Do the Chinese Bourses (Stock Markets) Really Matter?

Jeffrey E. Jarrett and Xia Pan

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ABSTRACT

We consider whether the Shanghai Bourse and Shenzhen Bourse (stock markets) in China are barometers of the economy of China. By relying on established methods, i.e. multiple Granger causality with group vector autoregression and Geweke linear dependence between the Chinese stock markets and the entire economy, we establish new evidence.

Key Words

Granger Causality
Linear Dependence
China
Purpose

Previously others (Eun and Huang, 2007) investigated the rapid growth in Chinese Stock markets and why they became increasingly important for investors in international markets. The markets play a vital and critical role in privatizing China's state owned enterprises and spreading ownership among the public and abroad. With energetic growth in China and commitment of the authoritarian government to privatization, we expect that the Chinese stock markets will continue to grow. Whether the stock markets are a useful barometer of the growth and conditions of the economy is always subject to questions. Zhong, Gu and Liu (1999) analyzed these points by investigating whether the Shenzhen and Shanghai stock markets have separate Cointegration with the Chinese Economic Prosperity Score (EPS) and departure from the “healthy level” of this score (EPS-D). By Granger (1969) causality [see Toda and Phillips, 1994 and Dufour et al., 2006] they analyzed by pairs of variables separately, the “Granger” causalities between the Shanghai Stock Index and EPS, between the Shanghai stock index and EPS-D. They concluded that the Chinese economic prosperity is the cause (by Granger) of the growth in the stock market. The same could not be concluded about the relationship of the economy growth and the Shenzhen stock market. They presented evidence of the test results of Granger causality but avoided concluding whether the stock markets influence the economy.
Hence, we will present additional evidence concerning the relationship of the Chinese macro-economy and the Chinese stock markets (i.e., the Bourses in Shanghai and Shenzhen).

**Granger Causality: A Simple Definition**

Granger causality tests (1969) are a useful method but should be utilized with great care. The purpose is to find clear conclusions in a simple two-dimensional system. The test may be between two vectors and therefore is not to be two-dimensional in the usual sense. Another potentially serious problem is the choice of the sampling period. For example, a long sampling period may hide the causality. Vector autoregressive (VAR see Chan, 2002, 124-135) systems for monthly data may yield serious measurement errors due to seasonal adjustment procedures. On the other hand Granger causality tests are most useful in the case of two-dimensional systems.

**Geweke Linear Dependence: A Simple Definition**

Geweke et al. (1983, 1984) proposes measures of linear dependence and feedback for multiple time series that are stationary (at least in a wide sense of the statistical definition), autoregressive and purely nondeterministic. The measure of linear dependence is the total of the measure of linear feedback from the first series to the second, linear feedback from the second to the first and instantaneous linear feedback. When feedback (or causality) is absent will the measure be zero and will never be negative. Furthermore, the measure of linear feedback from a series to another can be additively decomposed. Hence, this notion of linear feedback with that of Granger causality we can attempt to analyze whether the macro-economy of China and the variation in the Chinese stock market have a relationship. Hence, these methods coupled
together can give us a more meaningful result than simply finding the correlation between the macro-economy and the variation in the stock markets.

**A Short Synopsis of the Chinese Bourses**

Zhong, Gu and Liu (1999) did an important analysis of the relationship between Chinese markets and its economy. They found indications that the Shanghai and Shenzhen Bourses do not have separate Cointegration with the Chinese Economic Prosperity Score (EPS) and the departure from the healthy level of this score (EPS-D). Variation of stock market indices do cointegrate with the variation of EPS and the change of EPS-D. In addition, they found evidence of Granger causalities between the Shanghai Stock Index and EPS and EPS-D and between the Shenzhen Stock Index and EPS and EPS-D. Their conclusion was that economic growth is the Granger cause of the rise in the bourses. One exception was the relationship of the economy and the rise in the Shenzhen Stock Index. They did avoid concluding that the stock markets are the Granger cause of the rise in the size of the economy.

In the present study, we employ multi-group vector autoregression (VAR) to ascertain the Granger causality between the two bourses noted before the Chinese Macro-economy. Stated differently, we have the Shanghai and Shenzhen bourses as one group and the EPS and EPS-D as the second group.

**Multiple Granger Causality and Geweke Linear Dependence**

Simple Granger causality is between two variables. The VAR between these variables, $y_1$ and $y_2$ is (as follows):

\[ y_{1t} = c_1 + A_1(L) y_{1t} + A_2(L) y_{2t} + e_{1t} \]
\[ y_{2t} = c_2 + B_1(L) y_{1t} + B_2(L) y_{2t} + e_{2t} \]
where \( A_1(L), A_2(L), B_1(L), \) and \( B_2(L) \) are arrays of lag operator with order \( p \). As an example, \( A_1(L) = a_{11}L + a_{12}L^2 + \ldots + a_{1p}L^p \), and the coefficients are scalars. If the coefficients in \( A_2(L) \) are all zeros, \( y_2 \) is not a Granger cause of variable \( y_1 \). Stated differently, the values of \( y_2 \) in the previous time periods do not influence the current value of \( y_1 \). Similarly, if \( B_1(L) \) is zero, \( y_1 \) is not a Granger cause of variable \( y_2 \). Zhong, Gu and Liu (1999) tested the separate hypotheses of \( A_2(L) \) and \( B_1(L) \) equaling zero for each pair of the variables.

Multiple Granger causality is the result of VAR between two groups of variables and not two variables alone. If we denote \( \tilde{y}_{1t} \) as a \((n_1 \times 1)\) and \( \tilde{y}_{2t} \) as an \((n_2 \times 1)\) vector then each of these vectors consist of several variables deemed as a group of variables jointly describing one feature of reality. Also, we denote \( \tilde{x}_{1t} \) as the \((n_1p \times 1)\) vector consisting of all the lagged vectors of \( \tilde{y}_{1t} \) and \( \tilde{x}_{2t} \) as the \((n_2p \times 1)\) vector consisting of all the lagged vectors of \( \tilde{y}_{2t} \). That is, \( \tilde{x}_{1t} = (\tilde{y}_{11,t-1}, \tilde{y}_{12,t-2}, \ldots, \tilde{y}_{1p,t}) \) and \( \tilde{x}_{2t} = (\tilde{y}_{21,t-1}, \tilde{y}_{22,t-2}, \ldots, \tilde{y}_{2p,t}) \). In turn, the VAR are written as:

\[
\begin{align*}
\tilde{y}_{1t} &= \bar{c}_1 + A_1 \tilde{x}_{1t} + A_2 \tilde{x}_{2t} + \bar{e}_{1t} \\
\tilde{y}_{2t} &= \bar{c}_2 + B_1 \tilde{x}_{1t} + B_2 \tilde{x}_{2t} + \bar{e}_{2t}
\end{align*}
\]

where the constant items and the error terms are all vectors for the respective variable groups. The \( A_1, A_2, B_1, \) and \( B_2 \) are matrices of coefficients but without lag operators. Similarly, \( \tilde{y}_{2t} \), the variables for Group 2, is jointly not the Granger cause of \( \tilde{y}_{1t} \), the variables of the first Group when \( A_2 \) is a zero matrix. If \( B_1 \) is a zero matrix, then, we obtain that \( \tilde{y}_{1t} \), the variables of Group 1, is jointly not the Granger cause of \( \tilde{y}_{2t} \), the variables of the second Group.
With this multi-group VAR, we determine the linear feedback (granger causality) between two groups of variables as a whole instead of between two variables. The benefit of multi-group VAR is the one feature describes several variables. We may now observe that one variable in Group 1 is the Granger cause of a variable in Group 2, but a second variable in Group 1 is not a Granger cause of the variable in Group 2. By this reasoning, whether the feature described in Group 1 is the Granger cause of the feature described in Group 2 may not be conclusive. Multi-group VAR avoids this inconclusive result because it jointly includes all the effects of all the variables in all variables in all the periods of interest and the significance of the whole joint effects is determined statistically.

Geweke et al. (1983, 1984) linear dependence is measured on the basis of likelihood ratio analysis. Our research hypothesis is that there is no association between the two groups of variables. The statistical method for validating (or not validating) the aforementioned hypothesis is the likelihood ratio test explained in more detail by Felsenstein (1981), Huelsenbeck and Crandall (1997), Huelsenbeck and Rannala (1997), and Swofford et al. (1996). While the focus of this page is using the LRT to compare two competing models, under some circumstances one can compare two competing trees estimated using the same likelihood model. There are many additional considerations (e.g., see Kishino and Hasegawa 1989, Shimodaira and Hasegawa 1999, and Swofford et al. 1996).

In essence, the likelihood ratio test determines (1) the Granger causality between Group 2 and Group 1, (2) the Granger causality of Group 1 to Group 2, and (3) the instantaneous feedback (no time lags) between the two groups. Geweke (1984) linear dependence
combines the three feedbacks to measure the scale of linear dependence between the two groups of variables as a whole.

**Data Selected for Study**

For the Chinese Bourses (Shanghai and Shenzhen), we select the composite index for each market. The titles given to these indices differ in Chinese but they measure the composite change in the prices and returns for securities listed on each of the two bourses. For the variables measure the size of the total Chinese economy, we utilizes the Chinese Economic Prosperity Score (EPS, noted before). This score is the product of a department of the National Statistics Bureau of China. It combines most data collected about the entire Chinese economy. Further, this score indicates the scale of the prosperity in the economy and a score of 30 is deemed a healthy economic level. In turn, a departure from the health level measures a degree to which the economy differs from a healthy or level in either direction. This departure is the absolute value of the difference and indicates the degree to which the economy is expanding or contracting. Hence, we include this measure denoted before as EPS-D as one of the macroeconomic variables.

The Shanghai Composite (SH) and Shenzhen Composite (SZ) are the variables indicating the Chinese stock markets. The second groups indicating the Chinese economy are EPS and EPS-D. Data collected for this study are for a nine year and one month period. This nine year plus period indicates that we have a lengthy enough study to reduce the effect of short term interventions in either the economy and/or the bourses. Also, the information was the latest available for inclusion in this study. That is, later information was not available before the completion of the analysis.
Data Analysis and Results

Table 1 contains the analysis of the VAR and Geweke Linear Dependence between the Chinese Bourses and the Chinese Economy. The results are Likelihood Ratio Statistics (within twelve month lags) and our methodology is similar to the methodology of Zhong, Gu and Liu (1999). The likelihood ratio follows a Chi-Square distribution and therefore is preferable to the F-distribution in this case. The F-distribution would only be valid asymptotically for VAR for very large samples. In this study, the sample size is 98 and not considered large enough to produce the asymptotic environment necessary for us of the F-distribution and, hence, we utilize the Chi-Square.

---Insert Table 1 here! ---

Observe Table 1 where the likelihood ratio $LR_1$ for the hypothesis that Group 2 is not the Granger cause of Group 1; $LR_2$ is not the Granger cause of Group 2; and $LR_3$ is the hypothesis of no instant feedback between Group 1 and Group 2 (that is, the influence between the two groups within a month). Last, Geweke Linear Dependence time $T$ is the sum of $LR_1$, $LR_2$ and $LR_3$.

Observe in Table 1 the Shenzhen bourse leads the Shanghai bourse and the linear dependence between the two bourses is strong. The prosperity score and its departure from the (economy) "healthy" level do not lead each other. The instant feedback is very strong leading to a conclusion that linear dependence is both statistically significant and important. We can conclude that the Shanghai and Shenzhen are not the Granger causes of the economic prosperity. On the other hand, the Shanghai bourse is the Granger cause of the health-departure of the economy whereas this conclusion does not hold for the Shenzhen bourse. For every case, the economy as represented in this study is the Granger
cause of changes (expansions and contractions) in the values of the bourses. The
dependence between the Shenzhen bourse and economic prosperity is not strong.
Furthermore, we confirm the phenomenon that changes in the economy lead the stock
markets and not the other way around.
We observe in Table 2 the results of the multi-group VAR. By observing the relationship
of the two groups, we find that Chinese markets also have the Granger causality effect on
the economy in a run of ten months or more. If the run is shorter (nine months or less),
Granger causality does not exist. Contrarily, the economy leads the bourses over one
month intervals. We believe that lead time effects can better be studied in the future by
spectral analysis and point estimation of frequencies, however, our findings does suggest
that such an effect occurs. We, thus, have some rough idea of the profile about the length
of causality not existing. Broadly, the markets or bourses are not leading indicators of
changes in the Chinese economy. This conclusion rests on the strength of the analysis
performed and various statistical results that emanate from this exhaustive analysis.
We find that the linear dependence between the Shanghai Bourse and the Chinese
economy is not strong. The Geweke analysis could not reject the hypothesis that there
was no relationships between the variation in the returns to Shanghai Bourse and Chinese
economy as measured in this study (i.e., the period was nine months or less). This result
differs from Zhong, Gu and Liu (1999). Since they did not employ Geweke linear
dependence, their conclusion was based on a simpler analysis. In addition, we should
note that the feedback hypothesis for the Shenzhen Bourse implies a more immediate
impact than on the bourse in Shanghai. Stated differently, the Chinese macro economy
impacts the Shenzhen bourse fast than it impacts the Shanghai bourse. Although neither
is a very good barometer of the Chinese economy, the effects of the economies on these bourses differ.

--Insert Table 2 Here--

If we further examine the relationship between the individual macroeconomic indicators, we find a stronger relationship between the variation in the bourses and the departure from the “healthy economy” (EPS-D) than the relationship between the variation in the bourses and the prosperity score (EPS) alone. This indicates that the EPS-D contains more information concerning changes in stock market activity than the prosperity score alone. Hence, EPS-D (the absolute value of the departure from the “healthy economy”) is a better barometer of future stock market fluctuations than the EPS indicator.

Summary and Conclusions

We surmise that variation in the market indicators of the returns to investors are not barometers or reliable predictors on changes in the entire Chinese economy. The returns to the value investments in the Chinese Bourses respond greater to the sensitivity of absolute changes in the economy than to the economy itself taken in its entirety. Last, the Shenzhen Bourse is more sensitive to changes in the economy than the Shanghai Bourse. The differing characteristics of the Chinese Bourses could be related to the lack of maturity in the Chinese security markets and the rapid transformation of the Chinese economy. If we compare the size of these security markets in China to the size of the economy, we find that the security markets are a much small part of the economy than in other nations. Basically, these security markets are to small a portion of the entire economy to influence greatly the Chinese national economy. This result is not inconsistent with studies of the errors in forecasting returns for listed Chinese firms. Su
and Fleisher (1999) studied the difficulties in forecasting returns for Chinese firms, thus reinforcing the notion that Chinese stock returns and prices are not very good barometers of the changes in the Chinese macro-economy. Further, we should note as the securities markets grow their still will be great need to police the securities markets to make certain that these markets operate both efficiently and without corruption such as insider trading. As these markets increase in size, one expects that these markets will contain features and institutions more closely associated with the large Western and Japanese markets.
Table 1
VAR and Geweke Linear Dependence between the Chinese Economy and The Chinese Bourses
SH=Shanghai Bourse Composite Index  EPS= Chinese Economy Prosperity Score
SZ= Shenzhen Bourse Index  EPS-D = Departure from Chinese Prosperity Score
Lagging order  p= 12 months
Granger Groups  Likelihood Ratio Test Statistics (Bold print indicates significance at $\alpha = 0.05$

<table>
<thead>
<tr>
<th>Granger Groups</th>
<th>LR$_1$ for $A_2 = 0$</th>
<th>LR$_2$ for $B_2 = 0$</th>
<th>LR$_3$ for $B_1 = 0$</th>
<th>Geweke Dependence$^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH vs. SZ</td>
<td>82.6065</td>
<td>17.1751</td>
<td>0.7209</td>
<td>100.5025</td>
</tr>
<tr>
<td>EPS vs. EPS-D</td>
<td>19.3894</td>
<td>19.8408</td>
<td>8.4885</td>
<td>47.7187</td>
</tr>
<tr>
<td>EPS vs. SH</td>
<td>13.3623</td>
<td>32.2376</td>
<td>0.7343</td>
<td>46.3341</td>
</tr>
<tr>
<td>EPS-D vs. SH</td>
<td>23.2232</td>
<td>24.5726</td>
<td>0.7117</td>
<td>48.5075</td>
</tr>
<tr>
<td>EPS vs. SZ</td>
<td>5.5858</td>
<td>24.1701</td>
<td>2.2568</td>
<td>32.02128</td>
</tr>
<tr>
<td>EPS-D vs. SZ</td>
<td>18.5373</td>
<td>24.2000</td>
<td>0.5636</td>
<td>43.3010</td>
</tr>
</tbody>
</table>

*Values in this column are the Geweke Linear Dependence multiplied by $T = 98$. 
Table 1
VAR and Geweke Linear Dependence between the Chinese Economy and The Chinese Bourses

SH=Shanghai Bourse Composite Index  EPS= Chinese Economy Prosperity Score  
SZ= Shenzhen Bourse Index  EPS-D = Departure from Chinese Prosperity Score  
Lagging order  p= 12 months

Granger Groups | Likelihood Ratio Test Statistics (Bold print indicates significance at $\alpha = 0.05$) |
--- | --- | --- | --- | --- |
(Group 1 vs. Group 2) | LR$_1$ for $A_2 = 0$ | LR$_2$ for $B_2 = 0$ | LR$_3$ for $B_1 = 0$ | Geweke Dependence$^*$ |
--- | --- | --- | --- | --- |
| SH | 41.337 | 45.7061 | 4.4023 | 91.4421 |
| vs. | 16.7057 | 32.5264 | 1.7233 | 50.9554 |
| p=12 | 5.7943 | 22.8712 | 0.7504 | 29.4159 |
| EPS-D | 1.9738 | 10.1845 | 0.6986 | 12.8569 |
| p=1 | 2.1558 | 1.9314 | 0.9611 | 5.0484 |
| p=12 | 36.5214 | 50.8780 | 2.0902 | 89.4896 |
| (EPS & EPS-D) | 23.8997 | 42.7244 | 1.2369 | 67.8610 |
| vs. | 15.9788 | 28.2888 | 2.0205 | 46.2881 |
| p=6 | 4.2520 | 21.1568 | 2.9887 | 28.3974 |
| p=3 | 1.5121 | 1.6411 | 1.5870 | 4.7402 |
| p=1 | 19.0865 | 48.4990 | 4.0082 | 71.5938 |
| (SH & SZ) | 9.8751 | 34.4873 | 1.6517 | 46.0140 |
| p=9 | 3.3324 | 12.9388 | 0.8863 | 17.1576 |
| vs. | 15.5261 | 5.1219 | 1.7485 | 8.3965 |
| p=6 | 1.3898 | 3.3424 | 1.3397 | 6.0178 |
| (SH & SZ) | 11.5894 | 54.5248 | 3.6400 | 102.7542 |
| p=12 | 24.7875 | 43.5296 | 1.8096 | 70.1260 |
| vs. | 13.3051 | 30.7624 | 1.5142 | 45.5817 |
| p=9 | 8.9042 | 21.0744 | 0.7833 | 31.6620 |
| p=3 | 5.6753 | 1.5358 | 0.0048 | 7.2159 |
| p=1 | 44.5894 | 54.5248 | 3.6400 | 102.7542 |
| (SH & SZ) | 24.3148 | 101.5771 | 6.5726 | 182.4644 |
| p=12 | 42.6770 | 80.1184 | 2.8774 | 125.6729 |
| vs. | 12.8031 | 48.3929 | 2.9590 | 76.1550 |
| p=9 | 12.9811 | 25.7128 | 3.4330 | 42.1269 |
| p=3 | 7.1531 | 3.5347 | 1.3612 | 12.0911 |

*Values in this column are the Geweke Linear Dependence multiplied by $T = 98$. The LIKES 1993.
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