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Returns Transmission and Volatility Spillover: Evidence from Chinese A- and N-shares

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Abstract

We study the information linkage of Chinese stocks cross-listed as A-shares on the Shanghai Stock Exchange (SSE) and as N-shares on the New York Stock Exchange (NYSE). We find the N-shares returns have significant effects on the A-shares returns. Using a GARCH-BEKK framework to model the dynamics of conditional volatility, we find evidence of volatility spillover from A-shares to N-shares.

Keywords: Cross-listing; GARCH-BEKK; Information Transmission; Volatility Spillover
JEL Classification: G15, G10

I. Introduction

This paper examines the returns transmission and volatility spillover of Chinese companies' stocks cross-listed on the Shanghai Stock Exchange (SSE) and the New York Stock Exchange (NYSE). Securities regulations in China allow a Chinese company to list its stocks on two mainland markets in Shanghai or Shenzhen as "A-shares", in Hong Kong as "H-shares", or in the U.S. as "N-shares".

This paper belongs to a strand of literature that studies the joint process of the change in asset returns and their conditional volatilities, and the resultant international spillovers of these price-change volatilities across different markets (e.g., Karolyi (1995), Haomao, et al., (1990), and Engle, et al., (1994)). Existing literature on cross-listed Chinese stocks focuses on A-shares and H-shares (e.g., Wang and Jiang (2004), and Cai, et al., (2011)), as well as on H-shares and N-shares (Xu and Fung (2002), and Su and Chong (2007)). To the best of our knowledge, this paper is the first to examine the information linkage between A-shares and N-shares.

Using a bivariate GARCH-BEKK (1989) model, we find strong one-directional cross-market returns transmission from N-shares to A-shares. Interestingly we also find the evidence of strong one-directional cross-market volatility spillover from A-shares to N-shares. These findings suggest that in our sample, the cross-listed stocks on the overseas market (the NYSE) is more influential in affecting the returns of those on the domestic market (the SSE), while the domestic market is more influential in volatility spillover into the overseas market.

II. Data and Summary Statistics

Table 1 reports the background information of our sample. Eleven Chinese companies cross-listed their shares on the SSE and NYSE from 2008 to 2014. We obtain the data of A-shares from TDX Software and CSMAR, and N-shares from CRSP.

We define the returns for stock i at time t as $R_{X,i,t} = \ln P_{X,i,t} - \ln P_{X,i,t}$, where X = 1(2) for A(N)-shares. $P_{X,i,t}$ is the daily adjusted closing price, and *ln* is the natural logarithm. We construct the market value-weighted "A (N)-index" to estimate the overall effect of return and

volatility transmission between the two markets, defined as $I_{X,t} = \frac{\sum_{i=1}^{11} P_{X,i,t} Q_{X,i,t}}{\sum_{i=1}^{11} P_{X,i,0} Q_{X,i,0}}$, where $Q_{X,i,t}$ is the number of shares. We define the index return $R_{X,t}$ similarly.
Since the two markets do not have overlapping trading hours, we use the closing price of N-shares at time (*t-1*) and that of A-shares at time *t* to match their respective returns. We delete the dates when either market is closed. This results in 1,645 observations for each return series.

Table 2 reports the summary statistics for the returns of individual stocks and the two indexes. We observe similar patterns for all return series. All empirical distributions have non-zero skewness and excess kurtosis. The A-index returns exhibit negative skewness, while it is positive for the N-index returns. The Jarque-Bera tests for normality reject the null hypothesis of a normal distribution. The Augmented Dickey-Fuller (ADF) unit root tests for stationarity show all return series are stationary.[1] The Obs*R-squared statistic, the Lagrange Multiplier test for the ARCH effect, rejects the null hypothesis of no ARCH effect.

III. VAR and GARCH-BEKK Models

We apply the GARCH-BEKK model to study the effect of volatility spillover. We write the joint process of the returns and the residual conditional variance of A-shares and N-shares as:

$$\boldsymbol{R}_t = \boldsymbol{\alpha} + \sum_{p=1}^{P} \boldsymbol{\Phi}_p \boldsymbol{R}_{t-p} + \boldsymbol{e}_t, \quad (1)$$

$$\boldsymbol{H}_t = \boldsymbol{C}'\boldsymbol{C} + \boldsymbol{A}'\boldsymbol{e}_{t-l}\boldsymbol{e}'_{t-l}\boldsymbol{A} + \boldsymbol{B}'\boldsymbol{H}_{t-k}\boldsymbol{B}. \quad (2)$$

where $\boldsymbol{R}'_t = [R_{1,t}, R_{2,t}]$ is the return vector with the daily returns. $\boldsymbol{e}'_t = [\varepsilon_{1,t}, \varepsilon_{2,t}]$ is a column vector of forecast errors of the best linear predictor of $\boldsymbol{R}_t$ conditional on past information, and $\{\boldsymbol{H}_t\}_{ij} = h_{ij,t}$ is its corresponding conditional covariance matrix. The parameter vectors and matrices of the mean returns in Equation (1) are defined as $\boldsymbol{\alpha}' = [\alpha_1, \alpha_2]$ for the constant, and $\{\boldsymbol{\Phi}_p\}_{ij} = \phi_{ij,P}$ for the matrix of the coefficients with *P* lagged returns. The parameter matrices for the conditional covariance in Equation (2) are defined as $\{\boldsymbol{C}\}_{ij} = c_{ij}$, which is restricted to be upper triangular, and free matrices $\{\boldsymbol{A}\}_{ij} = a_{ij,t}$ and $\{\boldsymbol{B}\}_{ij} = b_{ij,t}$.

Equation (1) models the daily returns as a VAR process. The multivariate structure measures the effects of an innovation in the stock returns in one market on its own lagged return and that of the other market. Conditional on the dependence structure in the mean returns, the residual vector is bivariate normally distributed with conditional covariance matrix $\mathbf{H}_t$. Equation (2) models the dynamic process of $\mathbf{H}_t$ as a linear function of its own past values ($\mathbf{H}_{t-k}$), and as the past value of squared innovation ($\mathbf{e}_{t-l}\boldsymbol{e}'_{t-l}$), both of which allow for own-market and cross-market influences in the conditional variance.

Results in Table 3 show similar patterns of the coefficient matrix $\boldsymbol{\Phi}_p$ in the VAR and GARCH-BEKK models on the returns of two indexes.[2] We find significant cross-market returns transmission from N-index returns to A-index returns. For example, in the VAR model, the coefficients are 0.2646 on the immediate past N-index return, and 0.1678 at lag[3] 2, both significant at the 1% level. The immediate past A-index returns also have a significant effect on its own returns. We however do not observe any cross-market returns transmission from A-index

[1] Not reported, results are available upon request.
[2] The results for each stock are available upon request.
[3] We estimate the lag lengths as 2 for the VAR and 3 for the GARCH-BEKK.

returns to the N-index returns. Only N-index own lagged returns have a significant effect on its returns. This is consistent with the results of the Granger causality test, which reject the null hypothesis that N-index returns do not Granger-cause A-index returns, but cannot reject the null hypothesis that A-index returns do not Granger-cause N-index returns. This finding supports the global center hypothesis that suggests that information flows from a global financial center such as the NYSE to other financial markets.

Table 4 reports the results of conditional variance estimates according to Equation (2). We estimate the lag length (l, k) as (1, 1). The conditional variance of the A-index returns shows long persistence of conditional variance of its own, as well as that from the N-index returns. The parameter on its own immediate past conditional variance is 0.9589 and it is 0.0180 of N-index returns, significant at 1% and 5% levels, respectively. Only its own lagged squared innovation is significant on the conditional variance of the A-index returns. The parameter estimate is -0.2620, significant at the 1% level. We do not observe volatility spillovers from the N-index returns.

For the conditional variance of N-index returns, we again observe strong effect from its own lagged conditional variance as well as that from the cross-market, with parameter estimates of 0.9732 and 0.0104, respectively, both significant at the 1% level. Interestingly, both the lagged squared innovation from its own market as well as that from A-index returns are significant in affecting conditional variance of N-index returns. In particular, the coefficient of past squared innovation of A-index returns is -0.0801, significant at the 1% level, which suggests the cross-market volatility spillover from A-index returns into N-index returns. This supports the home bias hypothesis that suggests that domestic market information plays a dominant role in information transmission because firm-specific information such as earnings, dividends, and financing announcements is likely to be dominated by home factors. Such information flows from the home market to the overseas market.

IV. Conclusion

This paper examines returns transmission and volatility spillover of Chinese stocks cross-listed on the SSE and the NYSE using a GARCH-BEKK model. We find the stocks listed on the overseas market (NYSE) plays more important role in returns transmission, while those on the domestic market (SSE) is more influential in volatility spillover. Future research is needed to reconcile the differences in these results. This would further improve our understanding of information flows between the two countries, which has important implications such as international portfolio diversifications.

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Table 1. Chinese companies cross-listed on the SSE and the NYSE as of December 2014.

Company name	NYSE ticker	Sector	Industry	NYSE listing date	SSE listing date	Market Cap as of 12/28/2007 (USD Bn)
Aluminum Corp. of China, Ltd	ACH	Basic Materials	Aluminum	12/11/2001	4/30/2007	48.22
China Eastern Airlines Corp. Let.	CEA	Transportation	Airline	2/24/1997	11/5/1997	9.62
China Unicom Ltd.	CHU	Technology	Wireless communication	6/21/2000	10/9/2002	35.05
Guangshen Railway CO. Ltd.	GSH	Transportation	Railroads	5/13/1996	12/22/2006	7.27
Huaneng Power International Inc.	HNP	Utilities	Electric utilities	10/6/1994	12/6/2001	18.27
China Life Insurance Co. Ltd.	LFC	Financial	Life insurance	12/17/2003	1/9/2007	165.17
Petro China Co. Ltd.	PTR	Basic Materials	Major integrated oil & gas	4/6/2000	11/5/2007	686.29
Sinopec Shanghai Petrochemical Co. Ltd.	SHI	Energy	Oil and gas	7/26/1993	11/8/1993	11.21
China Petroleum and Chemical Group	SNP	Basic Materials	Major integrated oil & gas	10/18/2000	8/8/2001	224.28
Yanzhou Coal Mining Co. Ltd.	YZC	Mining	Mine	4/1/1998	7/1/1998	8.93
China Southern Airlines Co. Ltd.	ZNH	Transportation	Airline	7/30/1997	7/25/2003	12.24

Table 2. Summary statistics.

A Shares Returns												
Statistics	ACH	CEA	CHU	GSH	HNP	LFC	PTR	SHI	SNP	YZC	ZNH	A-Index
Mean	-0.0010	-0.0009	-0.0005	-0.0005	-0.0001	-0.0003	-0.0005	-0.0002	-0.0005	-0.0002	-0.0005	-0.0002
Median	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0004	0.0000	0.0000	0.0000	0.0000	-0.0009	-0.0002
Std. Dev.	0.0289	0.0294	0.0222	0.0207	0.0228	0.0246	0.0166	0.0233	0.0218	0.0316	0.0364	0.0188
Skewness	0.1527	-0.0727	0.0218	0.0688	-0.0757	0.1933	0.2900	-0.0169	-0.0667	0.1000	0.2806	-0.2388
Kurtosis	5.7896	5.5009	7.1265	6.8253	6.0775	5.8317	9.8448	5.6679	7.7250	4.6606	7.8685	9.6639
Jarque-Bera	539.76	430.15	1167.23	1004.25	650.71	559.83	3234.37	487.95	1531.49	191.76	1646.19	3050.12
p value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Obs*R-sq	52.9887	108.5750	59.0881	11.6841	85.9760	31.6858	129.8972	100.2811	44.0004	30.1196	99.8431	37.9467
p value	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

N Shares Returns												
Statistics	ACH	CEA	CHU	GSH	HNP	LFC	PTR	SHI	SNP	YZC	ZNH	N-Index
Mean	-0.0010	-0.0005	-0.0004	-0.0002	0.0001	-0.0004	-0.0003	-0.0003	-0.0002	-0.0005	-0.0005	-0.0002
Median	-0.0018	-0.0011	0.0000	-0.0006	0.0000	-0.0009	-0.0003	-0.0011	-0.0003	-0.0011	-0.0009	0.0001
Std. Dev.	0.0356	0.0385	0.0293	0.0258	0.0275	0.0259	0.0246	0.0324	0.0267	0.0365	0.0364	0.0244
Skewness	0.3692	0.7918	0.2869	0.2138	-0.0689	0.4262	0.0077	0.2161	0.4028	0.1426	0.2806	0.1041
Kurtosis	6.8321	14.6910	10.6195	7.6116	7.7836	7.7366	8.9915	6.0870	9.2174	6.9956	7.8685	10.0862
Jarque-Bera	1043.91	9540.11	4001.89	1470.21	1569.75	1587.54	2460.50	665.96	2694.05	1099.82	1646.19	3434.30
p value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Obs*R-sq	71.6671	14.9272	123.6889	22.0524	129.4866	95.6245	117.0568	104.0930	85.6363	44.1989	61.6408	113.4456
p value	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 3. VAR and GARCH-BEKK model estimates of the index returns.

		VAR Model						GARCH - BEKK Model					
		A-index returns			N-index returns			A-index returns			N-index returns		
Parameters	Lag	Coef.	*t* value		Coef.	*t* value		Coef.	*t* value		Coef.	*t* value	
A-index returns	-1	-0.0596	[-2.46]	**	0.034	[1.01]		-0.0846	[-3.21]	***	-0.012	[-0.37]	
	-2	0.011	[0.48]		-0.0114	[-0.36]		-0.0236	[-0.93]		-0.0275	[-0.88]	
	-3							-0.0161	[-0.68]		-0.0271	[-0.92]	
N-index returns	-1	0.2646	[15.00]	***	-0.0913	[-3.70]	***	0.2693	[15.76]	***	-0.0664	[-2.59]	***
	-2	0.1678	[8.98]	***	-0.1077	[-4.13]	***	0.1602	[8.78]	***	-0.0259	[-0.94]	
	-3							0.022	[1.22]		-0.0268	[-0.96]	
Constant		-0.0002	[-0.36]		-0.0002	[-0.36]		-0.0002	[-0.80]		0.0003	[0.72]	**
R-square		0.1507			0.0174			0.153			0.0099		
Durbin-Watson		2.0287			1.9994			1.9708			2.055		
Jarque-Bera		2567.39	***		3070.92	***		2552.65	***		3364.39	***	

Granger Causality Test	F-stat	Prob.	F-stat	Prob.
N-index returns does not Granger-cause A-index returns	289.47	0.0000	302.24	0.0000
A-index returns does not Granger-cause N-index returns	1.13	0.5676	4.46	0.2159

*** (**) indicates statistical significance at the 1% (5%) level.

Table 4. Conditional variance estimates using the GRACH-BEKK model on index returns.

			A-index returns			N-index returns		
	Parameters	Lag	Coef.	*t* value		Coef.	*t* value	
On past squared innovation	A-index returns	-1	-0.2620	[-13.34]	***	-0.0801	[-4.87]	***
	N-index returns	-1	0.0134	[0.47]		0.2109	[12.59]	***
On past conditional covariance	A-index returns	-1	0.9589	[170.32]	***	0.0104	[2.69]	***
	N-index returns	-1	0.0180	[2.54]	**	0.9732	[240.95]	***

*** (**) indicates statistical significance at the 1% (5%) level.

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