INFORMATION SHARES: EMPIRICAL EVIDENCE FROM THE FTSE CHINA A50 INDEX AND THE ISHARES FTSE A50 CHINA TRACKER

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Abstract

We study the price discovery process and common factor weights of *SS*50 (the FTSE China A50 Index traded in Mainland China) and *A*50 (the iShares FTSE A50 China Tracker traded in Hong Kong) using daily open-to-open price pairs and close-to-close price pairs. Due to Qualified Domestic Institutional Investor (QDII) scheme (13 April 2006) and US subprime mortgage crisis (middle 2007), our sample, which covers from November 18, 2004 to October 31, 2008, is divided into three periods. We find *A*50 has a much larger common factor weight than *SS*50, and *A*50 dominants for both open and close prices during all periods. The QDII enlarges the contribution of *SS*50, but financial crisis reduces it.

Keywords: corporate governance, stock market, China

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1. Introduction

Price discovery is a dynamic process of finding equilibrium price. In a perfectly integrated system, all markets impound information simultaneously, such that prices adjust to a new equilibrium with no lag. In fact, different market structures uniquely affect processing of incoming information, each security design distinguished from others by the speed at which it digests new information. Consequently, one security may be more capable of registering impact of new information than another, although both are based on the same underlying asset. Once venue or security design is known to dominate the price discovery process, it is possible to infer that who are the most informed traders and what is the nature and source of their informational advantage.

This article examines price discovery and common factor weights of the FTSE China A50 Index (traded in Mainland China's stock market; hereafter *SS*50) and the iShares FTSE A50 China Tracker (traded in Hong Kong's stock market; hereafter *A*50) using daily open-to-open price pairs and close-to-close price pairs. *SS*50 is designed to represent performance of the largest firms in China's stock markets and consists of 50 of the largest liquid Chinese companies. Securities in the Index are weighted by total market value of their shares, so those with higher total market value generally have higher representation in the Index, all of whose securities are traded on Shanghai and Shenzhen Stock Exchanges. *A*50, a sub-fund of iShares Asia Trust, is an exchange traded fund (ETF) established in Hong Kong; its objective is to track performance of *SS*50. The fund does not directly hold A-shares but rather Chinese A-shares Access Products (CAAPs) issued by a Qualified Foreign Institutional Investor (QFII). The QFII is a scheme which allows qualified foreign financial institutions to trade Chinese A shares via special accounts opened at designated custodian bank. On November 5, 2002, the China Securities Regulatory Commission and the People's Bank of China introduced the QFII program to provide a means for foreign capital to access China's financial markets. A CAAP is a security (such as a warrant, note or participation certificate) linked to an A-share, which synthetically replicates the economic benefit of the relevant A-share that is traded on the Shanghai or Shenzhen stock exchange. Each CAAP constitutes a direct, general and unsecured contractual obligation of the CAAP issuer, and subject to counterparty risk.

China's stock exchanges are relatively new players among the world's financial markets. Official Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange were established in December 1990 and July 1991, respectively. Since that time, they have expanded rapidly in terms of capitalization, turnover, and number of firms listed. The market capitalization of the SHSE was 10,093.5 billion RMB (about US$1,477.8 billion) in November 2008, 81.6% of total market capitalization in all Chinese stock markets. It is obvious that the SHSE plays a dominant role in Chinese stock market, which is also the reason why the FTSE China A50 Index is selected for this study.

The SHSE and Hong Kong Stock Exchange (HKSE) are order-driven markets using electronic trading without market makers. Both markets have a lunch break at midday, between the morning and afternoon trading sessions, which are thoroughly continuous from opening to close of trading. Morning session of SHSE is from 9:30 to 11:30, its afternoon session from 13:00 to 15:00. HKSE trades 10:00-12:30 and 14:30-16:00. There are some differences in trading rules, such as price limit, tick size and short-selling restriction. Finally, like many other emerging markets, SHSE has a relatively immature infrastructure: e.g., inadequate disclosure, opaque legal and governance framework, inexperienced regulator. Co-existence of the latter with a limited number of informed investors with financial strength, plus enormous member of uninformed and unprotected investors with budget constraint, gives informed investors an opportunity to manipulate stock prices to earn a profit at the expense of uninformed investors (Lu and Lee, 2004).

As one of the most successful financial innovations in the past two decades, ETFs are popular and growing rapidly in global markets. ETFs have characteristics of both closed-end funds and open-end funds. They offer possible tax benefits compared to open-end mutual funds. Since ETFs are not actively managed and managers do not need to sell some of the underlying securities when demand for ETFs decreases, they rarely have capital gains distributed to investors. Hence they provide a tax advantage over mutual funds with lower trading costs. Furthermore, introduction of ETFs also improves the price formation efficiency of underlying securities. Chu et al. (1999) employ Gonzalo and Granger (1995) common factor weight model to investigate the price discovery function of S&P 500 index markets and propose four hypotheses to explain why index products should contribute to the price discovery process based on market microstructure information models. The main idea is that prices reflect new information through the trading of informed traders; a particular market that informed traders prefer should lead other markets. Four hypotheses are: (1) leverage hypothesis, which predicts that informed traders tend to trade in higher leveraged markets to generate higher returns than lower leveraged markets with the same amount of capital; (2) trading cost hypothesis, which states that informed traders are more likely to trade in a market with lower transaction costs; (3) trading restriction hypothesis, which predicts that informed traders prefer a market with fewer restrictions; and (4) market information hypothesis, which states that informed traders tend to trade baskets of securities in order to avoid adverse selection risk (Subrahmanyam, 1991). Thus, index funds should dominate price discovery relative to individual component stocks.

Here we use *SS*50 as a proxy for Chinese domestic investors' assessment, *A*50 as a proxy for foreign investors' assessment, and employ Gonzalo and Granger's (1995) common factor weight model to compute information dominant between *SS*50 and *A*50 to find price discovery contribution. We divide our study into periods: [I] *A*50 was listed on the HKSE to enforce Qualified Domestic Institutional Investor (QDII) scheme (from November 18, 2004 to April 12, 2006); [II] after QDII but before US subprime mortgage crisis (from April 13, 2006 to June 30, 2007); and [III] after the subprime mortgage crisis (from July 1, 2007 to October 31, 2008). The QDII is a capital market scheme allowing financial institutions in Mainland China to invest in offshore markets such as securities and bonds in Hong Kong. One goal is to probe common factor weights between assessments of domestic and foreign investors, using matched daily open-to-open price pairs and close-to-close price pairs. A second is to observe the difference of common factor weights during these three periods.

The rest of the paper is organized as follows. Section 2 introduces and discusses empirical models. Section 3 describes data. Section 4 reports and analyses empirical results. Section 5 offers some conclusions.

2. Methodology

We utilize formal econometric models regarding price discovery and common factor weights for a relation between *SS*50 and *A*50. First, we specify empirical vector error-correction model (VECM). Next, we use the common factor weight model of Gonzalo and Granger (1995) to estimate common factor weights of variables.

2.1. Vector error-correction model

We formulate the long-term equilibrium relationship between variables:

$$\Delta S_t = \alpha_1 + \beta_1 Z_{t-1} + \sum_{i-1}^{p} \gamma_{1i} \Delta S_{t-i} + \sum_{i=1}^{p} \delta_{1i} \Delta A_{t-i} + \varepsilon_{1t}$$

$$\Delta A_t = \alpha_2 + \beta_2 Z_{t-1} + \sum_{i-1}^{p} \gamma_{2i} \Delta S_{t-i} + \sum_{i=1}^{p} \delta_{2i} \Delta A_{t-i} + \varepsilon_{2t}$$

where ΔS_t and ΔA_t indicate changes in natural logs of *SS*50 and *A*50, respectively. Optimal lag-length of VECM is determined using the modified Schwartz Information Criteria (MSIC). We use Johansen's (1991, 1995) methodology to test how many co-integration vectors span cointegration space. Z_{t-1} is the lagged log-level of each variable in the cointegrating equation estimated by Johansen's methodology.

2.2. Common factor weight model

Based on VECM, Gonzalo and Granger (1995) proposed a decomposition model for the common factor in the cointegration system. As suggested by Stock and Watson (1988), $I(1)$ cointegrated series can be portrayed by a common factor model:

$Y_t = \theta f_t + \tilde{Y}_t$,

where Y_t is the vector of variables considered: i.e., $Y_t = (SS50_t, A50_t)'$; θ is a loading matrix; f_t is a vector of $I(1)$ common stochastic trends; and $\tilde{Y}_t$ is a vector of $I(0)$ transitory components. Following Johansen's framework, Gonzalo and Granger showed the common factor given by

$f_t = \alpha_{\perp}' Y_t$,

where $\alpha_{\perp}$ is a matrix of full rank orthogonal to the error correction matrix α. Let matrix $X = X_{uu}^{-1} X_{uv} X_{vv}^{-1} X_{vu}$, where $X_{\bullet\bullet}$ is a variance-covariance matrix for residual vectors from ordinary least squares regression; and subscripts u and v denote the level and first-difference regression, respectively. By solving eigenvalues $\hat{\lambda}_1 > \hat{\lambda}_2 > \ldots > \hat{\lambda}_n$ and corresponding eigenvectors $\hat{m}_1$, $\hat{m}_2$, …, $\hat{m}_n$ of matrix X, satisfying $\hat{M}'X\hat{M} = I$ where $\hat{M} = (\hat{m}_1, \hat{m}_2, \ldots, \hat{m}_n)$, we find maximum likelihood estimator for the long-run common factor is now $\alpha_{\perp} = (\hat{m}_{r+1}, \ldots, \hat{m}_n)$, where r is the number of cointegration relations in the system, as found in the Johansen approach. Specifically, $f_t = \alpha_{\perp}' Y_t$ indicates common factor as linear combination of all cointegrated variables, where coefficients of $\alpha_{\perp}$ determine the weights of variables. A variable with greater weight contributes more to a common factor and moves more closely with common long-run stochastic trend. Gonzalo and Granger developed a χ^2 distributed test statistic for examining whether any individual series represents a common stochastic trend. If χ^2 test shows the variable having greatest weight is weighted more significantly than the other variables, this variable can be viewed as dominant.

3. Data Description and Sample Description

3.1. Data description

Interday data used in this study come from two sources. Daily quote data for *SS*50 is from the *Taiwan Economic Journal* (*TEJ*) China stock markets database, *A50* from Datastream Hong Kong stock market files. This study covers from November 18, 2004 to October 31, 2008. On April 13, 2006, the Beijing government announced the QDII scheme, letting Chinese institutions and residents entrust Chinese commercial banks to invest in financial products overseas, limited to fixed-income and money market products. In mid-2007, both markets suffered from the US subprime mortgage crisis. We divide our sample as: [I] from November 18, 2004 to April 12, 2006; [II] from April 13, 2006 to June 30, 2007; and [III] from July 1, 2007 to October 31, 2008.

Opening hours and trading mechanisms differ between SHSE and HKSE. Both conduct trading from Monday to Friday except for public holidays, which could differ for two regions. Therefore, our sample eliminates days when only one market data is available, since our cointegration and price discovery analysis requires the interaction between two markets. Besides, *SS*50 is traded in Chinese Yuan and *A50* is traded in Hong Kong dollars, we use corresponding days' exchange rates between Yuan and Hong Kong dollars to transfer *A*50 price to comparable Chinese Yuan to make prices consistent in terms of denomination and magnitude. We obtain everyday exchange rate between Chinese Yuan and Hong Kong dollars from the Datastream database.

To acquire synchronous assessment from investors, we form matched pair data sets that minimize span (i.e., observation interval) between *SS*50 and *A*50. Morning session of SHSE starts at 9:30 versus HKSE's 10:00; afternoon sessions end at 15:00, and 16:00 respectively, so two price pairs constructed by daily open-to-open prices and daily close-to-close prices are examined.

3.2. Sample description

Some sample statistics and correlation coefficients among variables appear in Table 1. Period III averages a larger standard deviation than Periods I and II. Besides, daily close prices have larger standard deviation than open prices, except for Period I.

4. Empirical Results

In this section, we test price discovery between *SS*50 and *A*50 for open and close prices at Periods I, II, and III. To avoid scalar problem, we transfer involved variables into natural log forms during our study period. First we assess whether all variables are non-stationary, then long-term contemporaneous relation between variables. Lastly, we estimate common factor weights reflecting which has dominant information.

Table 1. Summary statistics for open and close prices of *SS*50 and *A*50.

Panel A: Descriptive statistics of open prices

	Period I		Period II		Period III	
	*SS*50	*A*50	*SS*50	*A*50	*SS*50	*A*50
Mean	813.957	4.636	1652.527	9.194	3128.439	17.414
Median	818.189	4.505	1292.509	7.482	3065.509	16.975
Max	912.680	5.935	3133.307	17.088	4726.083	26.906
Min	699.266	3.755	908.253	5.628	1274.795	6.172
Std. Dev.	48.846	0.467	690.154	3.358	940.524	5.278
Skewness	-0.073	0.972	0.704	0.681	-0.171	-0.154
Kurtosis	1.981	3.097	2.043	2.181	1.805	1.933
Jarque-Bera	14.448	51.578	34.181	29.814	20.329	16.222
Probability	0.001	0.000	0.000	0.000	0.000	0.000
Observations	327	327	283	283	316	316

Panel B: Descriptive statistics of close prices

	Period I		Period II		Period III	
	*SS*50	*A*50	*SS*50	*A*50	*SS*50	*A*50
Mean	813.884	4.626	1667.554	9.259	3124.750	17.367
Median	817.497	4.500	1341.731	7.697	3024.481	16.826
Max	912.391	5.899	3133.531	17.228	4731.826	26.710
Min	700.434	3.754	892.133	5.594	1305.705	6.066
Std. Dev.	48.394	0.461	697.507	3.400	942.924	5.286
Skewness	-0.052	0.984	0.674	0.669	-0.162	-0.150
Kurtosis	2.024	3.133	2.000	2.178	1.795	1.922
Jarque-Bera	13.565	54.757	34.537	30.193	21.267	17.108
Probability	0.001	0.000	0.000	0.000	0.000	0.000
Observations	338	338	294	294	328	328

4.1. Unit root tests and cointegration

Augmented Dickey-Fuller (1981) test and Phillips-Perron test (1988) are used to check for presence of unit root. For each variable series, we consider three regression equations: the first has a drift term, the second a linear time-trend, and the third both of these. We use MSIC to determine number of leads and lags in the model. In general, our unit root estimations confirm both *SS*50 and *A*50 are non-stationary or containing unit root *I*(1). Subsequently, test for cointegration relation of these two non-stationary variables. Prior to testing for cointegration of *SS*50 and *A*50, we use Granger causality to check order between *SS*50 and *A*50. Results hint Granger causality unidrectional from *A*50 to *SS*50. We ascertain order of integration and optimal lag length for VECM, then test for cointegration and number of cointegrating vectors. The statistic $\lambda_{trace}(r)$ tests the null hypothesis that number of distinct cointegrating vectors is less than or equal to *r* against a general alternative. The statistic $\lambda_{max}(r, r+1)$ tests a null hypothesis that number of cointegrating vectors is *r* against the alternative of *r*+1 cointegrating vectors. Both λ_{trace} and λ_{max} follow nonstandard distribution. Results of both tests indicate one cointegrating vector significant at a 5% level (to save space, the results are not reported in detail here but available upon request).

4.2. Common factor weights and price discovery

We use Gonzalo and Granger's (1995) model to decompose common factors in the cointegration system, and to examine whether any one series signifies a common factor. Price discovery results are plotted in Table 2. Panel A shows common factor weight of *SS*50 at Periods I, II, and III as 0.134, 0.199, and 0.104; that of *A*50 at Periods I, II, and III as 0.866, 0.801, and 0.896, respectively. *A*50 has much larger common factor weights than *SS*50 during all three periods. For each time frame, the χ^2 test that single series is not included in the common factor f_t, with significant level 10%, is rejected for *A*50 but not for *SS*50. This implies that *A*50 is the dominant for open price during all periods. At Period II, QDII scheme increases (decreases) common factor weight of *SS*50 (*A*50) from 0.134 to 0.199 (from 0.866 to 0.801). Yet at Period III, financial crisis decreases (increases) the common factor weight of *SS*50 (*A*50) from 0.199 to 0.104 (from 0.801 to 0.896). Results suggest that QDII scheme, the deregulation of investment between Mainland China and Hong Kong, enlarges contribution of *SS*50, but financial crisis reduces it. The close price case reported in Panel B is similar to the open price case.

Table 2. Price discovery results for open and close prices of *SS*50 and *A*50

	Period I		Period II		Period III	
	*SS*50	*A*50	*SS*50	*A*50	*SS*50	*A*50
Panel A. Open price case						
Common factor f_t	0.134	0.866	0.199	0.801	0.104	0.896
H_0: single series is not included in f_t [a]	0.001**	0.034	0.013***	0.029	0.001**	0.092
P-value	0.982	0.853	0.909	0.864	0.971	0.761
Panel B. Close price case						
Common factor f_t	0.128	0.872	0.188	0.812	0.097	0.903
H_0: single series is not included in f_t [a]	0.000*	0.040	0.014***	0.027	0.001**	0.051
P-value	0.993	0.841	0.907	0.870	0.975	0.822

[a] Test statistic is distributed as $\chi^2(1)$
*, **, and *** mean significant at 1%, 5%, and 10% levels, respectively.

5. Conclusion

This study uses *SS*50 (FTSE China A50 Index) as a proxy for Chinese investors' assessment and *A*50 (iShares FTSE A50 China Tracker) for foreigners' assessment to examine the price discovery and common factor weights of *SS*50 and *A*50 based on daily data from November 18, 2004 to October 31, 2008. Due to the QDII scheme and subprime mortgage crisis, we divide sample periods: [I] November 18, 2004 to April 12, 2006; [II] April 13, 2006 to June 30, 2007; [III] July 1, 2007 to October 31, 2008.

To make the prices consistent in terms of denomination and magnitude, price of *A*50 is transferred to comparable Chinese Yuan by multiplying corresponding days' exchange rates between Yuan and Hong Kong dollars. Unit root tests conform both open and close prices of *SS*50 and *A*50 are non-stationary. Analyzing the daily pairs of open-to-open and close-to-close prices, we find that both kinds of pairs in *SS*50 and *A*50 cointegrated with one cointegrating vector.

Estimates of the Gonzalo and Granger (1995) common factor weights show the following: First, *A*50 plays a key role in price discovery, while close price contributes more than open price, probably because SHSE ends at 15:00 but HKSE at 16:00. Second, *A*50 contributes over 85% on the price discovery process on a daily basis except for Period II. Because index ETFs have characterize on high leverage, low cost and less restriction, which are most likely to bulk large in the price discovery process. Chinese stock markets exhibit government intervention, frequent regulatory change, poor shareholder protection, information transparency, and abundant speculative trading among retail investors. For example, price limits, in general, many studies find ineffective because they delay price discovery process, interfere with trading, and also increase volatility. Third, contribution of *A*50 is reduced during Period II, but increased during Period III. It seems that QDII scheme, deregulation of investment between Mainland China and Hong Kong, enlarges the contribution of *SS*50 during period II. However, financial crisis destroys this.

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