman procedure, these are not perfect solutions. In particular, we find certain differences between our foreign IPO firms and both Chinese and Hong Kong matched samples. Further research on this issue is warranted to confirm our findings. Additionally, the announcement of an agreement between the Hong Kong and Shanghai stock exchanges to allow inter-market trading may also offer extra research opportunities to examine pertinent issues related to foreign IPOs.

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Appendix A. Data construction

Data for each foreign IPO and matched firm is collected from Thompson Reuters Tick History (TRTH). Specifically we collect information on each trade, including the time, price and volume traded, and each quote revision, including the new best bid and ask price. We first match the prevailing quotes at the time of the each trade as the latest inside quotes immediately prior to the trade. Peterson and Sirri (2003) show that using contemporaneous quotes, rather than lagging quotes up to 5 s, results in less bias in estimates.

We then filter the data to exclude trades that occur outside the normal trading hours of the market; for Stock Exchange of Hong Kong this runs from 9:30 am–12 pm and 1 pm–4 pm, for the Shanghai Stock Exchange normal hours are 9:30 am–11:30am and 1 pm–3:30 pm while Shenzen Stock Exchange runs from 9:30 am–11:30am and 1 pm–3 pm. Trades occurring outside normal hours, including opening and closing auction periods, may have different characteristics and so are excluded.

We next determine the trade indicator variable. We start by excluding all trades where either the trade, bid or ask prices are 0, suggesting a data error. As the direction of a trade is unavailable from TRTH, we employ the Lee and Ready (1991) trade direction algorithm. This assigns a 1 to buyer initiated trades, defined as transaction where the price occurs above the midpoint of the prevailing quotes, and −1 to seller initiated trades where the transaction price is below the quoted midpoint. As per Lee and Ready (1991), trades at the midpoint, which occur relatively infrequently in our dataset, are then assigned based on the tick rule where a trade is defined as buyer initiated if they occur at a price above the last transaction price that is different to the current trade price, or seller initiated if they are below the last different transaction price. This allows us to successfully sign virtually all trades with the exception of rare instances where trades at the beginning of the sample period occur at the midpoint.

As a final step before we estimate the variables, we calculate returns and exclude any trades that exceed specific thresholds. We estimate with thresholds of 20%, 10% and 5% and also without any exclusion of outliers. At the 10% threshold we exclude in total 2825 trades out of a total of over 21 million trades with the maximum for 1 company being 195 out of 96,439 trades. On average we exclude less than .013% of trades and for the matched samples the figures are smaller again, excluding less than .001%. The choice of threshold may no real difference to the final outcome of the testing.

[10] An additional robustness test that was conducted relates to the reduction in minimum tick size that occurred in 2005 on the Hong Kong Stock Exchange. In results not reported here, but that are available on request, we find that when we repeat Table 6, compare the foreign IPOs with Chinese matched IPOs, we find that the spread measures cease to be significant either before or after the change in minimum tick size, but we find strong significance for all the other measures, including the autocorrelation in the post 2004 period. The results again support our findings that foreign IPO firms have significantly lower information risk and better weak form price efficiency.

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