



The Impacts of PM2.5 on Stock's Earnings in China

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Abstract

The particulate matter 2.5 (PM2.5) is a serious air-pollutant emission which has caused serious risks to public health in China. The concerns could impact the decisions of people when they are choosing which companies to work and the decisions further affect the earnings of the companies. This is because people especially the ones with high skills have more choices and would like to choose to work in a company which is located in a city with less PM2.5 concentration and the companies with more high-skill people tend to perform better. That is, the earnings should be higher. This paper studies the impacts of PM2.5 concentration on earnings per share (EPS) of stocks in China market. We find that PM2.5 has positive impacts on EPS in the entire market and the impacts are larger for stocks headquartered in the northwest of China. Also, we find that there exist heterogeneous effects of PM2.5 on EPS. That is, the impacts of PM2.5 tend to increase with EPS.

Keywords: PM2.5; Earnings per Share; Quantile Regression;

JEL codes: B26; G50;

1. Introduction

This paper explores the impacts of PM2.5 concentration on earnings per share (EPS) of stocks in China market.¹ In particular, we find that PM2.5 generally positively predict EPS. That is, PM2.5 has positive impacts on EPS. We also find that the impacts are larger for companies which have headquarters located in the northwest of China. Furthermore, we apply quantile regression to study the heterogeneous effects of PM2.5 on EPS and find that the effects of PM2.5 vary with the distribution of EPS. Specifically, The impacts of PM2.5 on EPS seem to increase with EPS.

This paper is related to the literature on relation between the environmental factors and the performance of listed companies. For instance, Makori and Jagongo (2013) shows that there is significant negative relationship between Environmental Accounting and Return on Capital Employed (ROCE) and Earnings per Share (EPS) and a significant positive relationship between Environmental Accounting and Net Profit Margin and Dividend per Share. Wu et. (2018) studies

the effect of air pollution proxied by Air Quality Index (AQI) on the stock yield of heavy pollution enterprises in China's key control cities. Dong et. (2019) documents a negative relation between air pollution during corporate site visits by investment analysts and subsequent earnings forecasts.

Ng and Rezabee (2020) investigates whether and how business sustainability performance and disclosure factors affect stock price informativeness (SPI). They use the idiosyncratic volatility proxy for SPI and find that non-financial environmental, social, and governance (ESG) sustainability performance factors are positively associated with SPI after controlling for financial-economic performance. Yildiz and Karan (2020) investigates the impact of country-level environmental performance on the stock price crash risk of renewable energy firms and find that there exists a significant nonlinear relationship between country-level environmental performance and stock price crash risk. Heyes, Neidell and Saberian (2016) provide detailed empirical evidence of a direct effect of air pollution on the efficient operation of the New York Stock Exchange, linking short-term variations in PM2.5 in Manhattan to movements in the S&P 500. Huang (2017) studies how PM2.5 affects the stock price of firms from heavy polluting industries and environment-friendly industries in China and find that PM2.5 has negative impact on stock price of heavy polluted firms, and has positive impact on environment-friendly industries firms. Zhang, Jiang and Guo (2017) study the relation between PM2.5 concentration and the performance of stocks of listed companies located in Beijing between 2010 and 2014 and find that haze pollution has significant negative effects on stock returns and significant positive effects on stock volatilities via the channel of investors' mood. Also, they find that the effects of haze pollution on stock returns emerge gradually and the effects of haze pollution on stock volatilities weaken gradually over time during a trading day.

This paper contributes to the literature in the following ways. First, we proxy air pollution using the PM2.5 concentration of the city in which the headquarter of the company is located. Second, we find the impacts of PM2.5 on stock's EPS are different for stocks located in different areas in China. Lastly, we show that the impacts of PM2.5 on EPS increase with EPS. That is, the impacts are smaller for stocks with low EPS and larger for stocks with high EPS.

The rest of the paper is organized as follows. Section 2 describes data and shows results. Section 3 presents heterogeneous effects of PM2.5 on stock's EPS. Section 4 concludes.

2. Data and Results

Our stock market data are obtained from the China Stock Market and Accounting Research (CSMAR) database. Following prior studies (Coval and Moskowitz, 1999; Ivković and Weisbenner, 2005), we use a firm's headquarters as a proxy for the firm's location "given that corporate headquarters are close to corporate core business activities." The PM2.5 data is a subset of a published global PM2.5 concentration dataset from the Atmospheric Composition Analysis Group at Dalhousie University. The data of other variables comes from the China City Statistical Yearbook, including 285 cities surveyed from 2000 to 2018. Table 1 shows definition of variables studied in this research. We have totally 3612 stocks. All variables take mean values over time. Figure 1 shows the geographical distribution of stocks and PM2.5 concentration. Left panel shows that lots of listed companies' headquarters are located in Shanghai and Shenzhen.

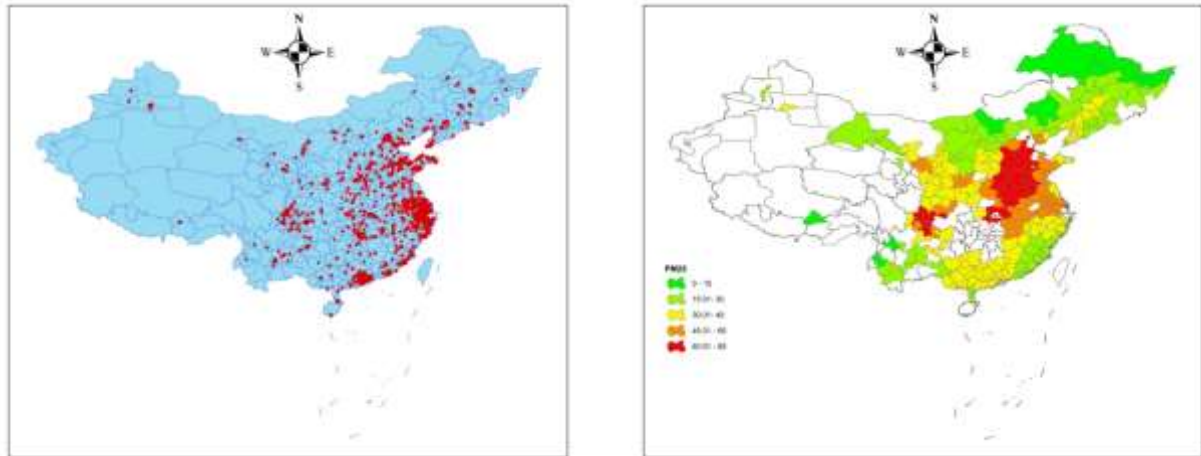


Right panel shows that the distribution of PM2.5 seems to be with higher variance in the west and north than in the east and south.

Table 1. Definition of independent variables

Variables	Definition
EPS	Earnings per Share
PM2.5	Average exposure to PM2.5
ciswur	Common industrial solid wastes utilized ratio
ctrstp	Centralized treatment rate of sewage treatment plant
dgaca	Domestic garbage harmless disposal rate
gcrca	Green covered rate of completed area
ieno	Industrial emission of nitrogen oxide
iesdio	Industrial emission of sulfur dioxide
pss	Proportion of service sector in GDP
psi	Proportion of secondary industry in GDP
gpc	GDP per capita
pd	Population density

Figure 1. Geographical distribution of stocks and PM2.5



Note: The left panel shows the geographical distribution of stocks and the right panel represents the distribution for PM2.5 concentration.

Table 2 shows regression results for the whole sample. We can see that the impacts of PM2.5 on EPS are positive and robust to controlling other variables. We also note that the impacts of dgaca and gpc of EPS are positive and statistically significant and the impacts of ieno are negative.

We also separate the whole sample in several ways. First, we divide the entire sample into south and north samples with the breaking point of value equal to the median of latitudes of all stocks, south (S) and north (N). Second, we separate the entire sample into west and north by the median of longitude, west (W) and east (E). Lastly, with the intersection of two sorts above, we have 2x2 subsamples: southwest (SW), southeast (SE), northwest (NW) and northeast (NE).

We then regress EPS on all variables for each subsample and Table 3 shows the results. We can see that for stocks in the south, the impact of PM2.5 on EPS is not economically small and statistically insignificant. Oppositely, the impact of PM2.5 on EPS is economically large and statistically significant for stocks in the north. W and E columns show that the impacts of PM2.5 on EPS are positive and significant for stocks in the west but not for stocks in the east. We also note that the greatest impacts of PM2.5 on EPS are for stocks in the northwest (NW) even though in the area the PM2.5 concentration is low (see right panel of Figure 1).

Table 2. Regression results for whole sample

EPS

	(1)	(2)	All
const	0.133	-	-0.098
		0.398***	
	(1.3)	(-2.8)	(-0.4)
PM2.5	0.037***	0.031**	0.038**
	(2.8)	(2.1)	(2.5)
ciswur		0.033**	0.022
		(2.2)	(1.3)
ctrstp		0.031**	0.013
		(2.1)	(0.8)
dgaca		0.028**	0.028*
		(2.0)	(1.7)
gcrca		0.008	0.002
		(0.9)	(0.2)
ieno		-	-0.047**
		0.057***	
		(-3.18)	(-2.6)
iesdio		0.012	0.008
		(1.44)	(0.9)
pss			-0.022
			(-1.1)
psi			-0.022
			(-0.8)
gpc			0.031***
			(2.8)
pd			0.002
			(0.2)

Note: “***” denotes $p < 0.01$, “**” $p < 0.05$, “*” $p < 0.1$.

Table 3. Regression results for different samples

	EPS								
	All	S	N	W	E	SW	SE	NW	NE
const	-0.098	-0.306	-0.055	0.548	-0.265	0.222	0.758	0.571	-0.09
	(-0.4)	(-0.7)	(-0.2)	(1.6)	(-0.5)	(0.4)	(0.6)	(0.8)	(-0.2)



PM2.5	0.038** (2.5)	0.022 (0.8)	0.107*** (4.4)	0.057*** (2.8)	0.027 (1.0)	0.044 (1.4)	0.007 (0.1)	0.155** (2.3)	0.073** (2.0)
ciswur	0.022 (1.3)	0.049 (1.5)	-0.004 (-0.2)	-0.022 (-1.0)	0.043 (1.3)	0.01 (0.2)	0.095 (0.9)	-0.068** (-2.0)	0.065* (1.8)
ctrstp	0.013 (0.8)	0.049* (1.7)	0.002 (0.1)	0.003 (0.1)	0.006 (0.3)	-0.017 (-0.5)	0.113 (1.1)	0.001 (0.0)	-0.03 (-1.2)
dgaca	0.028* (1.7)	-0.007 (-0.2)	-0.013 (-0.5)	-0.003 (-0.1)	0.075** (2.3)	0.035 (0.9)	- (-0.9)	- (-2.9)	0.035 (0.9)
gcrca	0.002 (0.2)	-0.009 (-0.8)	0.046 (1.4)	0.004 (0.4)	-0.029 (-0.7)	-0.002 (-0.2)	- (-1.3)	0.049 (1.0)	0.052 (1.1)
ieno	-0.047** (-2.6)	- (-2.6)	-0.005 (-0.3)	-0.038 (-1.4)	-0.029 (-1.0)	- (-2.3)	- (-1.0)	-0.017 (-0.6)	0.019 (0.7)
iesdio	0.008 (0.9)	0.034** (2.2)	-0.03* (-1.7)	0.007 (0.7)	-0.025 (-1.2)	0.035* (1.9)	-0.04 (-0.7)	-0.012 (-0.4)	-0.03 (-1.3)
pss	-0.022 (-1.1)	-0.007 (-0.2)	-0.055** (-2.1)	-0.049* (-2.0)	-0.022 (-0.5)	-0.036 (-0.9)	- (-0.9)	-0.076** (-2.2)	-0.091* (-1.8)
psi	-0.022 (-0.8)	0.032 (0.7)	-0.069* (-1.8)	-0.077** (-2.1)	-0.016 (-0.3)	-0.031 (-0.5)	- (-0.1)	-0.101** (-2.0)	-0.054 (-0.7)
gpc	0.031*** (2.8)	0.013 (0.7)	0.067*** (3.4)	0.06*** (4.2)	0.024 (0.9)	0.046** (2.3)	0.129 (1.4)	0.134*** (3.5)	0.021 (0.7)
pd	0.002 (0.2)	-0.012 (-0.8)	0.009 (0.7)	-0.004 (-0.2)	0.029* (1.9)	-0.025 (-1.2)	0.018 (0.6)	0.004 (0.1)	0.041** (2.2)

Note: S, N, W, E, SW, SE, NW, and NE denotes the south, north, west, east, southwest, southeast, northwest and northeast part of China. “***” denotes $p < 0.01$, “**” $p < 0.05$, “*” $p < 0.1$.

Heterogeneous Effects

The section 2 shows that the impacts of PM2.5 on EPS seem to be different for different samples of stocks. For this reason, we study heterogeneous effects of PM2.5 on EPS using quantile regression (Koenker and Hallock 2001). Table 4 and Figure 2 show the results. The impacts of PM2.5 on EPS are smaller in the low quantiles and larger in the high quantiles. This means that the companies with high EPS are more impacted by PM2.5 and the ones with low EPS are less impacted by PM2.5. The right panel of Figure 2 also shows the impacts gpc on PM2.5 which has similar pattern as the one for PM2.5.

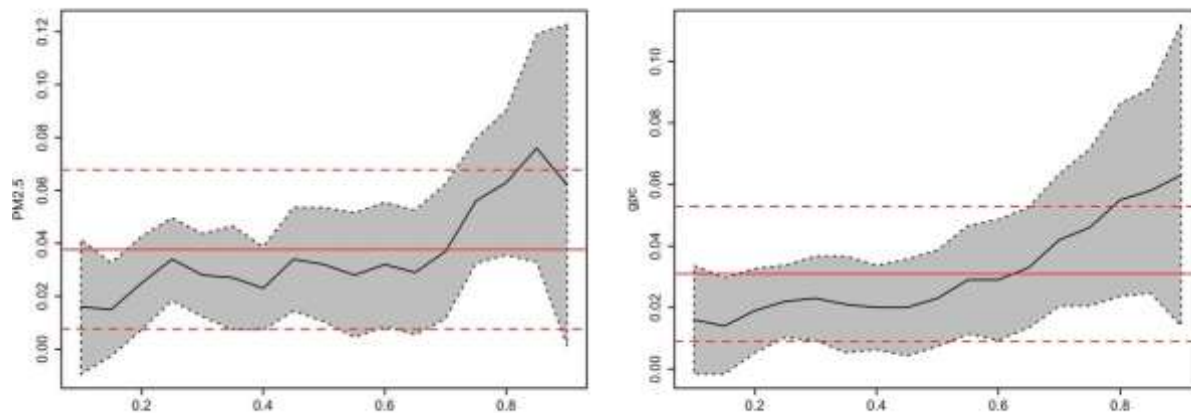
Table 4. Heterogeneous effects of PM2.5 on EPS

	EPS								
	10th	20th	30th	40th	50th	60th	70th	80th	90th
Intercept	- 0.57***	- 0.55***	-0.38**	-0.35**	-0.3	-0.04	0.25	0.17	0.81**
PM2.5	0.02	0.03**	0.03***	0.02**	0.03***	0.03**	0.04**	0.06***	0.06***

ciswur	0.01	0.01	0	0.01	0	0	0.01	0.02	0.03
ctrstp	0	-0.01	-0.01	0	-0.01	0	0.01	0.01	0.01
dgaca	0.02*	0.03***	0.03***	0.02*	0.03**	0.03**	0.03**	0.02	0
gcrca	0	-0.01	0	0	0	0	0	0.01	0
ieno	-0.03**	-0.02*	-0.01	-0.02*	-0.02	-0.02	-0.04**	-0.05*	-0.03
iesdio	0.02**	0.01	0	0.01	0	0	0.01	0	-0.01
pss	0.02	0.03*	0.01	0.02	0.01	-0.01	-0.04*	-0.04	-0.07**
psi	0.02	0.03	0.01	0.02	0.02	-0.01	-0.05	-0.04	-0.07*
gpc	0.02*	0.02**	0.02***	0.02***	0.02***	0.03***	0.04***	0.06***	0.06***
pd	-0.01	-0.01	0	0	0	0	0	0	0.01

Note: *th represents th quantile of the distribution of EPS. “***” denotes $p < 0.01$, “**” $p < 0.05$, “*” $p < 0.1$.

Figure 2. Heterogeneous Effects of PM2.5 and gpc on EPS



Note: The figure plots quantile effects and mean effects (in red) of PM2.5 and gpc on EPS with 95% confidence intervals.

3. Conclusion

The papers studies the impacts of PM2.5 on EPS of stocks in China market. We find that generally the PM2.5 has positive effect on EPS. That is, stocks with headquarters located in cities with higher PM2.5 tend to have higher EPS. We also find that the effects are larger for companies in the northwest of China. Furthermore, we use quantile regression to study the heterogeneous effects of PM2.5 on EPS and find that the effects of PM2.5 seem to increase with EPS.

Beside the academic contribution, our research has following implications. First, since PM2.5 has prediction power for EPS and EPS is important for practical investors, the investors could consider PM2.5 as one of factors which might be helpful for selecting stocks. Second, PM2.5 is harmful for health but positively associated with EPS. Therefore, policy makers should seriously consider about the trade-off of the pros and cons of PM2.5.



The limitation of this research is that we do not conduct research on the mechanism which explains how PM2.5 impacts EPS and we leave this for future research. We suppose that PM2.5 affects the job choices because people care about their health and PM2.5 is a serious air-pollutant emission in China and has caused serious risks to public health. The job choices made by people have impacts on the company's performance (i.e., EPS). This is a potential mechanism which links PM2.5 to EPS.

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