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# Environmental Risk and Audit Fees: Evidence from Monitoring of PM2.5

**Yue Wu**

Management School, Jinan University, Guangzhou, China
Email: wy1101@163.com

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## Abstract

Previous studies have found many factors that affect audit fees, such as company size, business complexity, internal control quality, firm characteristics and so on. Under the background of increasingly severe environmental problems, environmental risks will inevitably affect the business conditions of the company and thus affect the auditor's judgment of risks. However, we know little about whether and how environmental risks affect audit fees. In this paper, we use the monitoring after the PM2.5 explosion as an exogenous event, and the propensity matching score method and the difference-in-difference model are used to study the relationship between environmental risk and audit fees. The empirical results show that, first, after the monitoring of PM2.5 began in 2012, those listed companies located in cities that take the lead in monitoring PM2.5 would be charged higher audit fees. Second, this relationship exists only in heavily polluting enterprises with low internal control quality.

## Keywords

Environmental Risk, Internal Control, Audit Fees, PM2.5

## 1. Introduction

In 2006, China issued a series of auditing standards, of which No. 1631 proposed that auditors should pay attention to environmental issues in relevant industries during the audit process. Specifically, the environmental issues mentioned in the standard include four categories: mandatory or voluntary environmental protection measures; consequences that may result from violating environmental laws and regulations; consequences of environmental damage on others or natural resources; and liabilities caused by environmental damage. These auditing standards were implemented in 2007. At that time, environmental risk as a source of audit risk has begun to be noticed by the auditing regulators. However, how do auditors consider this environmental risk? The answer to this question is not very clear.

In recent years, people's environmental attention has increased a lot, especially after 2011, in which year PM2.5 index reached dangerous levels many times. After the incident, PM2.5 received extensive attention from the government and the public. On February 29, 2012, the Ministry of Environmental Protection issued new standard, which incorporated PM2.5 into the scope of monitoring, and proposed to implement environmental air quality standards, begin monitoring and release PM2.5 data, and promote air pollution control. The purpose of the new standard is not only to expand the scope of air quality monitoring, but more importantly, to strengthen the environmental supervision of heavily polluting enterprises. It can be foreseen that after this, the business risk of heavy polluting enterprises located in the monitored city will greatly increase. This article takes this opportunity to study the impact of environmental risks on audit costs, and consider the role of internal control in its regulation.

The possible innovations of this paper are: first, the literature on the factors affecting audit fees could be expanded. Previous studies focused on the influence of factors at the firm level and the auditor firm level on the audit fees. From the perspective of environmental risks, this paper uses the exogenous events to construct the DID model and believes that auditors will also consider environmental risks when deciding audit fees. Second, it will help deepen people's understanding of the PM2.5 event in 2011. This is not only a public event but also has an impact on the operation of listed companies.

The following structure of the paper is arranged as follows: The second part is the literature review, which summarizes the existing studies; the third part introduces the institutional background and puts forward the research hypothesis; the fourth part introduces the sample, variables, model and empirical results; finally, summarize the full text.

## 2. Literature Review

In the late 1970s, the US Securities Regulatory Commission began requiring listed companies to disclose audit fees externally. In China, this began in 2001. Since then, researches on audit fees have gradually increased.

Simunic (1980) first conducted a study on audit fees, which used data of audit fees to examine the competition in the audit industry, and pointed out that audit costs were related to factors such as company size, business complexity, and inventory ratio [1]. Among these, the most significant determinant is the size of the company, followed by the complexity of the business. Since then, there are many literatures discuss the factors affecting audit costs, and risk has become a very important factor, especially after the implementation of modern risk-oriented audit. John and Michael (2005) proved that the companies exposed to bribery risk will be charged higher audit fees than companies without bribery

[2]. Scott *et al.* (2017) compared cross-listed foreign companies in the United States with foreign companies that did not cross-list, and believed that audit fees are higher because of increased litigation risks and auditing effort [3]. Tianshu Zhang and Jun Huang (2013) examined the relationship between corporate risks and audit fees in China, which captured the exogenous impact of the 2008 financial crisis. The study found that when the company's operating risk increased under the financial crisis, audit fees also increased, indicating that the company's audit fees had a risk premium [4]. In addition, Yue Li (2017) focused on the impact of environmental compliance risk on audit fees, indicating that auditors would pay attention to companies' environmental performance [5].

Under the COSO Internal Control-Integrated Framework, a widely used framework in not only the United States but around the world, internal control is broadly defined as a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance. And COSO defines internal control as having five components: control environment; risk assessment; information and communication; control activities. There are generally two ways to measure the quality of internal control. One is to use the disclosed internal control information, such as internal control defects, internal control self-evaluation reports, etc., to measure the level of internal control quality; the other is to construct an internal control evaluation system or evaluation index based on the information disclosed in the annual report. This article uses the internal control index developed by Shenzhen DIB as a proxy variable for internal control quality.

## 3. Institutional Background and Research Hypothesis

### 3.1. Institutional Background

On February 15, 2006, Ministry of Finance of the People's Republic of China issued a series of auditing standards, of which No. 1631—"Consideration of Environmental Matters in the Auditing of Financial Statements" standardized the behavior of auditors concerned with environmental issues during the audit. The standards were implemented from January 1, 2007. The environmental issues mentioned in the standard include four categories: mandatory or voluntary environmental protection measures; consequences that may result from violating environmental laws and regulations; consequences of environmental damage on others or natural resources; and liabilities caused by environmental damage. This requires auditors to pay attention to the environmental problems, environmental regulations and internal controls which clients faces, especially those industries with high environmental risks, such as oil and gas, chemicals, pharmaceuticals, metallurgy, mining, papermaking, leather, printing, and utilities etc.

In March 2008, the U.S. Embassy in China began setting up an air monitoring station to monitor pollutants in the air, including PM2.5. Prior to this, China did not have PM2.5 monitoring data, and the public did not know what PM2.5 was.

In June 2009, the United States began to publicly release PM2.5 data, attracting some concern. Until October 2011, bad haze weather made it unbearable to some Beijing residents. At this time, the PM2.5 index from the US Embassy exceeded 300 many times. After this incident, "PM2.5" received extensive attention from the government and the public. On February 29, 2012, Ministry of Environmental Protection of the People's Republic of China issued new standard, which incorporated PM2.5 into the scope of monitoring, and proposed to implement environmental air quality standards, begin monitoring and release PM2.5 data, and promote air pollution control. The specific time requirements are: till 2012, Beijing, Tianjin, Hebei regions; Yangtze River Delta; Pearl River Delta and other key regions, as well as municipalities and provincial capital cities; till 2013, 113 major environmental protection cities and national environmental protection model cities; in 2015, all cities at prefecture level and above; January 1, 2016, new standard is supposed to implement all over the country. The purpose of the new standard is not only to expand the scope of air quality monitoring, but more importantly, to strengthen the environmental regulation of heavily polluting enterprises. For example, after the introduction of the notice, Beijing Environmental Protection Bureau began drafting a list of highly polluting industries. High-polluting industries that do not meet environmental protection requirements will gradually withdraw from Beijing; for example, every time the city suffer from serious air pollution, polluting factories will endure the risk of stopping production, not to mention the increasingly strict environmental supervision will bring the risk of asset impairment. This incident concerned with PM2.5 and subsequent measures have brought about a concentrated outbreak of environmental risks in heavily polluting industries.

### 3.2. Research Hypothesis

Based on the audit risk model and insurance theory, risk factors are an important factor when audit fees are decided. Combined with the institutional background introduced above, I consider the impact of environmental risks on audit costs.

Before 2011, PM2.5 was not known to most people as it is now. After the PM2.5 incident, the government began to monitor and release PM2.5 data so that PM2.5 began to enter the public view. In 2012, the Ministry of Environmental Protection issued the "Circular on Implementing the 'Ambient Air Quality Standards' (GB3095-2012)", and proposed to monitor and PM2.5 data gradually. The publication of the data serves as a basis for future supervision. The notice also gives the specific schedule, which provides us with a setting for quasi-natural experiment. Those cities that took the lead in monitoring implemented more stringent air quality standards and earlier measures to deal with air pollution. We know air pollution comes mainly from industrial companies, especially heavily polluting companies. For auditors, in order to reduce the risk of audit failures, they will implement more audit procedures to understand the monitoring of the operating conditions and internal control quality of the heavily polluting enterprises in the monitored region, and at the same time charge them more audit fees in order to compensate for their own increased risks. Based on this, I develop the first hypothesis:

H1: The auditors will charge higher audit fees for heavily polluted enterprises located in cities that are the first to monitor, compared with those not monitored.

Changes in the external environment have increased the risk of heavily polluting enterprises located in the monitored region. According to the modern audit risk model, if the internal control quality of the company itself is good, the total audit risk can be controlled at a suitable level. At this point, even if the auditors want to increase the audit fees in order to compensate themselves for the risks, they could receive resistance from the clients. Therefore, in heavily polluting enterprises with higher internal control quality, the relationship in H1 will be weakened; that is, the relationship in H1 is supposed to be more significant in heavily polluting enterprises with lower internal control quality. Based on this, we put forward the second hypothesis of this paper:

H2: In heavily polluting enterprises with higher internal control quality, the relationship in H1 will be weakened.

## 4. Research Design and Analysis Results

### 4.1. Sample Selection and Data Sources

This article selects heavily polluting listed companies as a sample. Considering 2012 was the event year, select the data for the year 2011 and 2013. The heavily polluting enterprises are identified according to the six industries mentioned in the "Announcement on the Implementation of Special Emission Limits for Air Pollutants". Since the listed companies in monitoring cities and non-monitoring cities may be very different in financial indicators, this paper performs Propensity Score Matching (PSM) to choose new sample. After PSM, the sample includes 1092 observations. As for data sources, the data of proxy internal control quality comes from the internal control index developed by Shenzhen DIB. The higher the internal control index, the better the quality of internal control. List of accounting firms and rankings are from the comprehensive evaluation of accounting firms issued by the Chinese Institute of Certified Public Accountants. The data of audit fees and other financial data are from CSMAR and Wind.

### 4.2. Model Design and Variable Definition

This paper mainly uses the difference-in-difference model to perform empirical analysis. The model is as Equation (1):

$$fee = \beta_0 + \beta_1 treat + \beta_2 after + \beta_3 T + Controls + \Sigma Industry + \Sigma Year + \varepsilon_{it} \quad (1)$$

In Equation (1), variable *fee* is the explanatory variable, which is represented by the logarithm of annual audit fee after adjusting for price index. *treat*, *after*, and *T* are the main explanatory variables, where *T* is the interactive item of *treat* and *after*. Here we focus on the sign and significance of the interaction term *T*. Other variables are control variables, including firm size, debt ratio, roa, current ratio, quick ratio, business complexity, and so on. The model also captures the industry fixed effect and the year fixed effect. The definition of variables are: ***size***, natural log of total assets; ***lev***, total liabilities to total assets; ***roa***, net income to total assets; ***current***, current assets to total assets; ***quick***, ratio of current assets (less inventory) to current liabilities; ***arinv***, ratio of receivables and inventory to total assets; ***ngs***, number of business units according to regions; ***nbs***, number of business units according to industries; ***big 4***, 1 if the auditor is a Big 4 audit firm and 0 otherwise; ***top* 10**, 1 if the auditor is a local top-10 audit firm based on the sum of total assets audited by an audit firm for each year and 0 otherwise; ***GDP***, natural log of GDP per capita of the city listed company located in; ***icindex***, natural log of internal control index from DIB. Also, industry effects and year effects are captured in the model.

## 4.3. Empirical Analysis

### 4.3.1. Descriptive Statistics

The original sample included 840 observations. Descriptive statistics (**Table 1**) showed that the treatment group accounted for 74%, and the sample distribution

**Table 1.** Descriptive statistics (Before PSM).

| variable | N | mean | p50 | min | max |
|---|---|---|---|---|---|
| fee | 840 | 11.72 | 11.61 | 10.7 | 13.66 |
| treat | 840 | 0.74 | 1 | 0 | 1 |
| after | 840 | 0.5 | 0.5 | 0 | 1 |
| T | 840 | 0.37 | 0 | 0 | 1 |
| size | 840 | 22.11 | 21.95 | 19.55 | 25.8 |
| lev | 840 | 0.47 | 0.48 | 0.04 | 0.89 |
| roa | 840 | 0.04 | 0.03 | −0.22 | 0.21 |
| current | 840 | 2.17 | 1.2 | 0.25 | 21.97 |
| quick | 840 | 1.67 | 0.83 | 0.12 | 20.71 |
| arinv | 840 | 0.21 | 0.2 | 0.01 | 0.59 |
| ngs | 840 | 6.44 | 5 | 2 | 25 |
| nbs | 840 | 2.63 | 2 | 1 | 12 |
| big4 | 840 | 0.05 | 0 | 0 | 1 |
| top10 | 840 | 0.53 | 1 | 0 | 1 |
| GDP | 840 | 10.93 | 10.99 | 8.77 | 12.19 |
| ic | 840 | 6.38 | 6.52 | 0 | 6.87 |

Note: Raw data from database of CSMAR and Wind, calculated with Stata.

was biased. Therefore, this article uses PSM to construct balanced sample. PSM, also known as propensity score matching, calculates the probability that each individual in the sample enters the treatment group, and selects individual whose probability is the closest from the control group for each one of the treatment group, to make up a new sample. The advantage of PSM is to make the other characteristics of the individuals in the treatment group and the control group closer, so we can solve the problem of missing variables better. Table 2 shows the descriptive statistics of the sample after the PSM. Due to the less observations in the control group, method of one-to-one matching with replacement is used here. After PSM, the observations in the treatment group and the control group are the same.

#### 4.3.2. Empirical Analysis

Table 3 shows the regression results for H1 and H2. In the second column, the coefficient of the interaction term T we are concerned with is positive and significant at the level of 0.001. The result supports H1, that is, the auditors will charge higher audit fees for heavily polluted enterprises located in cities that are the first to monitor, compared with those not monitored. The last two columns show the further analysis, namely H2 regression results. With the median as the boundary, the sample is divided into two groups according to the size of the internal control index: high internal control quality group and low internal control quality group. The results show that the relationship described in Hypothesis 1 is

Table 2. Descriptive statistics (After PSM).

| variable | N | mean | p50 | min | max |
|---|---|---|---|---|---|
| fee | 1092 | 11.69 | 11.65 | 10.83 | 13.69 |
| treat | 1092 | 0.50 | 0.50 | 0 | 1 |
| after | 1092 | 0.50 | 0.50 | 0 | 1 |
| T | 1092 | 0.25 | 0 | 0 | 1 |
| size | 1092 | 22.21 | 21.92 | 19.55 | 25.66 |
| lev | 1092 | 0.48 | 0.48 | 0.05 | 0.93 |
| roa | 1092 | 0.03 | 0.03 | −0.13 | 0.20 |
| current | 1092 | 1.98 | 1.13 | 0.35 | 21.97 |
| quick | 1092 | 1.50 | 0.72 | 0.08 | 20.71 |
| arinv | 1092 | 0.20 | 0.19 | 0.01 | 0.70 |
| ngs | 1092 | 6.22 | 5 | 3 | 25 |
| nbs | 1092 | 2.87 | 2 | 1 | 12 |
| top10 | 1092 | 0.47 | 0 | 0 | 1 |
| GDP | 1092 | 11.16 | 11.29 | 9.89 | 11.83 |
| ic | 1092 | 6.45 | 6.52 | 0 | 6.87 |

Note: Raw data from database of CSMAR and Wind, calculated with Stata.

Table 3. Empirical results.

| | 1) Full Sample | 2) High ic | 3) Low ic |
|---|---|---|---|
| treat | 0.0586* | 0.2800*** | −0.2164*** |
| | (1.8877) | (6.3342) | (−4.3381) |
| after | −0.1309*** | 0.0835** | −0.4644*** |
| | (−5.2432) | (2.3604) | (−9.7503) |
| ***T*** | **0.1554*** ** | **−0.0597** | **0.5132*** ** |
| | **(3.8772)** | **(−1.0006)** | **(8.8787)** |
| size | 0.3149*** | 0.3685*** | 0.2563*** |
| | (21.5723) | (17.3525) | (13.4023) |
| lev | −0.4388*** | −0.2066 | −0.2422* |
| | (−4.5112) | (−1.4142) | (−1.8583) |
| roa | −0.5315* | −0.8559** | −0.0841 |
| | (−1.9016) | (−2.0215) | (−0.2092) |
| current | 0.0021 | 0.0849 | 0.0090 |
| | (0.1521) | (1.3942) | (0.5339) |
| quick | −0.0151 | −0.0962 | −0.0181 |
| | (−0.9382) | (−1.5077) | (−0.9524) |
| arinv | 0.2807*** | 0.4328** | −0.1014 |
| | (2.6450) | (2.1575) | (−0.6753) |
| ngs | 0.0247*** | 0.0193*** | −0.0029 |
| | (5.8203) | (3.7248) | (−0.4097) |
| nbs | 0.0196*** | 0.0332*** | 0.0250*** |
| | (3.7466) | (3.1671) | (3.9011) |
| big4 | 0.7443*** | 0.6753*** | 0.7144*** |
| | (9.4643) | (7.9449) | (3.6385) |
| top10 | −0.0210 | −0.0334 | 0.0579* |
| | (−0.8275) | (−0.9382) | (1.6651) |
| GDP | 0.0225 | −0.0743* | 0.0857** |
| | (0.7256) | (−1.7085) | (2.0816) |
| icindex | −0.0514*** | | |
| | (−3.1886) | | |
| Year Effects | Yes | Yes | Yes |
| Industry Effects | Yes | Yes | Yes |
| _cons | 4.5855*** | 3.8285*** | 5.0509*** |
| | (9.8499) | (6.3762) | (8.7556) |
| $N$ | 1092 | 544 | 548 |
| adj. $R^2$ | 0.682 | 0.743 | 0.617 |

Note: Raw data from database of CSMAR and Wind, processed with Stata.

significantly positive in the group with low internal control quality, but disappears in the high internal control quality group. This is in line with our expectations. Because when heavily polluting enterprises suffer from the same environmental risks, companies with higher internal control quality can better resist risks and maintain misstatement risks at a receivable level. In this way, auditors do not need to increase a lot of efforts, thus no significant change in audit fees; on the contrary, companies with poor internal control have no such barriers, and audit fees will increase significantly.

## 5. Conclusion

This paper uses PM2.5 monitoring as an exogenous event to study the impact of environmental risk on audit fees. The main conclusion of this paper is, after the monitoring of PM2.5 began in 2012, those heavily polluting listed companies located in cities that take the lead in monitoring PM2.5 would receive higher audit fees. Moreover, this relationship exists only in heavily polluting enterprises with low internal control quality. So we can say, environmental risk will influence audit fees, especially when the substantive environmental risks are exposed, the auditors will take the initiative to consider environmental risks and increase audit fees for heavily polluting industries.

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