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PARAMETER UNCERTAINTY: EVIDENCE FROM  
CHINESE A- AND H-SHARES**

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# Explaining Share Price Disparity with Parameter Uncertainty: Evidence from Chinese A- and H-Shares

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## Abstract

The price disparity between the dual-listed Chinese firms in the A- and H-share markets is one of the most intriguing puzzles in the Mainland and Hong Kong financial markets. In this paper, we revisit this price disparity puzzle using the channel of parameter uncertainty. In the presence of information asymmetry and market segmentation, investors have different views on a firm's asset volatility, and hence, different valuations of the same reference firm. We estimate a structural model for equity pricing using a Bayesian approach, in which investors' model-parameter uncertainty is represented by the posterior distributions of the firm's asset volatility. Our regression analysis shows that parameter uncertainty explains variation of the price disparity, in addition to other market-based and macro factors. We also find that parameter uncertainty is related to a firm's market-to-book ratio of equity, its age and size, and global risk appetite in the financial market.

Keywords: Market Segmentation, A and H Shares, Uncertainty

JEL Classification: C11, G13, G32

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## 1. Introduction

The price disparity between the dual-listed Chinese firms in the A- and H-share markets<sup>1</sup> is one of the most intriguing puzzles in the Mainland and Hong Kong financial markets. Despite having the same voting rights and dividend payments for A- and H-shares, their respective markets are segmented by institutional barriers as individual foreigners are not allowed to purchase A-shares directly. Foreign investors (offshore investors) can only access the A-share market under the Qualified Foreign Institutional Investor program (QFII). The QFII was first set up in 2002 which would allow approved offshore investors to access the A-share market. However, QFII is only made available to institutional investors, with the turnover amount limited by an investment quota system.<sup>2</sup> Similarly, investors on the Mainland (onshore investors) are not allowed to invest abroad outside the Qualified Domestic Institutional Investor (QDII) program launched in 2006, which allows institutional investors to invest in offshore securities markets subject to a quota system as in QFII.<sup>3</sup> Despite the increasing degree of integration of the two markets in recent years, most of the onshore A-shares have usually been priced with premiums relative to their corresponding offshore H-shares – also known as the AH share price disparity.

Established explanations for why price disparity exists between onshore and offshore financial markets can be classified into five hypotheses. First, Hietala (1989), Bailey (1994), and Fernald and Rogers (2002) argue onshore and offshore investors may require different risk premiums (and thus different returns) due to the segmentation between the two markets. Second, Domowitz et al. (1997) and Sun and Tong (2002) find that the demand facing onshore and offshore investors may be different due to the differences in their investment opportunities. Third, Chan and Kwok (2005) show that the price disparity is also related to the differences in the liquidity conditions across the Hong Kong and Mainland stock markets. Fourth, Chakravarty et al. (1998) argue that the information received by onshore and offshore investors is different, and hence they will have different valuations of the same firm due to asymmetric information. Finally, the price disparity can also be related to macroeconomic conditions on the Mainland. Fong et al. (2010) demonstrate that a persistent trade surplus and the appreciation of renminbi can cause more saving, and hence encourage Mainland investors to purchase more stocks domestically.

This paper gives a new economic explanation of the AH share price disparity by applying the contingent claims analysis of equity-pricing in the presence of model-parameter uncertainty. Our model shares the theoretical insights from Pastor and Veronesi (2003) that investors are unsure about model parameters. In their model, uncertainty about the firm's average profitability due to incomplete

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<sup>1</sup> A-shares refer to stocks listed on the stock exchanges in Shanghai or Shenzhen with denomination in the renminbi. H-shares refer to stocks listed on the Hong Kong Stock Exchange with denomination in the Hong Kong dollar.

<sup>2</sup> The investment quota is approved by the State Administration of Foreign Exchange (SAFE). At April 2011, the SAFE has granted a total of 103 licensed institutions with total QFII quotas of US \$20.7 billion.

<sup>3</sup> Similar to QFII, the quota system is administrated by the SAFE. At April 2011, the SAFE has granted a total of 92 institutions with total QDII quotas of US \$72.6 billion.

information can lead to a higher market-to-book ratio of equity. They rationalise the technology boom in the US in the late 1990s may not be a bubble. We extend their idea of parameter uncertainty to the case of dual-listed firms in the Chinese stock markets. In our framework, investors need to infer the unobservable level and volatility of a firm's asset value to form their own equity valuation. We model investors' decision making process using a Bayesian framework in which they have to infer the posterior distribution of model parameters by solving a filtering problem, given their prior beliefs over the model-parameters and the observed data (e.g., historical equity prices, news and accounting data). Due to the discrepancy in the information sets perceived by the Mainland and Hong Kong investors, it is possible that they would have different valuations because their estimates about the level and volatility of the firm's assets are different. As a result, the model would yield different prices for a firm's A- and H-shares even if the underlying cash-flow and fundamentals of the firm are equivalent.

Our paper is also related to the corporate finance literature of incomplete accounting information. Duffie and Lando (2001) study the theoretical implications of incomplete accounting information for credit spreads and argue that periodic and imperfect accounting reports are a major source of parameter uncertainty. Their theoretical insights have been examined empirically by recent works of Korteweg and Polson (2010) and Cremers and Yan (2010). These studies show that investors' uncertainty about firms' asset values and their volatility explains a large portion of credit spreads in the US corporate bond market. This paper shows that parameter uncertainty is also applicable for explaining the AH share price disparity in the Chinese stock markets.

In this paper, we adopt the contingent claims analysis approach to pricing corporate bonds and equities based on the Merton (1974) model. In the Merton model, equity can be considered as a call option on a firm's asset value, which is unobserved in nature. Considering the Bayesian framework, we follow Korteweg and Polson (2010) and Huang and Yu (2010) to estimate the Merton model using the Markov Chain Monte Carlo (MCMC) method.<sup>4</sup> Based on the market data of equity prices and balance-sheet information, the MCMC method allows us to uncover the posterior distributions of a firm's asset value and its volatility. According to Bayes' theorem, these posterior distributions provide a succinct summary of the dispersion in investors' prior views as reflected by the observed historical data.<sup>5</sup>

Using daily equity prices and balance-sheet data of 44 dual-listed firms in the Hong Kong and Mainland stock markets over the sample period from 2006 to 2010, we estimate the parameters of the Merton model on a non-overlapping quarterly basis. The posterior standard deviation of firms' asset

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<sup>4</sup> Duan and Fulop (2009) show that particle filtering-based maximum likelihood estimation (MLE) is an alternative estimation method in the presence of pricing errors. Huang and Yu (2010) compare the parameter estimates of the Merton model using both particle filtering-based MLE and the MCMC method. They conclude that estimates from the MCMC are preferable as the MCMC eases the computation burden from numerical optimisation and the resulting estimates are more accurate as it avoids the boundary problem imposed by model-parameters (e.g., the zero bound imposed by the volatility of the firm).

<sup>5</sup> The Bayes theorem states that posterior probability is proportional to the product of prior probability and the likelihood given by data.

volatility is used to measure the level of parameter uncertainty. Regression analysis shows that parameter uncertainty is a robust variable in explaining variation in the AH share price disparity, in addition to other control variables which are used in previous studies. To our knowledge, this is the first attempt to apply the contingent claims approach and Bayesian analysis to investigate the AH-share price disparity. Our empirical findings suggest that parameter uncertainty complements the existing theories in explaining the AH share price disparity. We also shed light on the determinant of parameter uncertainty in our sample. Firms with high market-to-book ratio of equity, young in age and small in size are more prone to parameter uncertainty because of less information and shorter history of disclosure about their value and growth potential from an accounting perspective.

The rest of the paper is outlined as follows. Section 2 presents the recent development of the AH share price disparity. Section 3 introduces the structural equity-pricing model and illustrates how parameter uncertainty may arise in the framework. Section 4 discusses the econometric estimation of the model. In Section 5, we present the MCMC estimate and relate parameter uncertainty with the AH share price disparity, in the presence of other control variables which are used in previous studies. The determinant of parameter uncertainty and its relationship with the aggregate volatility index would also be discussed. Section 6 concludes.

## 2. Recent Development in the AH Share Price Disparity

Figure 1 shows the Hang Seng China AH Premium Index (henceforth, premium index) and its two components, the Hang Seng China AH (A) Index and the Hang Seng China AH (H) Index from the beginning of 2006 to the end of 2010.<sup>6</sup> The indexes consist of the dual-listed firms which have A-shares listed on the Shanghai Stock Exchange or the Shenzhen Stock Exchange and H-shares listed on the Main Board of the Hong Kong Stock Exchange.<sup>7</sup> The premium index is a weighted average of the premiums or discounts of A-shares over H-shares, normalised to 100 at 9 July 2007. Following Peng et al. (2007), we focus our analysis after 2006 to avoid the possible impact of structural changes in the renminbi exchange rate regime and the A-share market reforms in 2005.<sup>8</sup>

As shown in Figure 1, A-shares were initially traded at discounts relative to H-shares at the beginning of 2006. Since May 2006, A-shares started to be traded in premiums and prices of both A- and H-shares were on rising trends with their gap being widened. The latter observation suggests that the AH share price disparity was mainly brought by a stronger growing momentum in the Mainland stock market. The premium index continued to rally and reached the highest level of 195 in January 2008.

<sup>6</sup> Although the Hang Seng China AH premium Index was first launched on 9 July 2007, it can be backdated to 3 January 2006. If the index is higher (lower) than 100, it means that, on a weighted-average sense, A-shares are traded at a premium (discount) relative to H-shares. For the detailed calculation methodology and historical changes of the constituents, see <http://www.hsi.com.hk/HSI-Net/HSI-Net>.

<sup>7</sup> To be eligible for inclusion, companies in the A-share market must satisfy three criteria: 1) rank in the top 90% of total market turnover over the past 12-month period; 2) are not classified as special treatment stocks; and 3) have not been suspended for over one month as of the end of any review period. On the other hand, companies in the H-share market must be the constituents of the Hang Seng China Enterprises Index.

<sup>8</sup> The non-tradable share reform on 29 April 2005 increased the tradable share in the A-share market substantially. The Mainland authorities also allowed for a one-time revaluation of the renminbi on 21 July 2005.

This number indicates that the weighted average price for A-shares was almost two times more expensive than that of H-shares. On an individual stock level, the price disparity was more pronounced. In January 2008, one constituent stock in the premium index experienced a price difference of 280% between its A- and H-shares. Meanwhile, on a cross sectional level, there was also substantial heterogeneity for the premiums across the constituents at that time, with their price differences ranging from 16% to 280%.

Shortly after January 2008, both A- and H-share prices fell markedly. Despite their simultaneous declines, A-shares were still more expensive than H-shares amid the Lehman default in September 2008. However, this trend has reversed since the launch of the index futures for A-shares in early 2010. Compounded by the weak market sentiment caused by the turbulence of the European sovereign debt crisis, the year-on-year return for A-shares was -20.4%, compared to 2.2% for H-shares in 2010. Because of the A-shares' poor performance, the AH share disparity edged down significantly and remained around the parity level in the second half of 2010.

While the AH share price disparity as measured by the premium index has appeared to diminish in recent years, the disparity still exists on an individual stock basis. Table 1 shows the closing prices of the constituent stocks in the premium index in both A- and H-share markets and their respective AH premiums at 31 December 2010. The individual firm's share price disparity is constructed as the ratio of each firm's exchange rate adjusted AH share price difference to its H-share price.<sup>9</sup> A positive disparity indicates the exchange rate adjusted price of a firm's A-share is more expensive than its H-share price. It can be seen that there is substantial heterogeneity in the disparity, with a range from -23.8% to 163.1%, indicating that idiosyncratic price differences still exist in many constituent stocks.

Korteweg and Polson (2010) show that parameter uncertainty about asset values and volatilities are higher during times of market distress. If the AH share price disparity is driven by investors' uncertainty, we should see the premium index co-move with some standard measures of investors' uncertainty. We use the AlphaShare China Volatility Index and the HSI Volatility Index as the measures of investors' uncertainty in the two markets.<sup>10</sup> Figure 2 depicts the time-series movements of the premium index and two volatility indexes. The premium index moves in tandem with the volatility indexes most of the time in the sample period, while the magnitudes of the spike in the volatility indexes are more pronounced than that of the premium index when Lehman Brothers filed for bankruptcy protection in September 2008. The correlation coefficient in first difference for the premium index and the HSI Volatility Index (the AlphaShare China Volatility Index) is 0.44 (0.36),

<sup>9</sup> Hong Kong dollar per one renminbi is 1.1796 at 31 December 2010.

<sup>10</sup> The AlphaShare China Volatility Index and the HSI Volatility Index were launched in July 2009 and February 2011 respectively. These two volatility indexes use option prices to track stock market volatility. Both indexes employ the methodology similar to that used for the Chicago Board Options Exchange Volatility Index (VIX) and are backdated to January 2006. The difference between them is that the HSI volatility index uses options information for the Hang Seng Index only, while the AlphaShare China Volatility uses both options information for both the Hang Seng Index and the iShare FTSE China 25 Index, with the latter index tracks 25 of the largest companies on the Mainland by market value.

suggesting that the AH share price disparity is closely related to the changes in investors' uncertainty.<sup>11</sup>

### 3. The Structural Model for Equity-Pricing

We assume that a firm generates after-tax cash flows with the dynamics

$$\frac{dC_t}{C_t} = gdt + \sigma dW_t^P, \quad (1)$$

where  $g$  and  $\sigma$  are the expected growth rate and volatility of the cash flows, and  $dW_t^P$  is a standard Brownian motion under the physical measure  $P$ . The market value of asset  $V_t$  can be formulated as the discounted cash flow with a discount rate  $r$  as

$$V_t = E_t \left[ \int_t^{\infty} e^{-r(s-t)} C_s ds \right] = \frac{C_t}{r - g}, \quad (2)$$

with  $g < r$  such that the firm's asset value is finite and well-defined. Goldstein et al. (2001) show that the dynamics of  $V_t$  follows

$$\frac{dV_t}{V_t} = \mu dt + \sigma dW_t^P, \quad (3)$$

where  $\mu = g$  and  $\sigma$  are the expected return and volatility of the firm's assets. This illustrates that the expected growth and volatility of the firm's cash flow are directly linked to the expected return and volatility of the firm's asset value. Following Merton (1974), we assume that the firm has a simple capital structure and issues only two types of claims - equity ( $S$ ) and a zero coupon debt ( $F$ ) with time-to-maturity of  $T$ . When the debt matures, the firm pays back its debt and equity holders receive the residual claims of the firm's asset (i.e.,  $V_T - F$ ); otherwise, default occurs when the amount of assets at the debt maturity fails to meet the obligations of liability and equity holders will receive nothing. Under such setting, the firm's equity is a European call option on the asset value with a strike price  $F$  and time-to-maturity of  $T$ .<sup>12</sup> Assuming that the firm's asset value and its volatility are known and the no-arbitrage argument, the equity value  $S_t$  at time  $t$  can be obtained as the expectation under the risk-neutral measure  $Q$ :

<sup>11</sup> The correlation coefficient for the level of the premium index and the HSI Volatility Index (the AlphaShare China Volatility Index) is 0.60 (0.62).

<sup>12</sup> In a similar fashion, debt can be priced as a European put option on the firm's assets with the same strike price  $F$ .

$$\begin{aligned}
S_t &= S(V_t, \sigma) \\
&= E_t^Q \left[ e^{-r(T-t)} \max(V_T - F, 0) \mid V_t, \sigma \right], \\
&= V_t \Phi(d_t) - F e^{-r(T-t)} \Phi(d_t - \sigma \sqrt{T-t})
\end{aligned} \tag{4}$$

where

$$d_t = \frac{\log(V_t / F) + \left( r + \frac{\sigma^2}{2} \right) (T-t)}{\sigma \sqrt{T-t}},$$

$r$  is the constant risk-free interest rate,  $\Phi$  is the standard cumulative normal distribution. It is worth noting that the expected return  $\mu$  has no effect on the market value of equity because the fair option value is determined under the risk-neutral probability measure.

In Eq. (4), we denote  $S_t = S(V_t, \sigma)$  to stress the dependence of the pricing formula on  $V_t$  and  $\sigma$ . That is, when investors know exactly the firm's asset value and its volatility, they can price the equity value of the firm by the pricing formula.<sup>13</sup> In reality, however, both  $V_t$  and  $\sigma$  are not observable and different investors could have different estimates based on their information sets. The extent to which their information sets are different is affected by any publicly available information such as accounting data and earning forecasts, or any beliefs and views regarding the firm's valuation and its asset value volatility. In the context of the Chinese stock markets, the price disparity could be attributed to the differences between Mainland and Hong Kong investors' estimates of the firm's asset volatility when they apply the structural equity-pricing model. Plugging different model parameters into the pricing formula of Eq. (4) would then yield different valuations of the firm's equity.

We provide a simple numerical example to illustrate the effect of parameter uncertainty on the price disparity of a dual-listed firm. Suppose a firm has a one-year zero-coupon bond with a face value of 100 and for simplicity, we let the risk-free rate be zero. Investors also know that the firm's asset value is 105, but they are unsure about the firm's asset volatility. Figure 3 illustrates the pricing function implied by the model. Standard property of a call option implies that a firm's asset volatility and its equity value are positively related.<sup>14</sup> If Mainland investors perceive a higher volatility estimate ( $\sigma_{China}$ ) than that ( $\sigma_{HK}$ ) perceived by Hong Kong investors, given other things being equal, the equity price ( $S_{China}$ ) inferred by Mainland investors must be higher than that ( $S_{HK}$ ) inferred by Hong Kong investors. Furthermore, if the degree of parameter uncertainty is higher (i.e., a larger gap between  $\sigma_{China}$  and  $\sigma_{HK}$ ), the disparity in equity price would also be larger. This positive relationship

<sup>13</sup> Other model parameters including debt ( $F$ ), interest rate ( $r$ ) and the time-to-maturity of the debt ( $T-t$ ) are observable.

<sup>14</sup> It can be shown that  $\frac{\partial S_t}{\partial \sigma} = V_t \phi(d_t) \sqrt{T-t} > 0$ , where  $\phi$  is the probability density function for standard normal. This partial derivative is called vega in option pricing studies.

between the degree of parameter uncertainty and the magnitude of the price disparity is the key intuition behind our approach to explaining the AH share price disparity. This latter observation motivates our choice in using the posterior standard deviation of  $\sigma$  as a measure of parameter uncertainty.

The model generates more expensive A-shares than the corresponding H-shares whenever Mainland investors tend to incorporate higher uncertainty of the firm's assets (i.e., higher asset volatility) into their equity valuation than Hong Kong investors do, and vice versa. This is in line with the anecdotal evidence provided by Chan and Kwok (2005) that the Hong Kong investors have better access to market-wide information due to the information barrier on the Mainland (i.e.,  $\sigma_{HK} < \sigma_{China}$ ). As a result, the parameter uncertainty hypothesis resolves the puzzle that while shares in offshore markets are usually traded in premiums relative to those in onshore markets in other economies,<sup>15</sup> a majority of the H-shares in Hong Kong have been traded at a discount relative to the corresponding A-shares on the Mainland.<sup>16</sup>

#### 4. Bayesian Estimation of the Model

This section explains how to estimate the Merton model for the dual-listed firms and obtain the measure of parameter uncertainty using the MCMC method. We approximate the continuous time diffusion Eq. (3) based on the Euler discretisation as

$$\ln V_{t+1} = \left( \mu - \frac{\sigma^2}{2} \right) h + \ln V_t + \sigma \sqrt{h} \varepsilon_t, \quad (5)$$

where  $\varepsilon_t \sim N(0,1)$  and  $h$  is the sampling interval between observations. We further assume that the equity value is observed with a measurement error such that

$$\begin{aligned} \ln(S_t) &= \ln S(V_t, \sigma) + v_t \\ &= \ln \left[ V_t \Phi(d_t) - F e^{-r(T-t)} \Phi(d_t - \sigma \sqrt{T-t}) \right] + v_t, \end{aligned} \quad (6)$$

where  $v_t \sim N(0, \delta)$  is the measurement or pricing error. This assumption follows Duan and Fulop (2009), Huang and Yu (2010) and Korteweg and Polson (2010). Korteweg and Polson (2010) assume equity holders do not exactly know the value of the firm. They use the correct value on average, which may be off with an error from time to time. Alternatively, this pricing error can be interpreted as the market microstructure noise found by Duan and Fulop (2009) and Huang and Yu (2010), which exists

<sup>15</sup> See Hietala (1989) for the Finnish stock market and Domowitz et al. (1997) for the Mexican stock market.

<sup>16</sup> As shown in Table 1, more than 60% of the constituent stocks in the AH premium index still experienced higher exchange rate adjusted prices in their A-shares at the end of 2010.

in high frequency US equity data. In our model, the inclusion of the pricing error prevents over-estimation of the asset volatility due to model risk. In closely related studies, Ait-Sahalia et al. (2005) and Bandi and Russell (2006) demonstrate the importance of identifying the pricing errors, especially when one estimates the model using high frequency data (which is the case in our estimation).

Given a time series of equity prices for each firm,  $S^T = \{S_t\}_{t=1}^T$ , we need to infer the sequence of latent asset values  $V^T = \{V_t\}_{t=1}^T$  and parameters of the model  $\Theta = (\mu, \sigma, \delta)$  using Eqs. (5) and (6). We estimate the model using the Bayesian MCMC method based on the joint posterior distribution of parameters and latent asset values given the observed prices,  $p(V^T, \Theta | S^T)$ . By Bayes' theorem, the posterior distribution of the unobservable given the data is proportional to the prior multiplied by the likelihood function:

$$p(V^T, \Theta | S^T) \propto p(\Theta) \times \prod_{t=2}^n p(\ln V_t | \ln V_{t-1}, \Theta) \times \prod_{t=2}^n p(\ln S_t | \ln V_t, \Theta).$$

It is noted that the equity pricing formula in Eq. (4) enters into the estimation when we compute the likelihood function  $p(\ln S_t | \ln V_t, \Theta)$ .

The joint posterior distribution, however, is usually a high dimensional object which precludes any efficient sampling algorithm. The use of the MCMC method can circumvent this problem by decomposing the complicated joint posterior distribution into a hierarchy of conditional distributions, which makes the sampling feasible. In theory, the joint posterior distribution  $p(V^T, \Theta | S^T)$  can be characterised by two conditional distributions: (i) the conditional distribution of latent asset values,  $p(V^T | S^T, \Theta)$ ; and (ii) the conditional distribution of parameters,  $p(\Theta | S^T, V^T)$ . Under mild regulatory conditions,<sup>17</sup> it can be shown that iterative draws from  $p(V^T | S^T, \Theta)$  and  $p(\Theta | S^T, V^T)$  for many times can assure that drawing from those simpler conditional distributions is equivalent to drawing from a complicated joint posterior distribution. Such iterative drawing from a hierarchy of conditional distributions is called the Gibbs sampling in the Bayesian analysis. In this paper, we make use of the software routines MATBUGS, a Matlab interface to the all-purpose Bayesian package WinBUGS, to perform the MCMC method using the Gibbs sampling.<sup>18</sup> To minimise the effect of the initial conditions and ensure the convergence of the Markov chain, we choose the number of iterations of the Gibbs sampler to be 50,000 and discard the first 10,000 burn-in samples. We conduct statistical inference (mean, variance, median, etc.) based on the sample from these remaining draws.<sup>19</sup>

<sup>17</sup> The regulatory conditions ensure that the draws from the conditional distributions form a convergent Markov Chain. For details, see Johannes and Polson (2009).

<sup>18</sup> We would like to thank Jun Yu for sharing his WinBUGS code with us.

<sup>19</sup> See Johannes and Polson (2009) for the technical details of MCMC estimation of the continuous time model. See also Meyer and Yu (2000) and Huang and Yu (2010) for the applications of WinBUGS in finance.

## 5. Data and Empirical Analysis

In this section, we describe the data used in this study and provide the MCMC estimates of the dual-listed firms. We then investigate the relationship between parameter uncertainty and the AH share price disparity through a panel regression framework. Finally, we explore the determinants of parameter uncertainty.

### 5.1 Data

We construct an unbalanced quarterly panel dataset of 44 dual-listed firms over the sample period from 2006 to 2010.<sup>20</sup> Time series data on firms' daily equity values ( $S$ ), debts ( $F$ ), time-to-maturity ( $T-t$ ) and the risk-free interest rate ( $r$ ) are used as inputs for estimating the model to obtain the measure of parameter uncertainty. Equity values for these dual-listed firms consist of price and quantity information for their A- and H-shares and are defined as  $S = P_A \times Share_A + P_H \times Share_H \times CNY$ , where  $P_A$  and  $P_H$  are the closing prices of firms' A- and H-shares respectively. Similarly,  $Share_A$  and  $Share_H$  are the numbers of firms' outstanding A- and H-shares respectively.  $CNY$  denotes the spot exchange rate of the renminbi per unit of the Hong Kong dollar. We follow Vassalou and Xing (2004) to set  $F$  as the sum of the short-term debt and half of the long-term debt.<sup>21</sup> The time-to-maturity of the debt is set to be one year. As the majority of the firms in our sample have their main operations on the Mainland, their asset and debt values should be more sensitive to the Mainland's monetary conditions, so we use the one-year base interest rate of the People's Bank of China as the risk-free interest rate ( $r$ ) in the model.

For variables used in the regression analysis, an individual stock's disparity (*disparity*) is defined as the ratio of each firm's exchange rate adjusted A- and H-shares price differences to its H-share price, i.e.,

$$Disparity = \frac{P_A \times CNY - P_H}{P_H}$$

For market-based and macro factors which have been identified in the previous studies, their definitions are follows:

- I. A proxy for the difference in risk appetite (*risk*) between onshore and offshore investors is defined as the logarithm of the ratio between the 30-day annualised volatility of A-shares and that of H-shares, as suggested by Hietala (1989) and Bailey (1994);

<sup>20</sup> All the data used in the paper are obtained from Bloomberg and CEIC database. The choice of 44 dual-listed firms is based on the constituents of the AH premium index at the end of December 2010.

<sup>21</sup> Customer deposits are included in the seven banks' short-term debt in the sample.

- II. A proxy for the possibility of informational asymmetry (*mktcap*) between the two markets is captured by the size (market capitalisations) of the firm, suggested by Chakravarty et al. (1998);
- III. The possibility of different liquidity conditions (*liquidity*) between the two markets is captured by the logarithm of the trading volume of total outstanding shares in the A-share market over that in the H-share market;
- IV. Relative supply of A-shares over H-shares (*supply*) is used to control for the possibility of differential demand between onshore and offshore investors, and is defined as the logarithm of the ratio of the number of outstanding shares in the A-share market to that in the H-share market, following the suggestion by Domowitz et al. (1997);
- V. The expected appreciation of the renminbi (*cur*) is defined as the quarterly growth rate in the 12-month renminbi non-deliverable forward exchange rate; and
- VI. The money growth (*moneygrowth*) is defined as the quarter-on-quarter growth rate in the Mainland's money supply (M2)

We refer (I)-(IV) as the market-based factors and (V)-(VI) as the macro factors. Table 2 provides summary statistics for these variables. To investigate the determinants of parameter uncertainty, we also collect accounting data for the firms in our sample and they are available semi-annually only. These accounting variables will be discussed in subsection 5.4.

## 5.2 MCMC Estimate of the Structural Model

We estimate the structural model for each firm-quarter, using the time series of daily equity values over each quarter on a non-overlapping basis. Table 3 reports the posterior means and standard deviations for the firms' asset volatilities and pricing errors.<sup>22</sup> The estimated average firms' asset volatility,  $\sigma$ , is 28% across firm-quarters, and its standard deviation (our measure of parameter uncertainty) is around 3%. The small and yet significant estimate of the pricing error,  $\nu$ , indicates that although we cannot reject the existence of the pricing errors in our sample, its quantitative implication for our empirical results is likely to be negligible.

## 5.3 Panel Regression Analysis

We use regression analysis to study how parameter uncertainty is related to the price disparity. We are interested in not only whether parameter uncertainty ( $SD\sigma$ ) is a qualitatively important factor in explaining the AH disparity, but also its quantitative economic impact. Moreover, we test whether the relationship between parameter uncertainty and the price disparity is robust and distinct from the previously identified market-based and macro factors which are the control variables in the analysis.

<sup>22</sup> The estimate for expected return,  $\mu$ , is not reported as it is not the objective of this paper.

The regression framework is an extension of Domowitz et al. (1997) in which the dependent variable (*disparity*) can be explained by its previous lag and  $SD\sigma$ , together with the market-based and macro factors. The regression model is

$$disparity_{it} = \beta_1 disparity_{it-1} + \beta_2 SD\sigma_{it} + \beta_3 supply_{it} + \beta_4 liquidity_{it} + \beta_5 risk_{it} + \beta_6 mktcap_{it} + \beta_7 cur_t + \beta_8 moneygrowth_t + \pi_i + \delta_{it}, \quad (7)$$

where  $\pi_i$  and  $\delta_{it}$  are the unobserved firm-specific effects and the error term in the model.

It is well known that the inclusion of a lagged dependent variable would induce endogeneity problems between the regressors and the error term. To overcome this endogeneity problem, we use the system generalised-method-of moments (GMM) estimator developed for dynamic panel models by Arellano and Bover (1995) and Blundell and Bond (1998).<sup>23</sup>

The results are summarised in column 1 of Table 4. Hansen J-statistics and the AR(2) serial correlation test suggest that our models are adequate and the instruments are valid. We summarise the estimation results as follows:

1. Lagged disparity: Similar to the previous findings, the lagged disparity is positive and statistically significant, indicating that the disparity itself is highly auto-correlated. The level of persistence estimated in our model (around 0.4) using quarterly data is slightly lower than those estimated in the previous studies (around 0.6 to 0.7) using monthly data.
2. Parameter uncertainty: The posterior standard deviation of the firms' asset volatility is a significant factor for the price disparity. Regarding its sign and magnitude, a positive and significant estimate of 15.74 means that for every one percentage-point increase in  $SD\sigma$ , the price disparity will increase by around 15.74%.
3. Market-based factors: The results show that the market capitalisations and differential demand are insignificant. As all listed companies in both the Mainland and Hong Kong stock markets have been required to be compliant with relative high information/financial disclosure standards in recent years, market capitalisation may not be an appropriate measure of information asymmetry. Regarding the demand factor, the relative scarcity of A-shares over H-shares is not an important factor in explaining the price disparity, reflecting that the lack of substitutes for stock investment on the Mainland is no longer a driving factor of equity prices. The differential liquidity condition is still an important factor with the sign in line with the

<sup>23</sup> The system GMM combines the regression in levels (i.e., Eq.(7)) and its first-difference in a system of equations for identification and estimation. Blundell and Bond (1998) show that in case of persistent explanatory variables, this estimator achieves higher efficiency compared to the differenced GMM estimator in Arellano and Bond (1991) which only utilises the information from the first-differenced equation. We have also estimated our model using differenced GMM, and the main result relating parameter uncertainty and the price disparity remains unchanged. Details are available upon request.

previous finding. However, we observe that the difference in risk level is now negatively related to the price disparity, contrary to the previous finding which argues that A-shares are more expensive due to the fact that Mainland investors are more risk tolerant and hence willing to pay higher prices with the same level of risk (proxy by the realised volatility). A closer look at Figure 1 reveals that such argument may not be applicable in our sample period. Around the onset of the subprime financial crisis at the end of 2007, volatility in both markets spiked, but the selloff pressure in the A-share market was much stronger than that in the H-share market. This suggests that price disparity and volatility may not necessarily be positively related once we extend the time series to include the subprime crisis.

4. Marco factors: Consistent with the finding in Fong et al. (2010), renminbi appreciation is negatively related to the disparity while money supply growth is positively related to the disparity. However, the estimated coefficients are only significant at the ten-percent level, indicating that their roles in explaining the AH disparity may not be as important as the other factors.

We perform two robustness checks to verify the significance of parameter uncertainty in explaining the price disparity. The regression in column 2 drops the variables which are not significant in column 1, while the model in column 3 includes the disparity on its lag and market-based factors only.<sup>24</sup> Comparing the coefficients on parameter uncertainty across the three specifications, the sign and significance of parameter uncertainty remain largely unchanged, suggesting that parameter uncertainty is a robust factor for the price disparity.

#### 5.4 Origin of Parameter Uncertainty

One key implication in the model of Pastor and Veronesi (2003) is that the age of a firm is related to parameter uncertainty. Investors may be unsure about the growth potential of younger firms and thus willing to pay higher prices for them, which increases their market-to-book ratios of equity. Parameter uncertainty is also related to a firm's transparency from an accounting perspective as intangible assets such as goodwill may not reflect the true growth potential of the firm.

To investigate the determinants of parameter uncertainty, we follow Korteweg and Polson (2010) to regress parameter uncertainty on a set of uncertainty proxies.<sup>25</sup> These proxies are listed as follows: First, we define *age* of a firm as  $-1/(1+corp)$  where "corp" is the number of years since the firm first incorporated, this particular functional form is motivated by the theoretical insight from Pastor and Veronesi (2003). Second, we define *FA* as the ratio of net fixed assets over total assets. Firms with a high *FA* ratio have more tangible assets which would make them more transparent for investors to

<sup>24</sup> The model with the lag of disparity, parameter uncertainty and macro factors only cannot pass the AR(2) test, indicating that this model is misspecified and hence is omitted in our analysis.

<sup>25</sup> The regression reported in this subsection is in semi-annual frequency due to the availability of balance sheet data. Parameter uncertainty used in this subsection is obtained from re-estimating the structural model for each firm on every non-overlapping half year.

gauge the firms' growth potential. Third, the size of a firm, proxied by its book value of assets (*size*), should affect parameter uncertainty as larger firms are expected to be covered more by media and stock analysts which provide more information for valuation. Fourth, firms with high market-to-book ratios of equity (*M/B*) are identified by Pastor and Veronesi (2003) to be more prone to parameter uncertainty. Finally, firms with more volatile earnings are arguably more difficult to be valued due to parameter uncertainty and we capture this characteristic by using the standard deviation of earnings per share over the past five reporting periods (*VolEPS*).

Column 1 of table 5 reports the regression results between parameter uncertainty and the five proxies. The coefficient for *age* is negative and significant, reflecting that younger firms are more prone to parameter uncertainty, consistent with the theoretical insights in Pastor and Veronesi (2003). The other significant variables include *size* and *M/B* with the expected signs. However, the volatility of earnings (*VolEPS*) and ratio of fixed asset over total asset (*FA*) are not significant.

As market uncertainty is usually related to aggregate risk appetite, we use the HSI volatility index (*VHSI*), the market volatility of the Hang Seng index in the regression, to gauge the global risk appetite in the financial market as proposed in Brunnermeier et al. (2009). An increase in the VIX index is usually associated with heightened volatility across different asset classes in particular equities. Column 2 of table 5 shows that parameter uncertainty is significantly related to *VHSI* which explains an additional 8% of the variation in parameter uncertainty.<sup>26</sup> This suggests that investors' uncertainty as measured by parameter uncertainty is indeed correlated with global risk appetite in the financial market.

## 6. Conclusion

In this paper we revisit the determinants of the AH share price disparity in the Chinese stock markets. By using the contingent claims approach to pricing equity, we establish parameter uncertainty as a previously unidentified channel through which the price disparity may arise. Applying a Bayesian analysis of the model, we empirically establish parameter uncertainty as a robust factor in addition to other market-based and macro factors in explaining the AH share price disparity observed in the Mainland and Hong Kong stock markets. We also find that parameter uncertainty is related to a firm's market-to-book ratio of equity, its age and size, and global risk appetite in the financial market.

The source of parameter uncertainty for the price disparity in our model is related to the different assessments of a firm by Mainland and Hong Kong investors. The punch line of our framework is that even though individual investors use the same model to price a firm's equity value, a small difference in their estimates of model-parameters would lead to totally different valuations through the channel of parameter uncertainty. The result also implies that the AH share price disparity is inevitable as long as investors have different assessments about the valuations and the risk of the dual-listed firms in the

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<sup>26</sup> The calculation follows from the difference in the R-squared across the two columns in Table 5.

presence of information asymmetry and market segmentation with limited arbitrage. In view of this finding, parameter uncertainty could be a determinant of price disparity of other financial assets including the renminbi exchange rates in the onshore and offshore markets.

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Table 1. Share Prices of A- and H-Shares and AH Share Price Disparity

Company name	Share prices		Disparity (exchange rate adjusted) A over H <sup>2</sup>
	A-share(in RMB) <sup>1</sup>	H-share (in HKD) <sup>1</sup>	
<u>Basic Materials</u>			
Aluminum Corporation of China Limited	10.14	7.09	68.70%
Jiangxi Copper Company Limited	45.17	25.55	108.54%
Zijin Mining Group Co Ltd	8.21	7.21	34.32%
Angang Steel Company Limited	7.73	11.9	-23.38%
Maanshan Iron & Steel Company Limited	3.41	4.14	-2.84%
<u>Consumer and Communications</u>			
ZTE Corporation	27.3	30.9	4.22%
Air China Ltd	13.68	8.73	84.84%
China Eastern Airlines	6.58	3.94	97.00%
China Southern Airlines Limited	9.74	4.76	141.37%
Weichai Power Company Limited	52.37	47.85	29.10%
Tsingtao Brewery Company Limited	34.68	40.7	0.51%
Jiangsu Expressway Company Limited	6.64	8.9	-11.99%
Sichuan Expressway Company Limited	6.63	5	56.41%
<u>Energy</u>			
China Oilfield Services Limited	25.54	16.84	78.90%
China Petroleum & Chemical Corporation	8.06	7.44	27.79%
PetroChina Company Limited	11.22	10.16	30.27%
China Coal Energy Company Limited	10.86	12.14	5.52%
China Shenhua Energy Company Limited	24.71	32.6	-10.59%
Yanzhou Coal Mining Co.	28.39	23.75	41.01%
<u>Financial</u>			
Bank of China Limited	3.23	4.1	-7.07%
Bank of Communications Co., Ltd	5.48	7.83	-17.44%
China CITIC Bank Corporation Limited	5.25	5.04	22.88%
China Construction Bank Corporation	4.59	6.97	-22.32%
China Merchants Bank Co., Ltd	12.81	19.62	-22.98%
China Minsheng Banking Corp., Ltd	5.02	6.65	-10.95%
Industrial and Commercial Bank of China	4.24	5.79	-13.62%
China Pacific Insurance (Group) Co., Ltd	22.9	32.3	-16.37%
Ping An Insurance (Grp) Co of China Ltd	56.16	86.9	-23.77%
Beijing North Star Company Limited	3.5	2.11	95.67%
China Life Insurance Company Limited	21.3	31.75	-20.86%
<u>Industrial</u>			
Anhui Conch Cement Company Ltd	29.68	36.45	-3.95%
China Railway Construction Corp Limited	6.78	9.36	-14.55%
China Railway Group Limited	4.33	5.61	-8.95%
Metallurgical Corporation of China Ltd.	3.91	3.43	34.47%
China COSCO Holdings Company Limited	9.4	8.24	34.57%
China Shipping Development Company Ltd.	9.6	10.36	9.31%
China South Locomotive & Rolling Stock	7.55	10.22	-12.86%
Dongfang Electric Corporation Limited	34.9	38.5	6.93%
Guangshen Railway Co., Ltd	3.45	3.06	32.99%
Shanghai Electric Group Company Limited	8.48	5.13	94.99%
China Shipping Container Lines Co Ltd	4.48	3.44	53.62%
<u>Utilities</u>			
Datang Inter. Power Generational Co Ltd.	6.09	2.73	163.14%
Huaneng Power International, Inc	5.76	4.11	65.32%
Huadian Power International Corp. Ltd	3.26	1.52	152.99%

Notes: (1) Closing prices of the constituent stocks of the Hang Seng China AH Premium Index at 31 December 2010.

(2) The share disparity is calculated as the ratio of each firm's exchange rate adjusted A and H- shares price differences to its H-share price. (i.e.,  $premium = \frac{P_A \times CNY - P_H}{P_H}$ , where  $P_A$  and  $P_H$  denote the price for the A- and H- shares

respectively. CNY is the exchange rate of one Hong Kong dollar per one unit of the renminbi.

**Table 2. Summary Statistics of Variables in Eq (7) between the First Quarter of 2006 to the Fourth Quarter of 2010**

Variable	Mean	Std. Dev.	Median	Max	Min	Skewness	Kurtosis
<i>Corporate variables</i>							
<i>Disparity</i> (%) <sup>1</sup>	57.55	64.34	37.37	415.78	-23.48	1.40	5.45
<i>Supply</i> <sup>2</sup>	0.92	0.76	1.03	2.04	-3.25	-0.33	1.86
<i>Mktcap</i> <sup>3</sup>	11.55	1.45	11.36	15.55	8.03	0.36	2.67
<i>Risk</i> <sup>4</sup>	-0.05	0.27	-0.04	0.82	-0.74	-0.04	2.75
<i>Liquidity</i> <sup>5</sup>	0.80	1.24	0.48	13.83	0.02	5.30	41.1
<i>Macroeconomic variables</i>							
<i>Cur</i> <sup>6</sup>	17.67	6.25	19.44	28.24	7.84	-0.33	1.86
<i>Moneygrowth</i> <sup>7</sup>	4.58	2.13	3.95	11.67	2.20	1.97	6.97

- Notes: (1) *Disparity* is defined in Table 1.  
(2) *Supply* is the logarithm of the ratio of the number of outstanding A-shares to that in the H-shares for the dual-listed firms.  
(3) *Mktcap* is the total market capitalisation of firms (i.e., A-shares plus H-shares).  
(4) *Risk* is the logarithm of the ratio between the 30-day annualised volatility of A-shares to that of H-shares.  
(5) *Liquidity* is the logarithm of the trading volume of total outstanding shares in the A-shares market over that in the H-shares market.  
(6) *Cur* measures the appreciation of the renminbi.  
(7) *moneygrowth* is the quarter-on-quarter growth rate of the Mainland's money supply (M2).

Table 3. Estimation Results of the Bayesian Analysis of the Structural Model

Company	$N^a$	Firm's asset volatility		Pricing errors	
		$\sigma^b$		$V^c$	
		mean	s.d	mean	s.d
<b>Basic Materials</b>					
Aluminum Corporation of China Limited	20	38.20%	3.70%	0.62%	0.23%
Jiangxi Copper Company Limited	20	44.00%	4.30%	0.64%	0.20%
Zijin Mining Group Co Ltd	20	49.70%	4.70%	0.62%	0.18%
Angang Steel Company Limited	20	37.00%	3.30%	0.62%	0.18%
Maanshan Iron & Steel Company Limited	20	26.90%	2.60%	0.61%	0.17%
Sector Mean		39.16%	3.72%	0.62%	0.19%
<b>Consumer and Communications</b>					
ZTE Corporation	20	28.80%	2.90%	0.61%	0.20%
Air China Ltd	20	31.60%	3.10%	0.63%	0.18%
China Eastern Airlines	20	28.60%	2.10%	0.61%	0.18%
China Southern Airlines Limited	20	21.60%	2.00%	0.60%	0.17%
Weichai Power Company Limited	20	37.10%	3.60%	0.63%	0.25%
Tsingtao Brewery Company Limited	20	29.20%	3.10%	0.62%	0.17%
Jiangsu Expressway Company Limited	20	24.70%	2.80%	0.62%	0.16%
Sichuan Expressway Company Limited	20	37.20%	5.10%	0.77%	0.70%
Sector Mean		29.85%	3.09%	0.64%	0.25%
<b>Energy</b>					
China Oilfield Services Limited	20	42.10%	4.40%	0.68%	0.21%
China Petroleum & Chemical Corporation	20	29.70%	3.00%	0.62%	0.18%
PetroChina Company Limited	20	31.70%	3.70%	0.61%	0.31%
China Coal Energy Company Limited	16	44.60%	4.30%	0.63%	0.27%
China Shenhua Energy Company Limited	20	37.60%	3.70%	0.62%	0.18%
Yanzhou Coal Mining Co.	20	37.20%	3.80%	0.64%	0.22%
Sector Mean		37.15%	3.82%	0.63%	0.23%
<b>Financial</b>					
Bank of China Limited	16	7.40%	0.70%	0.54%	0.13%
Bank of Communications Co., Ltd	20	8.30%	0.80%	0.56%	0.14%
China CITIC Bank Corporation Limited	12	8.00%	0.80%	0.56%	0.14%
China Construction Bank Corporation	20	8.20%	0.80%	0.54%	0.13%
China Merchants Bank Co., Ltd	16	10.30%	1.00%	0.58%	0.16%
China Minsheng Banking Corp., Ltd	4	6.60%	0.70%	0.55%	0.13%
Industrial and Commercial Bank of China	16	7.80%	0.80%	0.54%	0.13%
China Pacific Insurance (Group) Co., Ltd	4	26.30%	2.80%	0.57%	0.14%
Ping An Insurance (Grp) Co of China Ltd	20	35.50%	3.60%	0.64%	0.19%
Beijing North Star Company Limited	20	32.90%	3.50%	0.94%	0.53%
China Life Insurance Company Limited	20	37.50%	4.00%	0.64%	0.19%
Sector Mean		17.16%	1.77%	0.61%	0.18%
<b>Industrial</b>					
Anhui Conch Cement Company Ltd	20	38.20%	4.10%	0.65%	0.24%
China Railway Construction Corp Limited	8	11.30%	1.10%	0.49%	0.10%
China Railway Group Limited	12	19.40%	2.00%	0.59%	0.16%
Metallurgical Corporation of China Ltd.	4	10.30%	1.00%	0.51%	0.11%
China COSCO Holdings Company Limited	20	36.30%	3.40%	0.61%	0.20%
China Shipping Development Company Ltd.	20	38.50%	3.80%	0.61%	0.23%
China South Locomotive & Rolling Stock	8	20.90%	2.30%	0.59%	0.15%
Dongfang Electric Corporation Limited	20	25.90%	2.40%	0.62%	0.19%
Guangshen Railway Co., Ltd	20	33.60%	4.40%	0.80%	0.23%
Shanghai Electric Group Company Limited	16	37.90%	2.90%	0.62%	0.19%
China Shipping Container Lines Co Ltd	20	42.70%	4.00%	0.62%	0.19%
Sector Mean		28.64%	2.85%	0.61%	0.18%
<b>Utilities</b>					
Datang Inter. Power Generational Co Ltd.	20	25.00%	2.50%	0.62%	0.18%
Huaneng Power International, Inc	20	19.80%	2.00%	0.58%	0.15%
Huadian Power International Corp. Ltd	20	19.30%	1.90%	0.59%	0.16%
Sector Mean		29.22%	2.91%	0.63%	0.19%
Mean		27.90%	2.80%	0.62%	0.20%
Max		49.70%	5.10%	0.94%	0.70%
Min		6.60%	0.70%	0.49%	0.10%

Note: MCMC estimates of the parameters of the Merton model for the constituent. Parameters are estimated for each firm-quarter.

- $N$  is the number of quarters available for a given firm.
- $\sigma$  is the volatility of asset returns.
- $V$  is the standard deviation of the equity pricing error.

Table 4. Determinants of AH Share Price Disparity

	(1) All factors	(2) Significant factors only	(3) Market-based factors only
Constant	-58.337 (67.384)	-17.648 (13.700)	16.172 (64.790)
Lag AH disparity	0.425 (0.121)***	0.426 (0.115)***	0.419 (0.08)***
Parameter uncertainty ( $SD\sigma$ )	15.740 (2.091)***	15.797 (1.893)***	15.831 (1.965)***
RMB appreciation ( <i>cur</i> )	-0.80 (0.478)*	-0.655 (0.573)	
M2 growth ( <i>moneygrowth</i> )	1.346 (0.752)*	1.352 (0.743)*	
Differential demand ( <i>supply</i> )	3.397 (29.938)		-13.131 (23.20)
Information asymmetry ( <i>mktcap</i> )	3.551 (5.524)		-2.598 (6.136)
Differential risk premiums ( <i>risk</i> )	-61.146 (13.466)***	-60.521 (14.114)***	-65.115 (12.163)***
Different liquidity condition ( <i>liquidity</i> )	12.395 (7.019)*	13.276 (6.762)*	14.214 (6.053)***
Hansen test (pval)	0.524	0.583	0.700
AR(2) test (pval)	0.160	0.153	0.148

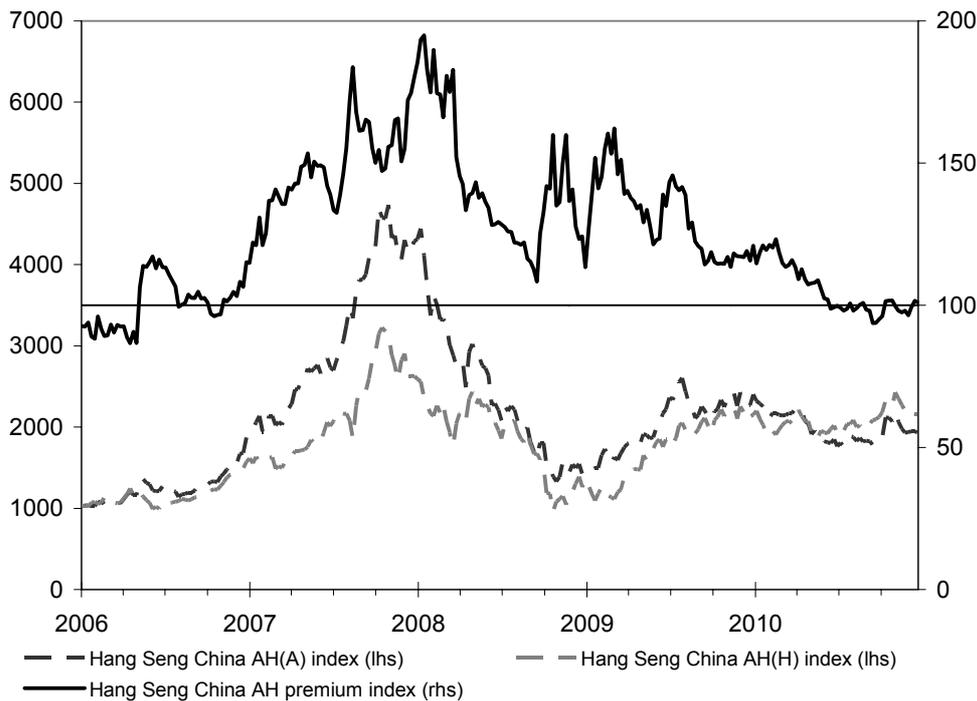
Note: Panel regression of the AH disparity to its own lag and the measure of parameter uncertainty ( $SD\sigma$ ), market based (*mktcap*, *risk*, *supply*, *liquidity*) and macro (*cur*, *moneygrowth*) factors. The definition of the disparity is given in Table 1 and other explanatory variables are defined in Table 2. Hansen test reports the Hansen J statistics and AR(2) test reports the second-order serial correlation test of residuals. Robust standard errors are in parenthesis. \*\*\*, and \* denote significance at the 1% and 10% levels, respectively.

Table 5. Parameter Uncertainty Regression

	(1)	(2)
Constant	8.886 (2.371)**	5.845 (2.238)**
Age	-4.355 (2.381)*	-4.816 (2.782)*
FA	-0.170 (0.959)	0.086 (0.923)
Size	-1.239 (0.357)***	-1.323 (0.354)***
M/B	0.126 (0.072)*	0.168 (0.081)**
Voleps	-0.276 (0.929)	-0.909 (0.937)
VHSI		0.109 (0.019)***
R-squared	6.91%	14.97%

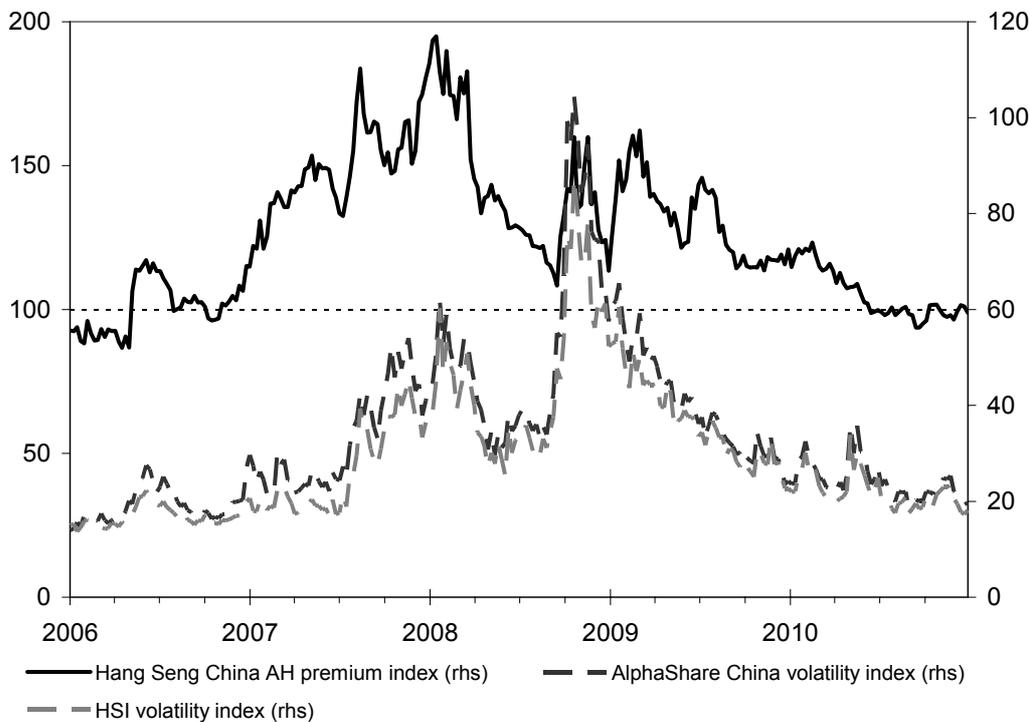
Note: Panel regression of the parameter uncertainty ( $SD\sigma$ ) and proxies. Age is  $-1/(1+corp)$ , where corp is the number of years since the firm first incorporated. FA is the ratio of net fixed asset over total asset. Size is the logarithm of total asset. M/B is the market-to-book ratio. Voleps is the standard deviation of earnings per share over the past five periods. VHSI is the Hang Seng volatility index. Robust standard errors are in parenthesis. \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10% levels, respectively.

**Figure 1. Dynamics of the AH Share Price Disparity from 2006-2010**



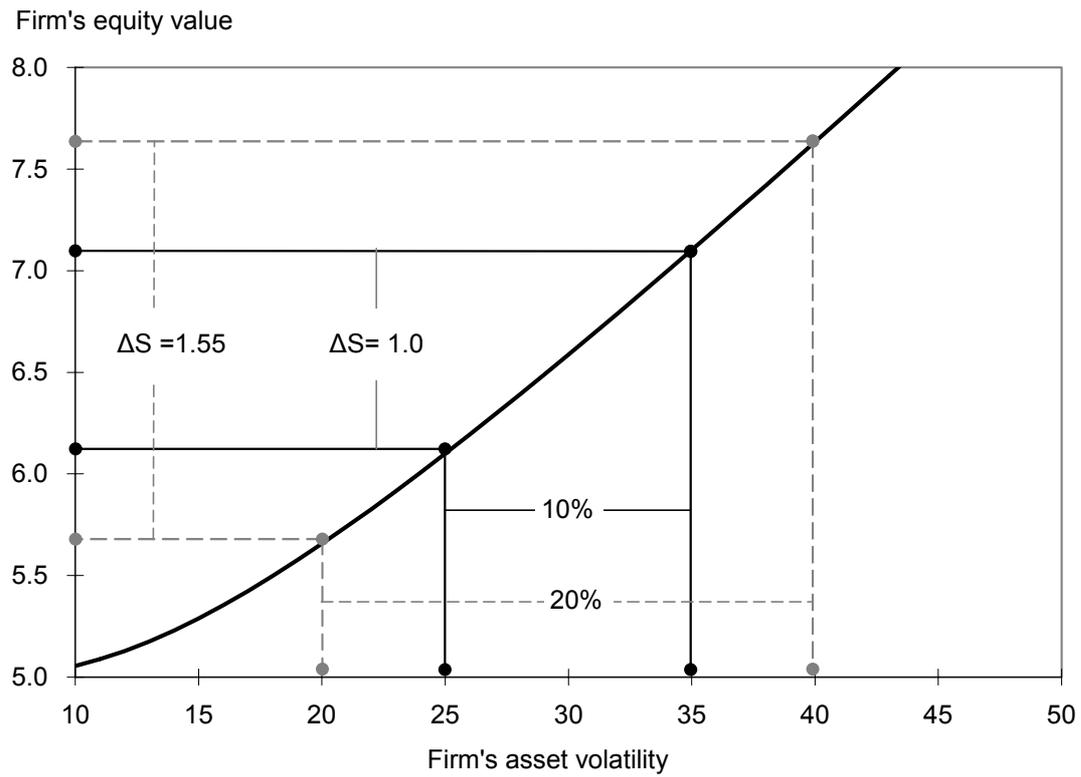
Note: This figures shows the time series of the Hang Seng China AH premium index and its two sub indexes, the Hang Seng China AH(A) index and the Hang Seng China AH(H) index between the first quarter of 2006 and the fourth quarter of 2010. The premium index is plotted on the right axis. The two sub indexes are plotted on the left axis.

**Figure 2. Relationship between AH Share Price Disparity and Volatility**



Note: This figure shows the time series of the Hang Seng China AH premium index and the two volatility indexes, the HSI volatility index and the AlphaShare China volatility index. The premium index is plotted on the left axis while the volatility indexes are plotted on the right axis.

**Figure 3. Graphical Illustration of the Effect of Parameter Uncertainty**



Note: This figure shows the theoretical relationship between the firm's equity value and its asset volatility under the Merton model. For illustration purpose, we set the face value of the debt to 100, time-to-maturity 1 year, risk-free rate 0% and the value of the firm 105.  $\Delta S$  denotes the change in firm's equity values.