Do the Chinese Bourses (Stock Market) Predict Economic Growth?

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ABSTRACT

We study the relationship of the Chinese Macro-Economy and the Chinese stock markets, i.e. the Bourses in Shanghai and Shenzhen. With this goal, we utilize the Multiple Granger Causality and Geweke Linear Dependence and test the Likelihood Ratio statistics between two sectors of the Chinese Economy, that is, the Chinese Economic Prosperity Score (EPS) and its departure from the health level (EPS-D) –and the group for composite indexes for Chinese securities markets – Shanghai Composite (SH) and Shenzhen Composite (SZ). The data covers a period of nine years and one month. The authors found no evidence that SH and SZ are the Granger causes of the economic prosperity. Last, the evidence supports the notion that Chinese stock markets respond greater to changes in EPS-D than to EPS and the SZ is more sensitive to changes in the economy than the SH.

Key Words

Granger Causality

Geweke Linear Dependence

Likelihood Ratio tests

Vector Autoregression
Purpose

Investment opportunities in Chinese financial markets documented before [Chen (1991), Cheung and Ng (1998), and Liaw (2007)] describe China as an economic power offering tremendous business and economic opportunities. However, its financial markets are still not fully developed when analyzed by methods developed by financial economists [Fama (1990, 1991), Wei and Wong (1992), Zhong, Gu and Lui (1999) hereafter, ZGL]. Unlike their Western counterparts and also Japan, Chinese financial markets are in comparison highly speculative. The majority of participants are individuals and naïve investors who lack the knowledge of investing and a large enough fund base for sophisticated investing in developed financial markets. Moreover, government intervention is far more often and stronger than those in developed nations. Thus, the relationship between stock markets and real economic activity remains a subject matter for empirical investigation. Thomas (2001) discusses in detail the workings of the Shanghai Bourse over its illustrious history yield insight into the characteristics of the financial market including the behavior of both domestic and foreign investors in this market. It is a descriptive history including aspects in the twentieth but not twenty-first century. Another interesting report on these same markets is by Gao (2002) noting both the strengths and shortcomings of the China markets. He used phrases such as “unusual market structure,” “market manipulation and speculation,” and “dominated by a limited number of large cap stocks,” “multitude of
small cap stocks”, “widespread government holdings” and the like in characterizing the markets. Furthermore, he argues for greater regulatory control in markets to foster an environment in which the stock markets can survive. All of this indicates the great differences between Western oriented stock markets and the Chinese Bourses. Hence both the cultures and the way in which Chinese markets do business cannot be judged by the standards used to judge markets in the United States, Japan and the markets of Central and Western Europe.

If we observe some relationships between the rapid growth in China GDP (the horizontal variable and the Dow-Jones Shanghai Financial Market Index (Figure 1), we can ascertain that both grew rapidly over the period for the yearly closing data collected (1994 to 2007). Note a linear regression line was plotted in Figure 1 shows an upward trend over time. However, the actual observations are not distributed randomly or normally about the line. We surmise that there are many other economic factors affecting this relationship; and the growth in GDP and growth in the Shanghai Index are not strongly related. At this point a more sophisticated form of research is warranted.

In addition, Figure 2 contains the scatter plot for the Dow-Jones Shenzhen Financial Market Index vs. the China GDP for the same time period. Simply examining the relationship between the two indicators of change again indicates that both grew substantially over the time period. However, when observing the actual data plotted adjacent to a linear regression, we observe that other factors are affecting this relationship. Most important, one cannot surmise anything by the simple scatter whether GDP predicts changes in the financial market indexes or the relationship is the other way around. Finally, a third scatter plot (Figure 3) shows the relationship between the Dow-
Jones China 88 Index and China GDP for yearly data over the same time period. This index measures change in the closing prices of 88 significant Chinese firms included in the index. The similarity between this scatter plot and the two previous ones indicate again the need for a more sophisticated study of the effects of China GDP on closing prices on China financial markets. Last, note that all three figures show large standard errors of regression (S) and coefficients of determination (R²) of less than 50 percent. The new study should explore both whether financial indexes are barometers of economic activity and what is the direction of such activity. Other economic indicators such as output of China industrial output plotted against the financial market indexes would show similar results. By other economic indicators, one usually refers to indicators that make up the composite indicators of business conditions. Such an analysis would show similar results as done here. Others such as the unemployment rates tend to lag economic indicators such as personal income, business inventories and similar indicators of economic activity so some results would differ in times slightly.

Figure 1
Relation of Shanghai Market and China GDP

Shanghai = 15.52 + 0.01360 GDP

S = 88.6295
R-Sq = 47.1%
R-Sq(adj) = 42.6%
Figure 2

Relation of Shenzhen Market and China GDP

Shenzhen = 21.77 + 0.01231 GDP

\[ S = 88.7656 \]
\[ R\text{-Sq} = 42.1\% \]
\[ R\text{-Sq(adj)} = 37.2\% \]
Others (Eun and Huang, 2007, Ng and Wu, 2007, Su 1998, and Wang, Burton and Power, 2004) 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. ZGL 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 Granger cause 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).

ZGL further 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). Variations 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 and 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. Thus, we can go much further in establishing the linkages between the growth in the Macro-Economy and the two financial markets and in turn give greater comprehension to the roles that all of these economic entities play. By following and improving upon the methods of ZGL for a later time period, we will verify or not whether their research conclusions hold under a newer and more thorough investigation.

**Multiple Granger Causality and Geweke Linear Dependence**

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) (Chan, 2002, 124-135) systems for monthly data may yield serious measurement errors due to seasonal adjustment procedures. Moreover, Granger causality tests are most useful in the case of two-dimensional systems. 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 that is there is no upward or downward trend in the average over time, no change in the
variability about the average over time and no seasonal pattern in the data, O'Donovan, 1983, p.24), 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. Previous studies of stock market analysis utilized these methods successfully. Geweke studied the measure of linear dependence and spectral feedback for grouped multivariate time series. Pan (2007) applies the measure of linear dependence and spectral feedback to examine the relationship between grouped variables of economy and stock market indices. Placing economic variables into one group and stock market variables into another, he estimated the between-group relationship within the US, within Japan, and within the European Union. The feedback spectra for grouped variables were calculated and displayed. Risk exists in that the significance levels for these tests which may reduce their reliability, he determined the feedback spectra on possible nonstationary variables in level; also he found the patterns of the feedback spectra providing information about the cyclical effect between the variable groups.
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, $A_1(L) = a_{11} L + a_{12} L^2 + \ldots + a_{1n} L^n$, 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, $\tilde{x}_{1t} = (\tilde{y}_{1,t-1}, \tilde{y}_{1,t-2}, \ldots, \tilde{y}_{1,t-p})$ and $\tilde{x}_{2t} = (\tilde{y}_{2,t-1}, \tilde{y}_{2,t-2}, \ldots, \tilde{y}_{2,t-p})$. In turn, the VAR are written as:

$$\tilde{y}_{1t} = \tilde{c}_1 + A_1 \tilde{x}_{1t} + A_2 \tilde{x}_{2t} + \tilde{e}_{1t}$$

$$\tilde{y}_{2t} = \tilde{c}_2 + B_1 \tilde{x}_{1t} + B_2 \tilde{x}_{2t} + \tilde{e}_{2t}$$

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. An example of this analysis on data are given in Lemmens et al. (2008) where by they decompose Granger causality over a spectrum allowing them to disentangle potentially different Granger causality relationships over different frequencies. This yielded new and complementary insights compared to traditional versions of Granger causality. The usefulness of Granger results are discussed in detail and shown to support the use of the Granger causality analysis utilized in this and other studies.

Geweke et al. (1983, 1984) measures linear dependence 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 (hereafter, LRT) 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 study is utilizing 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)]. Last, Barnett, Geweke and Shell (1987) present fundamental new research on the analysis of complicated outcomes in relatively simple macroeconomic models.

In essence, the LRT 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. The usefulness of all test and models present thorough evidence as the reliability of Geweke linear dependence in the study of the groups of variables developed in this study.

**Data Selected for Study**

Following the study of ZGL for the Chinese Bourses (Shanghai and Shenzhen), we selected the composite index for each market. The length of data was for approximately ten years resulting in a time period where analysis can lead to interpretable results. Small time periods such as two or three or even four years are usually to small to reduce the effects of disturbances in economic data and more specifically to not produce enough degrees of freedom such that one may identify significant events and factors. A small number of degrees of freedom in sample data may not lead to determining ‘statistically significant’ events even when they exist. We could have examined alternative measures
of Chinese stock market behavior and there are studies using such indicators as the Dow Jones China 88. However, the purpose of these other studies (Fama and Schwert (1977), Fama (1990, 1991), Chen 1991, Wei and Wong (1992) and Cheung and Ng (1998) differed greatly from the purpose this study. The Dow Jones China 88 does not measure changes in the Shenzhen and Shanghai indexes. Furthermore, we gathered our data from private sources and which better reflected the existing Chinese financial markets. The index represents monthly closing composite returns over the early nine year one month time period for the financial markets. New indexes are now being prepared and when they have a lengthy history; one will be able to study them as well.

The titles given to the indices utilized in this study 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 utilized 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 ZGL. 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.

<table>
<thead>
<tr>
<th>Granger Groups</th>
<th>Likelihood Ratio Test Statistics (Bold print indicates significance at $\alpha = 0.05$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH vs. SZ</td>
<td>82.6065 for $A_2 = 0$ 17.1751 for $B_2 = 0$ 0.7209 for $B_1 = 0$ 100.5025 Geweke Dependence*</td>
</tr>
<tr>
<td>EPS vs. EPS-D</td>
<td>19.3894 19.8408 8.4885 47.7187</td>
</tr>
<tr>
<td>EPS vs. SH</td>
<td>13.3623 32.2376 0.7343 46.3341</td>
</tr>
<tr>
<td>EPS-D vs. SH</td>
<td>23.2232 24.5726 0.7117 48.5075</td>
</tr>
<tr>
<td>EPS vs. SZ</td>
<td>5.5858 24.1701 2.2568 32.02128</td>
</tr>
<tr>
<td>EPS-D vs. SZ</td>
<td>18.5373 24.2000 0.5636 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
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 were 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 ZGL. 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 more quickly 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.

<table>
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<th>Granger Groups</th>
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<tbody>
<tr>
<td>(Group 1 vs. Group 2)</td>
<td>LR$_1$ for $A_2 = 0$</td>
</tr>
<tr>
<td>(EPS &amp; EPS-D) vs. SH</td>
<td>p=12</td>
</tr>
<tr>
<td>vs. SH</td>
<td>p=9</td>
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<tr>
<td>vs.</td>
<td>p=6</td>
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<td>vs.</td>
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<td>p=9</td>
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<td>----------------</td>
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<tr>
<td>vs.</td>
<td>p=6</td>
</tr>
<tr>
<td>SZ</td>
<td>p=3</td>
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<td></td>
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<td>p=3</td>
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<td></td>
<td>p=1</td>
</tr>
</tbody>
</table>

• *Values in this column are the Geweke Linear Dependence multiplied by $T = 98$. 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 is not barometers or reliable predictors on changes in the entire Chinese economy. Although Liang and Teng (2001) found unidirectional causality from economic growth to financial development, we found no evidence that the opposite direction occurred. 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 a relatively small portion of the economy and thus have little influence on 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.
References


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Mission

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