

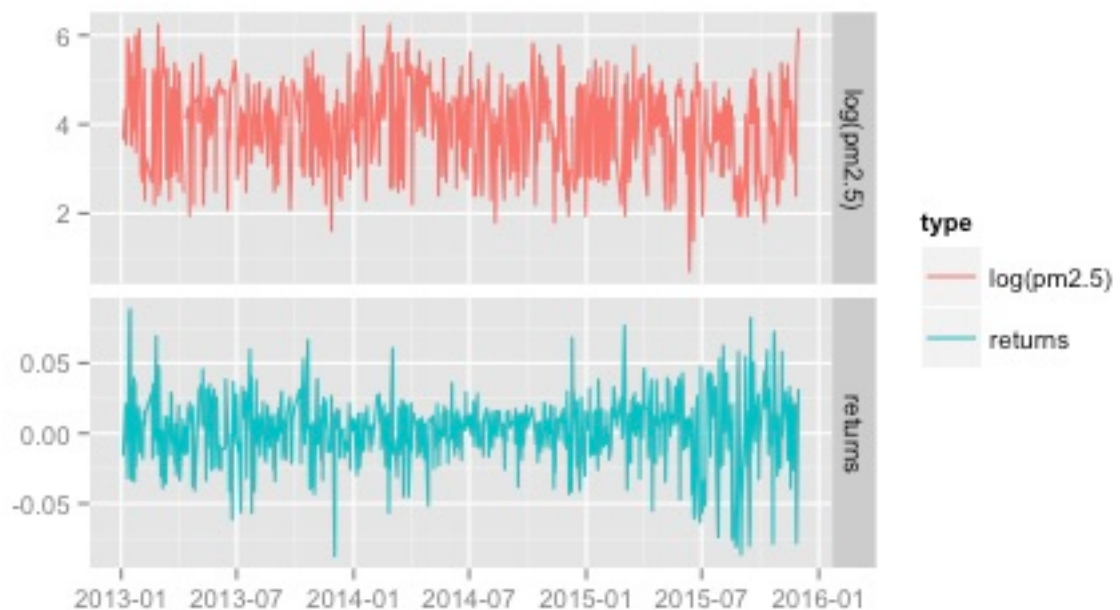
# Air Quality in China Study Design

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## 1. Introduction

In recent years, air quality is one of the major concerns of China. PM2.5, as a well-known measurement of air quality, has drawn much more attention. An increasing number of people start to wear masks when they go out and care about their health, which definitely stimulates the mask manufacturing and puts heavy pressure on the local government to draft bills for emergency measures against serious air pollution.

Since 2013, shares in environment-related companies have been gaining momentum on Chinese stock market. The China Security Index Company created a PM2.5-related industrial average for continuous attention on the high-tech environmental companies' stock such like air quality instrumentation, filter presses, and separators. And the government issues specific policies that are beneficial to high-tech environmental companies. Thus, we are keenly interested in how the air quality affects the stock of those companies.



The figures above display the time series of logarithmic transformation of PM2.5 index in Beijing and the log return plot of PM2.5-related industrial average from January 1, 2013 to December 31, 2015. We take the logarithmic transformations of original data to make the series less variable. As we can see, the patterns of log returns seem to be correlated with that of the PM2.5

index; in addition, it is likely that a lag effect exists. This brings us to our primary question as follows.

## **2. Key question**

How does the PM2.5 index affect the shares of air quality-related companies in China?

## **3. Plan of approach**

As mentioned above, there is supposed to be corresponding variations in the stock price with the fluctuations of the air quality. To explore the internal relation between the air quality and the stock price of environmental companies, we'll investigate the granger causality, impulse response and cointegration test of PM2.5 Stock Index and air quality data, based on VAR model. Here are some basic steps:

- ADF test
- Lag selection
- Cointegration and granger causality test
- Impulse response

Here ADF test can tell us whether the time series are stationary, which is prerequisite for granger causality test. Based on information criterion, we can perform the lag selection. Granger causality test, which is the key part of the answer, helps us decide whether a time series is useful in forecasting another. When the time series are not stationary, we can explore the cointegration between time series. Impulse response functions represent the mechanisms through which shock spread over time. They can show us the effect of a sudden increase in PM2.5 on stock market in next few days.

## **4. Data source**

PM2.5 index: <http://www.stateair.net/web/historical/1/1.html>

PM2.5-related industrial average: Wind(Professional financial data terminal in China)

### **Process of working in my team – Yaqi Zhou**

Our team met twice for this study plan. At the first meeting, we brainstormed to set our key question. In the beginning, we came up with ideas, like looking for spatial patterns and trends of the PM2.5 index throughout the whole nation, or studying the relationships of air quality among big cities and their surrounding ones, which were abandoned due to lacking access to the data in China. Then, we thought that we could find explanatory variables, involving geographic, demographic and economic ones, such as altitude, population, local GDP, and so on, to make inference about the important factors influencing the air quality. However, we believed that some politic interventions might cause large fluctuations in air quality and it was hard to measure the politic factors. Therefore, we decided to turn to some specific questions, e.g. how the air quality can cause cancer. Finally, we agreed that the relationship between PM2.5 index and the environment-related industrial average in finance was of great interest to us because it is a white hot topic at present in China.

When we started to draft our study design, I helped to clean the data and plot the figures in R to seek for the relationship intuitively. It shocked us when we saw a big jump in the early 2015 when Chinese stock market surged. Besides, the PM2.5 index also fluctuates a lot. To make the series more stationary, I took the log transformations on both series; the log returns were then calculated. After that, the correlation between two time series appeared to be much more evident, together with the lag effect. This result convinced us that there was something indeed waiting for us to explore!