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How does Air Pollution Affects the Employment in Service Sector? Empirical Evidence from China

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Abstract: Air pollution has significant negative externalities and affects all aspects of life. This paper examines whether air pollution levels affect service sector employment using panel data for 270 prefecture-level cities in China from 2010 to 2020. The results found that urban air pollution level has a significant negative impact on employment in the service sector, and it still holds after quantile estimation. The findings of this paper have some policy implications for improving relevant air pollution control measures and promoting the employment in service sector.

Keywords: Air Pollution; Negative Impact; The Employment in Service Sector.

1. Introduction

The relationship between air quality and economic development has been a key concern in the field of development economics. Studies on the relationship between environmental pollution and economic growth have generally used the environmental Kuznets curve (EKC) theory. Human activities bring air pollution and at the same time air pollution has an impact on human activities (Evans & Jacobs, 1981) and the feasibility of unlimited economic growth in a finite global ecosystem is declining (Cordier et al., 2021). A large number of studies have taken the perspective of air as a public good to study the negative externalities of air pollution, which are mainly reflected in the following two aspects. On the one hand, it can directly endanger human health, and long-term exposure to high PM2.5 levels can cause bronchitis, pneumonia, asthma and other respiratory diseases, increasing the mortality rate of heart and lung diseases among Chinese residents(Ebenstein et al., 2015; Kunii et al., 2002; Jing et al., 2018), which directly undermine human capital accumulation in cities (Grossman, 2017; Zivin & Neidell, 2012); On the other hand, it can lead to a significant negative impact on a country's economy due to other problems such as reduced employee performance, low visibility, slow crop growth, and damage to building structures (Chang and Graff, 2019; Yi et al., 2016).

The two-way relationship between air pollution and manufacturing employment has been extensively studied in the literature, and it has been shown that the development of manufacturing industries worsens air quality. Areas with high levels of air pollution face severe environmental regulation policies, which in turn discourage the development of highly polluting manufacturing industries (Cebula et al., 2008). However, are the services sector, with its relatively clean production processes, also affected by air pollution levels? This question remains to be explored.

The remainder of the paper is organized as follows: part II contains the theoretical analysis and research hypotheses, part III describes the variable constructs, benchmark models, and data sources, part IV reports and discusses the empirical results, and part V summarizes the conclusions, implying limitations and future research directions.

2. Literature Review and Research Hypotheses

By combing through the existing literature, it is found that air pollution mainly affects service sector employment through two channels. One is the decline in service sector employment as a direct result of labor mobility caused by pollution, and the other is the decline in service consumption demand caused by pollution that indirectly affects the decline in service sector employment.

Long-term living in highly polluted areas can negatively affect people's mental health, causing psychological disorders such as insomnia and anxiety and reducing people's subjective well-being and mental health (Dolan & Laffan, 2016). For physical and mental health reasons, more and more households eventually choose to move away from cities with high air pollution, causing a decrease in labor supply in cities with poorer air quality (Khuc et al., 2022; Hanna & Oliva, 2015). In addition, the labor force will actively avoid cities with poorer air quality when making employment choices (Chen et al., 2022), which will directly contribute to the decline in local service employment.

The health hazards of air pollution are cumulative over time and can directly lead to an increase in healthcare expenditures for Chinese residents, which can have a crowding-out effect on consumer demand (Barwick et al., 2018; Williams, 2019). He and Luo (2022) use daily data on movie ticket sales and find that air pollution reduces the number of cinema-goers, empirically investigating the phenomenon of adopting avoidance behavior and thus reducing consumption demand in the face of environmental pollution costs. Crouch (2001) and Brau (2006) suggest that the quality of the natural environment is critical to attracting tourists and that poor weather conditions increase tourists' risk perceptions of future travel, and potential travelers are less likely to visit a destination due to increased risk perceptions (Sönmez et al., 1998). In turn, demand is one of the important factors that drive employment, so the reduction in demand for service consumption caused by air pollution will, to some extent, cause a decline in employment in the service sector.

Hypothesis 1: Air pollution hurts the development of urban services.

Hypothesis 2: Air pollution can affect the development of urban services by reducing consumer demand and investment demand.

3. Data and Methodology

3.1. Model Setting

To test the effect of air pollution on employment in the service sector, the following econometric model is constructed:

$$\ln Employ_{it} = \alpha + \beta \ln Poll_{i,t-1} + \gamma \ln X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

where the subscript i denotes the city and the subscript t denotes the year. The explained variable $\ln Employ_{it}$ is service sector employment. The $\ln Poll_{i,t-1}$ is the core explanatory variable indicating urban air pollution levels, to alleviate the possible endogeneity problem, this paper treats it with a one-period lag. The $\ln X_{it}$ is a series of control variables. This study also controls the province fixed effect (μ_i) and year fixed effect (v_t) in the model, and the ε_{it} is the random disturbance term.

3.2. Variable Specification

Dependent variable. Service sector employment (Employ) is the explained variable in this paper, measured by the regional service industry employment population.

Independent variable. Air pollution (Poll) is used as the explanatory variable in this paper, measured by pm2.5 concentration.

Control variables. This study selects as control variables a series of important factors that affect service sector employment. Including per capita income (PCI), government spending (GOV), openness to the outside world (OPEN), resident savings (SAVE), population size (POP), and urban infrastructure (INF).

3.3. Data Sources and Descriptive Statistics

Table 1. Descriptive statistics of all variables

Variable	Obs.	Mean	Std. dev	Min	Max
Employ	2,970	2.3305	0.9454	0.4574	5.8924
Poll	2,970	3.7021	0.3500	2.7974	4.5231
PCI	2,970	10.9355	0.5534	8.6975	12.1848
GOV	2,970	13.9167	1.0499	10.1013	18.2405
OPEN	2,970	0.0018	0.0042	0.0002	0.1724
POP	2,970	4.7312	0.7688	2.9444	7.2570
SAVE	2,970	0.4541	0.6949	0.0186	27.1745
INF	2,970	7.1354	0.9495	4.6728	9.5921

4. Empirical Results and Analysis

4.1. Benchmark Regression Analysis

Table 2. Benchmark regression model estimation results

Variable	(1)	(2)	(3)	(4)
Poll	-0.229***	-0.117**	-0.072***	-0.087***
	(-4.44)	(-2.51)	(-3.27)	(-4.07)
PCI		0.086***	0.195***	0.210***
		(3.78)	(12.82)	(11.32)
GOV		0.087***	0.178***	0.280***
		(4.63)	(17.25)	(18.04)
OPEN		2.972*	0.397	-4.942*
		(1.89)	(0.25)	(-1.88)
POP		0.271***	0.391***	0.515***
		(4.65)	(23.33)	(27.28)
SAVE		-0.016	0.018**	0.119***
		(-1.46)	(2.03)	(7.62)
INF		0.018	0.080***	0.177***
		(1.3)	(8.4)	(13.13)
Hausman test			413.65	
(P-value)			(0.000)	
F test				54.04
(P-value)				(0.000)
City-fixed effects	Yes	Yes	No	No
Year-fixed effects	Yes	Yes	No	No
Constant	2.918***	-0.945**	-4.432***	-7.281***
	(14.97)	(-2.40)	(-22.54)	(-41.36)
R-squared	0.557	0.639	0.572	0.856
N	2970	2970	2970	2970

Note: t statistics are reported in parentheses. *, **, ***indicate statistical significance at the 10%, 5%, and 1% levels, respectively

A series of data on the economic characteristics of cities in the explanatory and control variables are obtained from the China City Statistical Yearbook, and the data on pm2.5 concentration in the explanatory variables are obtained from the raster data published by the Atmospheric Composition Analysis Group (ACAG). All data were logarithmically processed to ensure the smoothness of the data. Considering the effect of extreme values, all variables were scaled down at the 0.5% and 99.5% levels, and the descriptive statistics of the variables are shown in Table 1.

The model (1) was analyzed using mixed regression, fixed effects (FE), and random effects (RE). Table 2 reports the results of the baseline regression model, where columns (1) and (2) show the results of fixed effects estimation, column (3) shows the results of random effects (RE) regression, and column (4) shows the regression results of mixed regression. The F-test and Hausman test find that the fixed-effects model outperforms the mixed regression and random-effects models, so this paper chooses the fixed-effects model to empirically analyze the linear relationship of how the negative externalities of air pollution affect the development of the urban service sector.

The results in columns (1) and (2) show that the coefficient of air pollution is significantly negative at the 1% level, with or without control variables, after controlling for city-fixed and year-fixed effects. This indicates a significant negative effect of air pollution on the number of jobs in the urban service sector.

4.2. Quantile Regression Analysis

Table 3. Quantile regression model estimation results

Variable	(1)	(2)	(3)	(4)
	25%	50%	75%	90%
Poll	-0.079***	-0.067**	-0.055*	-0.155***
	(-3.09)	(-2.31)	(-1.83)	(-4.13)
Control variables	Yes	Yes	Yes	Yes
City-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R-squared	0.5472	0.5854	0.6457	0.7021
N	2970	2970	2970	2970

Note: t statistics are reported in parentheses. *, **, ***indicate statistical significance at the 10%, 5%, and 1% levels, respectively

The OLS regression estimation of the baseline regression yields the change in the conditional mean of the explanatory variables on the explanatory variables, and the results reflect the average effect of air pollution on the level of development of urban service industries. However, if air pollution levels are asymmetrically distributed across different regions, this average effect cannot fully portray its impact on service sector employment. In contrast, quantile regression not only presents the effect of air pollution in the overall distribution of service sector employment, but also avoids the interference of outliers or extreme values in the model estimation. Therefore, four quartiles of 25%, 50%, 75% and 90% were selected for quantile regressions to understand the negative impact of air pollution on service sector employment at different quartiles.

5. Conclusion and Policy Implications

With the increasing share of the service sector in the economy and the national concern about air pollution, this paper theoretically analyzes and empirically tests the effect of urban air pollution levels on employment in the service sector, using a sample of 270 prefecture-level cities in China from 2010 to 2020. It is found that urban air pollution has a significant negative effect on the number of service sector employment, and the results remain robust under the quantile regression model. Based on the findings of this paper, the following insights can be drawn. A long-standing and common perception of air pollution on economic development in the context of economic construction is that air pollution inevitably harms economic development and leads to difficulties in achieving quality development in some regions. Air pollution significantly inhibits the number of people employed in urban service industries, and such a dilemma can only be fundamentally resolved through the implementation of sound and effective environmental management policies by the government. Therefore, the government should implement strict environmental management policies to enhance consumers' confidence and investors' confidence in the future and reduce their uncertainty about the future, so that factors of production will continue to flow from the inefficient high-energy-consuming and high-emission manufacturing sector to the low-energy-consuming and low-emission service sector, driving employment in the service sector and achieving continuous optimization of the economic structure.

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