Can Stock Market Bubbles in China Be Predicted?
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With the emerging of new and complicated time-series methods and machine learning techniques that allow us to better diagnose and understand stock market bubbles to be able to predict and make an early warning on a stock market bubble burst. This project examined the multiple bubble periods on two main stock market indexes in China and then using machine learning classification models to predict the next bubble periods. Two main questions that this project wants to answer 1) How accurate the GSADF test to define the bubble periods in China stock markets? 2) Can we use complexity variables like entropy to generate an early warning signal to predict stock market bubble? The data is weekly from Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE), which are two official stocks market of China and were established on December 1990 and July 1991 respectively. The SSE has 1520 observations and SZSE has 1307 observations.

Theoretical model background

In this project, I used the sup augmented Dickey-Fuller test(SADF) that developed by Phillips et al. (2011) and the generalized sup augmented Dickey-Fuller test (GSADF) by Phillips et al. (2013) to identify bubbles in Shanghai and Shenzhen stock markets. The GSADF is a generalized version of the SADF. Both methods rely on a recursive right-tailed ADF unit root test to detect exuberance and collapse of bubbles. The SADF test is only able to identify a single bubble because of the procedure is using a forward expanding window so that it is fixed starting point. But the GSADF test given user minimum window size and try to use all possible subsamples to test exuberance. The GSADF is that it allows date-stamping to find the exact date of past bubbles. The GSADF test is good for test multiple bubble periods with non-linear structure. Another pros of the test given user minimum window size and try to use all possible subsamples to test exuberance.

The Generalized Sup Augmented Dickey-Fuller Test (GSADF)

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The GSADF test helped define two main bubble period in China’s stock markets. In Shanghai stock exchange index, the first was the subprime mortgage crisis period, which start from 2006-11-19 to 2008-01-27. The second collapsing period was from late 2014 and end in 2015-06-14. Shenzhen stock exchange index has similar bubble period, but the second bubble period start early 2015 and the duration is 11 weeks. Because of the two markets have the similar bubble pattern, I only used SSEC series to predict bubble in the following section and the SZSE should follow the similar result.

I calculated the lag 1 of autocorrelation, standard deviation, permutation entropy, sample entropy, the correlation between two entropies, and price. Scheffer et al. (2009) discovered autocorrelation and standard deviation could be the early-warning signals for system regime shifts. Entropy has been used to describe the level of randomness, disorder or complexity. Hou et al. (2017) showed permutation entropy has strong negative relationship with market crashes depend on the research on SSEC and SZSE.

Key References