Effect of air pollution on the stock yield of heavy pollution enterprises in China's key control cities

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A B S T R A C T

Under the background of climate change, the haze days in China have increased significantly, which seriously hinders the sustainable development of society and arouses wide attention from the public. However, the researches on the effect of air pollution on the stock yield of heavy pollution enterprise in key control cities are quite limited, This paper collects the Air Quality Index (AQI) from key control cities above prefecture level in China as well as the stock yield data of these cities' heavy pollution enterprises in December from 2014 to 2016 and through multi-discontinuities regression model, testes the effect of air pollution on the stock yield of heavy pollution enterprise. The results show that: (1) Heavy air pollution (AQI = 300) has negative influence on the stock yield. (2) There exists time effect of air pollution on stock yield. Since the year 2014, heavy air pollution has exerted significantly negative influence on the stock yield in that 2013 may be the "first year" when the Chinese society began to take air pollution seriously. This paper gives a brief discussion on the cause of it and suggests that severe air pollution should be strictly controlled. Only by facing air pollution seriously, can we eliminate air pollution with collective wisdom and concerted efforts and achieve the sustainable development of city. Being the first study to look into the effect of air pollution on stock yield in key control cities in China, this paper provides empirical reference for government supervision departments, stock investors as well as enterprises.

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1. Introduction

Due to climate change, the environmental problem in China is increasingly serious (Mi et al., 2017). It is estimated that, from 2001 to 2010, the annual premature death toll caused by air pollution increases from 418 thousand to 514 thousand in China. According to the *Global Burden of Disease Study* conducted by the World Health Organization, the estimated premature death toll of China is higher and reaches 1.2 million in 2010.[1] Apart from health and lifespan, air pollution exerts adverse influences on other aspects of people's daily life as well, such as outdoor travel frequency, social interaction intention, and emotion. Through an analysis based on nationwide investigated data, Sexton (2012) found that when air quality warnings were given, the time people spent on outdoor activities would drop by 18%. Zheng et al. (2016) found that under severe air pollution, people were forced to dine out less often and they would get less satisfaction from dinning out. Graff and Neidell (2012) found that air pollution had a significant negative impact on productivity. Workers would feel distracted and down in the dumps during work. Besides, they would ask for leave frequently.

Air quality, which has attracted more and more attention from the public, will influence the psychology and behavior of people fully and thoroughly (Lundberg, 1996; Lepori, 2009). Similarly, environmental stress like weather change can influence stock market through investor sentiment. Saunders (1993) found there was a significant negative correlation between cloud coverage rate and stock yield. Hirshleifer and Shurnway (2003) verified the negative correlation between cloud coverage rate and stock yield. Lepori (2009) found that air pollution was negatively related to stock yield. Lu (2011) found weather index had no significant effects on stock yield while it could significantly influence the

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turnover rate and volatility. Guo and Zhang (2016), through a multivariate progressive empirical approach based on the data of air quality and stock market of Shanghai, found that the stock market tended to have higher yield, lower turnover rate and volatility with excellent air quality.

As air quality and economic behavior are closely related, this paper, based on and improved the researches of Saunders (1993) and Hirshleifer and Shurnway (2003), attempts to study the impacts of air pollution on investor sentiment and stock yield under climate change from the aspect of city. Based on the air quality data of key control cities in China and the stock yields of heavy pollution enterprises, this paper, through regression discontinuity, discusses how seriously and in which year will air pollution influence stock market. The main features of the present study are as follows: First, the object of study is the data of the listed companies in 120 key control cities in China. It can reduce the errors of results caused by the differences between samples and thus get more persuasive conclusions. Second, as people feel different about air pollution degree, the impacts of air pollution at different levels on the stock yield are examined through regression discontinuity. This paper studies the effects of air pollution on the stock yield of heavy pollution enterprises in key control cities from different aspects, and then provides corresponding policy making suggestions on how to adapt to climate change and achieve sustainable development. The present study is a useful supplement to relevant researches. The rest of this paper is arranged as follows: Section 2 is literature review; Section 3 is introduction to indices and data; Section 4 is empirical analysis, and the last section is conclusions.

2. Literature review

As stock yield is influenced by air pollution through investor sentiment, the literature review of this paper is divided into two parts, namely, the researches on the effect of air pollution on investor sentiment and the researches on the effect of investor sentiment on stock yield. A brief introduction to the ways air pollution affects stock yield and the reason for using regression discontinuity in this paper is given.

In terms of the researches on the effect of air pollution on investor sentiment, in 1903, Nelson pointed out that it would be rather difficult for investors to deal in shares in muggy and rainy weathers as confidently and freely as in dry and sunny weathers. People tended to be happy and optimistic in good weather. Air quality, as one of the index for weather conditions, would affect the emotions and feelings of people at some extent, and would further affect the transactions in stock market. Evans et al. (1987) believed air pollution would influence people's sentiment and sentiment would affect decision making. People would feel angrier, more depressed, and more helpless when exposed to severe air pollution. Zhou (1999) believed weather conditions, which human beings rely on for existence and development, highly restricted the activities of people. Weather conditions had attracted extensive attention from people because any change in weather would significantly influence people's life. Eagles (1994) found that the lack of sunshine would make people depressed or even lead to a rise in suicide rate. In stock market, the mental activities of investors would be influenced by the surrounding environment, for instance, weather conditions, and the mental activities would further influence the exchange of stock. Mehra and Sah (2002) found that a minor mood swing could lead to a significant fluctuation in capital price. Lucey and Dowling (2005) found that weather and biologic changes could affect the exchange of stock through influencing people's sentiment. According to these researches, serious air pollution could cause negative emotions on investors and their will of transaction would become weaker, through which the stock yield

would be affected.

In terms of the researches on the influence of investor sentiment on stock yield, Forgas and Bower (1987) found that there was an emotion congruent effect in human being's behavior. In other words, when somebody feels happy, he/she is more likely to run into positive things, while when he/she feels upset, things around him/her are tend to be negative. Lee et al. (1991) came up with the "investor sentiment theory" which said that the expectations of trader on future earnings were easy to be affected by sentiment volatility. According to some psychological researches, the behavior decision-making and judgment of people can be affected by emotions. Wright and Bower (1992) put forward that people made positive evaluations on many things when they were in good moods, increasing investment and consumption for example. Isen (1993) proposed that people would simplify the cognitive processes to help themselves make decision when they were happy. Liu et al. (2000) and Song et al. (2003) gave objective evidence of the interaction between Chinese stock market and investor sentiment. Wu et al. (2016a,b) found that investor sentiment could not only be used to predict the current stock yield but also the long-term (or intertemporal) stock yield. Other researches on the influences of investor sentiment on stock yield are conducted by Baker and Wurgler (2006), Kaplanski and Levy (2010), Levy and Yagil (2011), Brown and Cliff (2004). Due to space limitations, the details of these researches will not be given.

Air pollution influences stock yield in different ways. Guo and Zhang (2016) proposed that air quality affected the preference and decision-making of such stock market participants as supervision department, listed company, and local and non-local investors through policies (Oberndorfer and Andreas, 2006; Mulatu et al., 2010; Kong et al., 2012), sentiment (Thaler 1993; Daniel et al., 1998; Bullinger 1990; Schottenfeld 1992; Nowakowicz-Debek et al., 2004; Coates and Herbert 2008; Hirshleifer 2001) and market expectations (Banerjee 1992; Yang et al., 2004) respectively. Then the trading behaviors (direction, quantity, and timing) are determined, through which the stock yield is affected eventually. It should be pointed out that policy, sentiment, and market expectation are closely related and influence each other.

This paper conducts an empirical analysis with regression discontinuity model, through which endogency can be avoided effectively. Yu and Wang (2011) believed that regression discontinuity, second to random experiment, was an approach which could analyze the correlations between variables through the effective utilization of realistic constraint conditions. Lee (2008) proposed that regression discontinuity was widely applied as it could avoid the endogency in parameter estimation and faithfully reflect the correlations between variables. This paper attempts to find out whether the stock yield of enterprise will be affected when AQI reaches a certain threshold. Regression discontinuity is quite suitable for the case and thus is used in this paper.

3. Introduction to indices and data

3.1. Air pollution level

Using which kind of index to measure air pollution level is one of the research focuses. Khanna (2000) put forward the air pollution index system by means of comprehensively evaluating multiple pollutants. Kyrkilis et al. (2007) and others proposed aggregate air quality index. It is worth mentioning that Zhou has made in-depth research on this field. Taking the use of the "loss of information" thinking, Zhou et al. (2006) constructed a composite environmental index (CEI) which could objectively measure the environmental pollution level. By means of empirical study, simulation as well as comparative analysis, Zhou and Ang (2009)